

**WHITE HOUSE ENVIRONMENTAL JUSTICE
ADVISORY COUNCIL**

MAY 2022 MEETING SUMMARY

**VIRTUAL PUBLIC MEETING
May 11, 2022**

TABLE OF CONTENTS

PREFACE.....	3
AGENDA	5
1.0 WHEJAC Meeting.....	7
1.1 Welcome, Introductions & Opening Remarks	7
1.2.1 Brenda Mallory, Chair – The Council on Environmental Quality (CEQ)	8
1.3 WHEJAC Climate Resilience Workgroup Update & Discussion.....	9
1.4 Public Comment Period.....	16
1.5 WHEJAC Business Meeting Reflection & Conversation	28
1.6 Closing Remarks & Closing.....	32
APPENDIX A:	33
APPENDIX B.....	41
APPENDIX C:.....	55

PREFACE

The White House Environmental Justice Advisory Council is established by Executive Order 14008, titled “Tackling the Climate Crisis at Home and Abroad” (issued on January 27, 2021). As such, this is a non-discretionary committee and operates under the provisions of the Federal Advisory Committee Act (FACA), 5 U.S.C. App. 2.

The WHEJAC will provide independent advice and recommendations to the Chair of the Council on Environmental Quality (CEQ) and to the White House Interagency Council on Environmental Justice (Interagency Council), on how to increase the Federal Government’s efforts to address current and historic environmental injustice, including recommendations for updating Executive Order 12898. The WHEJAC will provide advice and recommendations about broad cross-cutting issues related, but not limited to, issues of environmental justice and pollution reduction, energy, climate change mitigation and resiliency, environmental health and racial inequity. The WHEJAC’s efforts will include a broad range of strategic scientific, technological, regulatory, community engagement, and economic issues related to environmental justice.

The duties of the WHEJAC are to provide advice and recommendations to the Interagency Council and the Chair of CEQ on a whole-of-government approach to environmental justice, including but not limited to environmental justice in the following areas:

- Climate change mitigation, resilience, and disaster management.
- Toxics, pesticides, and pollution reduction in overburdened communities.
- Equitable conservation and public lands use.
- Tribal and Indigenous issues.
- Clean energy transition.
- Sustainable infrastructure, including clean water, transportation, and the built environment.
- National Environmental Policy Act (NEPA) enforcement and civil rights.
- Increasing the Federal Government’s efforts to address current and historic environmental injustice.

EPA’s Office of Environmental Justice (OEJ) maintains summary reports of all WHEJAC meetings, which are available on the WHEJAC website at: <https://www.epa.gov/environmentaljustice/white-house-environmental-justice-advisory-council>. Copies of materials distributed during WHEJAC meetings are also available to the public upon request. Comments or questions can be directed via e-mail to whejac@epa.gov

Committee Members in Attendance

- Richard Moore, Co-Chair, Los Jardines Institute
- Peggy Shepard, Co-Chair, WE ACT for Environmental Justice
- Carletta Tilousi, Vice-Chair, Havasupai Tribal Council
- Catherine Coleman Flowers, Vice-Chair, Center for Rural Enterprise and Environmental Justice
- Angelo Logan, Moving Forward Network
- Rachel Morello-Frosch, PhD, UC Berkley
- Miya Yoshitani, Asian Pacific Environmental Network
- Kim Havey, City of Minneapolis
- Kyle Whyte, PhD, University of Michigan
- Tom Cormons, Appalachian Voices
- LaTricea Adams, Black Millennials for Flint
- Harold Mitchell, ReGenesis
- Juan Parras, Texas Environmental Justice Advocacy Services
- Maria Belen-Power, GreenRoots
- Maria Lopez-Nunez, Ironbound Community Corporation
- Nicky Sheats, PhD, Kean University
- Ruth Santiago, Latino Climate Action Network

AGENDA



**THE COUNCIL ON ENVIRONMENTAL QUALITY
WHITE HOUSE ENVIRONMENTAL JUSTICE ADVISORY COUNCIL
VIRTUAL PUBLIC MEETING**

AGENDA	May 11, 2022	3:00 P.M. – 7:45 P.M. EDT
3:00 p.m. - 3:15 p.m.	INTRODUCTIONS & OPENING REMARKS <ul style="list-style-type: none"> ○ Karen L. Martin, <i>Designated Federal Officer – U.S. Environmental Protection Agency</i> ○ Richard Moore, <i>White House Environmental Justice Council Co-Chair – Los Jardines Institute</i> ○ Peggy Shepard, <i>White House Environmental Justice Council Co-Chair – WE ACT for Environmental Justice</i> ○ Catherine Coleman Flowers, <i>White House Environmental Justice Council Vice Chair – Center for Rural Enterprise and Environmental Justice</i> ○ Carletta Tilousi, <i>White House Environmental Justice Council Vice Chair – Havasupai Tribe</i> 	
3:15 p.m. - 3:30 p.m.	OPENING REMARKS <ul style="list-style-type: none"> ○ Brenda Mallory, <i>Chair – The Council on Environmental Quality</i> 	
3:30 p.m. – 4:30 p.m.	WHEJAC CLIMATE RESILIENCE WORKGROUP UPDATE & DISCUSSION <ul style="list-style-type: none"> ○ Maria López-Núñez, <i>Workgroup Co-Chair – Ironbound Community Corporation</i> ○ Miya Yoshitani, <i>Workgroup Co-Chair – Asian Pacific Environmental Network</i> 	
4:30 p.m. – 4:45 p.m.	BREAK	

4:45 p.m. – 6:15 p.m.	<p>PUBLIC COMMENT PERIOD</p> <p><i>Members of the public will be given three (3) minutes to present comments relevant to the current charge of the WHEJAC Climate Resilience Workgroup. The charge includes the following questions:</i></p> <ul style="list-style-type: none"> • What type of support is needed for disadvantage communities to participate in federal disaster preparedness or relief programs? • How can Federal disaster relief and aid programs better serve disadvantaged communities that have historically received fewer federal benefits? • What process steps and information would help eliminate these disparities? • What steps can Federal agencies and the White House take to reduce disparities in climate change impacts for communities, including, but not limited to risks from, extreme heat, flood, wildfire, drought, and coastal challenges?
6:15 p.m. – 6:30 p.m.	<p>BREAK</p>
6:30 p.m. – 7:30 p.m.	<p>WHEJAC BUSINESS MEETING REFLECTION & CONVERSATION</p> <p>The WHEJAC will use this time to reflect on the meeting proceedings and public comment period; provide workgroup updates; discuss action items and finalize next steps.</p> <ul style="list-style-type: none"> ○ Karen L. Martin, Designated Federal Officer – U.S. Environmental Protection Agency ○ Richard Moore, White House Environmental Justice Council Co-Chair – Los Jardines Institute ○ Peggy Shepard, White House Environmental Justice Council Co-Chair – WE ACT for Environmental Justice ○ Catherine Coleman Flowers, White House Environmental Justice Council Vice Chair – Center for Rural Enterprise and Environmental Justice ○ Carletta Tilousi, White House Environmental Justice Council Vice Chair – Havasupai Tribe

WHITE HOUSE ENVIRONMENTAL JUSTICE ADVISORY COUNCIL (WHEJAC)
Virtual Public Meeting
May 11, 2022

MEETING SUMMARY

The White House Environmental Justice Advisory Council (WHEJAC) convened via Zoom meeting on Wednesday, May 11, 2022. This synopsis covers WHEJAC members' deliberations during the two-day meeting. It also summarizes the issues raised during the public comment period.

1.0 WHEJAC Meeting

This section summarizes WHEJAC members' deliberations during the one-day meeting, including action items, requests, and recommendations.

1.1 Welcome, Introductions & Opening Remarks

Karen Martin, Designated Federal Officer (DFO), U.S. EPA, welcomed attendees and made announcements. She stated that everyone is in listen and view mode only, and public commenters are invited to speak later that afternoon. She noted that Spanish translation and closed captioning are available. She turned the meeting over to Richard Moore, the WHEJAC co-chair, for opening remarks.

Richard Moore introduced himself and thanked everyone for their hard work and participation. He recognized that a lot of issues are affecting both rural and urban communities. He assured everyone that this WHEJAC understands that this moment in history is crucial and take this work extremely serious. He stated that he's looking forward to the public comments and hearing the report back in the discussion that will take place.

Peggy Shepard introduced herself and assured everyone that the WHEJAC takes the public comments very seriously. She stated that they listen and incorporate those into the recommendations to the administration. She stated that the screening tool and some other issues from the working groups will be discussed.

Catherine Coleman Flowers introduced herself and stated that she looked forward to hearing public comments and getting closer to reaching the goals.

Carletta Tilousi introduced herself and stated that she looked forward to hearing everyone's comments on some of the work that they've been asked to do. She said that she is looking forward to the presentations addressing the beta version of the Climate and Environmental Justice Screening Tool and the federal government agency's implementation of the Justice40 Initiative.

DFO Martin invited the Council members to briefly introduce themselves and state their affiliations. She informed the Council that the quorum was met.

Co-Chair Moore reminded everyone that WHEJAC is a historical moment in the life and the history of many that have been involved in this environmental and economic justice struggle for a long time. He informed everyone that, at this moment, over 200,000 acres in New Mexico are on fire and that is affecting many rural and grass-root communities, forcing them to evacuate. He noted that his group just returned from delivering supplies to those camped out on the side of the road, in rest areas and in other people's homes and yards. He reminded everyone to remember those that are suffering and going through injustice. He turned the meeting over to Brenda Mallory, the chair of CEQ.

1.2.1 Brenda Mallory, Chair – The Council on Environmental Quality (CEQ)

Brenda Mallory thanked Mr. Moore for the powerful reminder and grounding everyone in why they're here and what they're doing. She thanked everyone for inviting her to the meeting, the WHEJAC members for their time and dedication and everyone for participating, especially new attendees.

Ms. Mallory stated that it's been about a year now since the WHEJAC produced a very robust set of recommendations on the Justice40 Initiative, the Climate and Economic Justice Screening Tool, and revisions to Executive Order 12898. She thanked the group and recognized what a significant contribution and significant sacrifice had to be made to participate in that activity. She stated that over the past year, those recommendations have been used on numerous occasions in guiding policymaking and decision making across the federal government. She also announced that CEQ will soon be providing a comprehensive, government-wide response to those recommendations to give a sense of what has taken place since the recommendations were made.

Ms. Mallory announced a few updates. She stated that first on staffing, the two new hires at CEQ -- Amanda Aguirre, senior advisor to her on environmental justice; and Jess Ennis, CEQ's Director of Public Engagement -- were doing a great job in implementing the president's agenda. She announced that Dr. Jalonne White-Newsome will be starting soon at CEQ as the Senior Director for environmental justice. She gave Dr. White-Newsome's background and stated that the Council will get a chance to meet her at the next public meeting once she has started.

Ms. Mallory also updated the Council on the Climate and Economic Justice Screening Tool. She stated that CEQ extended the public comment period on the beta version of the tool to Wednesday, May 25th, because extending the comment period would help to deliver robust feedback from the public and tribal nations, capturing the reality on the ground. She stated that the tool will be a living document that continues to reflect information that advances the overall goals of the president's program, and it is critical to the Justice40 Initiative.

Ms. Mallory clarified that, while they are still accepting public feedback, federal agencies have already started implementing the Justice40 Initiative. She stated that they are relying on the interim guidance instructions that was put out in July of 2021, and hoping that, with the tool, everyone will be operating on a consistent framework.

Ms. Mallory informed the Council that of the formal written response to WHEJAC, which will

be made public, that focuses on three next steps. She explained that the first is the need of administrative support, expert support, financial support, and additional resources to fulfill its mission. She stated that they are continuing to ensure that CEQ staff attend WHEJAC public meetings and provide support as needed in the workgroups.

Ms. Mallory explained the second step is on the revisions to Executive Order 12898. She stated that since receiving the WHEJAC's recommendations last year, they have been working to develop a durable, impactful, and effective approach to updating the executive order given that the deliberative process for developing this executive order is still ongoing. She stated that details cannot be shared publicly at this point, but they plan to schedule a meeting of the WHEJAC Executive Order 12898 Workgroup to provide an update on the status of that work.

Ms. Mallory explained the final step. She stated that over the coming weeks, CEQ will unveil a new website that will include information on the White House Environmental Justice Interagency Council, the Justice40 Initiative, et cetera. She stated that they will continue to add more to the website over time but hopes that the website will serve as a space for ongoing and clear communication about the administration's work.

Ms. Mallory stated that there is critical work happening at CEQ and across the federal government to advance environmental justice, but they can't work alone. She stated that they need WHEJAC's help, ideas and partnership.

Co-Chair Moore stated that slowly but surely, progress is being made. He thanked Ms. Mallory for her time and commitment and the CEQ staff for their hard work. He transitioned the meeting to the next agenda item.

1.3 WHEJAC Climate Resilience Workgroup Update & Discussion

Maria Lopez-Nunez asked for better attendance and membership in the workgroup. She stated that they wanted to hear stories from members about climate resiliency and federal agencies that may have failed communities before, during and after disasters.

Miya Yoshitani reiterated that request and stated that they wanted to ensure that the workgroup develop recommendations for federal agencies to shift, change and transform their approach to disaster response and disaster preparedness. She stated that they want recommendations to reflect the realities that communities have faced and that communities should not just survive but thrive through the climate crisis.

Ruth Santiago reminded everyone that in September of 2017, Puerto Rico was impacted by two category four and five hurricanes: one was a direct hit and the other very close. She stated that the devastation mostly impacted the electric grid, especially transmission lines, poles, wires and substations and that the response from FEMA has not been one that promotes resilience. She stated that recently there was an announcement about \$1 billion worth of FEMA funding for public lighting and for rebuilding.

Ms. Santiago noted that FEMA is approving the use of the \$1 billion to rebuild the centralized interconnected poles, like public lighting poles, wires and towers rather than doing, for example,

solar and battery-powered public lighting in Puerto Rico. She explained that there is another 11 or 12 billion that FEMA has allocated for the electric system in Puerto Rico, and none of it is for renewable or community-based projects that will lessen the burden on the environmental justice communities, mostly in southeastern PR. She stated that those plants keep operating with what FEMA is funding right now and that doesn't align with the Biden administration's Executive Order 14008 that created the WHEJAC and is supposed to address the climate crisis central to environmental Justice. She stated that it doesn't comply with the National Environmental Policy Act and there was no environmental justice analysis for this huge funding that FEMA is about to start dispersing.

Nicky Sheats reminded everyone of Hurricane Sandy and the response from FEMA and others. It was reported that a lot of attention was paid to what happened in coastal areas but a lot of things happened to EJ communities as well. He explained that there was a roundtable created, called the Sandy Climate Justice roundtable, and it included the New Jersey EJ Alliance, representatives from EJ communities, and organizations. He explained that the group felt that the government didn't seem comfortable working with these groups in close partnership and relegated these groups to tasks they thought were just good communication, even though the groups were doing much more. He stated that they also found that EJ groups wanted to work on a neighborhood level, like developing emergency and resiliency plans with the participation and the guidance of community groups and community residents, whereas FEMA and the government tended to think of the community level as the municipal level, so they had a larger scale than what the group wanted to work on.

Kyle Whyte reminded everyone that the Anishinaabe people in the Great Lakes region are exposed to a number of different disasters, including flooding, but also other types of disastrous habitat changes that affect our economies and cultures. He stated that this is referring to well over 30 tribal nations in the Great Lakes region, numerous communities that depend on tribal self-governance to support their way of life of well-being and also native people that are living in urban areas. He noted that in terms of tribal government, it's extremely problematic that some tribes may have a single person who is responsible for all facets of disaster response and preparedness, whereas the U.S. federal government will have multiple people serving that particular media. He explained that there are some organizations out there as well as some tribal staff that have made great strides in different parts of the country to fix this problem, but the inequalities continue and it's completely unfair and unjust that tribal governments do not have the same access to federal funds that states do. He stated that other governing entities are also supposed to juggle numerous cultural, social, economic and political issues of great complexity even for very small tribal communities. He noted that it seemed as if tribes were a lesser form of government even though they are sovereign and not given access to commensurate resources for staffing and response preparedness.

Vice-Chair Flowers reminded everyone that, especially in rural communities, people who are renting or living in mobile homes can't get help during a disaster, so that eliminates help for the most vulnerable. She stated that she has read about corporations buying up rental properties and sometimes these mobile homes are overpriced to the point that what they're being offered to replace their homes would never put them back in a newer one because the homes are so overpriced.

Ms. Flowers stated that while she was at a conference, a woman who lives near Aspen in Colorado stopped her and said that a lot of migrant families are living in mobile homes because they can't afford housing in expensive places like Colorado with the resorts and a lot of them are also EJ communities.

Ms. Flowers stated that wildfires are starting in places that they've never had before. She asked, what's going to happen to those families? She asked if the government is prepared to offer help to families that are also victims of wildfires when they lose their homes in these disasters and how are we going to get to climate resilience? She also asked how do we deal with disaster preparedness and provide relief for those that are most vulnerable, especially those who rent or who live in overpriced homes?

Maria Belen-Power stated that in Chelsea and East Boston, Massachusetts, she's seen a lot of those investments going to communities that are white and wealthy and she sees EJ communities bearing the burden of that transition. She stated that substations are being placed next to jet fuel that is in overcrowded neighborhoods of black and brown residents, especially non-English speaking immigrants. She stated that it seems like because there was a WHEJAC created, all the problems are solved and that everything has changed and, meanwhile, these inequalities continue to be impacting people every day.

Ms. Belen-Power stated that Chelsea was the hardest hit city from COVID in the entire commonwealth of Massachusetts and their rates were five times higher than the state average. She added that it was uncovered last week that the Department of Transportation of Massachusetts has been dumping asbestos in the community for an entire year. She emphasized that the idea that these things are a thing of the past, that we've moved on, that there's a new administration and that a WHEJAC was created, is a false understanding of what's actually happening on the ground in EJ communities today. She noted that as we transition to a clean energy economy, that is an unjust transition because the burdens of that infrastructure are being placed in black and brown communities and communities of color and in non-English speaking communities where immigrants live.

Co-Chair Moore agreed with the previous comments about the wildfires and the total disregard and disrespect for sovereign nations. He also reminded everyone that many in EJ communities don't have insurance when a disaster occurs. He stated that the U.S. government needs to be held not only accountable but responsible for what's taking place in many EJ communities. He stated that the U.S. Forest Service needs to be held responsible and accountable for what's taking place presently in the northeastern part of New Mexico.

Angelo Logan lifted up a comment that resiliency has a connotation that EJ communities are resilient in that they can continue to survive under extreme circumstances. He stated that it should be recognized that it's not just about continuously putting the burden on the communities and that they are resilient because it is happening to them.

Vice-Chair Tilousi reminded everyone that the tribes around the Grand Canyon have been experiencing a lot of flooding in the past 25 years. She stated that when they've gone into disaster mode, they asked FEMA to come in and help and their response was pretty slow. She stated that FEMA told her tribe that the tribe has a lot of logistical planning that needs to be done

such as developing an emergency operations center, having an organizational chart and doing an assessment. She stated that in the meantime, the community was walking through contaminated sites like sewer pipes that were broken. She stated that relief is needed immediately. She felt that at the time they were caught in this long logistical process while the people needed help immediately and there was a lot of back and forth. She stated that they were told by FEMA to go through the state emergency operation center and the community had a difficult time getting services.

Ms. Lopez-Nunez stated that it seems like communities are expected to develop infrastructure while in the middle of a disaster. She continued with the next topic of disaster preparedness and relief questions in response to their charge. She stated that inherent discrimination and diminishing of communities are embedded even in the way we talk about disasters.

Ms. Yoshitani stated that there will be a discussion in the workgroup specifically about the terminology when they have more time to discuss it. She stated that there were four original charge questions and they wanted to address the one with disaster preparedness and relief -- what type of support is needed for disadvantaged communities to participate in federal disaster preparedness or relief programs?

Ms. Yoshitani stated that they were concerned with the way that the question was framed. She explained that it sounded like blame to the communities in that somehow environmental-justice-impacted communities are the ones that need to change to receive the accountability, responsibility, benefits and resources of the federal government. She stated that this should be shifted and directed back to federal agencies and the federal government's approach. She suggested a more general charge question; what changes need to be made to federal agencies to ensure the equitable distribution of resources for federal disaster preparedness and relief programs?

Ms. Yoshitani highlighted four areas to consider when forming recommendations. She explained that the first is funding impact and stated, for instance, how do we ensure that recovery funding doesn't perpetuate polluting and equitable systems in housing, energy and other infrastructure? She stated that the example that Ms. Santiago gave earlier points to this question to formulate recommendations. She stated that they have a few recommendations, and they would love to hear more from the Council.

Ms. Yoshitani stated the second area, community participation. She asked how can FEMA and other agencies reach communities they often leave behind? She stated that they've heard some of the stories already about how the federal government agencies have and have not related to communities. She stated that they would like to hear how agencies need to improve the way that they are communicating and responding to communities.

Ms. Yoshitani stated the third area, accessibility. She asked who are the most marginalized groups who have been the worst impacted or left out of FEMA funding/programs? She asked what recommendations ensure the accessibility of the most marginalized communities and all communities for the resources, not just through FEMA, but through the federal government for disaster preparedness and response?

Ms. Yoshitani stated that the fourth area is around legal accountability and asked how can we get federal agencies to follow existing executive orders and existing law? She asked how can we ensure that the federal government is responding to and communicating and delivering both preparedness and relief in disasters? She asked how can we then ensure that the government are following all existing regulatory and executive orders and existing law? She noted that there are a lot of existing laws in place that should be protecting and ensuring a more equitable response, but they're not being followed. **Ms. Lopez-Nunez** invited any recommendations for addressing or changing the charge question and for the screening tools that can apply to disaster preparedness and community climate resilience.

Ms. Santiago suggested that, if the Biden administration's policy is to electrify or decarbonize the electric grid by 2035, FEMA could earmark funds specifically for that and not for rebuilding the same thing, like fossil fuel electric projects or anything that enables that. She noted that this could include things like energy conservation, efficiency, demand response programs, locally sited community-based renewables, and battery energy storage systems.

Ms. Santiago also suggested that other agencies provide funding for energy projects and bring down the matching portion for community-based projects. She explained that this would go a long way to allowing a non-profit organizations, workers, co-ops, and other groups that are community-based to do energy projects. She stated, for example, HUD sometimes has a \$10 million minimum capital base that an organization needs to have. She noted that EJ communities don't have that kind of money so that hurdle is impossible to overcome.

Ms. Santiago noted in terms of accessibility, large outside corporations are attracted to disaster recovery work. She stated that they are not locally based and do not hire local help and, if they do, they are paid a minimum wage. She stated that they usually take the funds and don't reinvest substantial amounts of it, so the money does not have a multiplier effect within the local economies. She stated that FEMA, HUD, and other agencies need to make sure that they're working with local groups and organizations, especially non-profits, worker-owned and co-ops.

Dr. Sheats addressed the community participation area. He stated that there should be community-level resiliency plans. He stated that to make this work accessible to local community groups, they need funding and resources to ensure the community members and local community groups can put together these plans and work on these issues in their local community.

Dr. Sheats addressed the question; how do we ensure the recovery funding doesn't perpetuate polluting and inequitable systems? He explained that to reduce pollution in these communities, they need to come at it from the cumulative impact framework. He asked is there a cumulative impacts problem or multiple sources of pollution? He asked is there a plan to address it and if in the recovery plan, will pollution be reduced or made worse?

Dr. Sheats shared an example in New Jersey where the Passaic Valley Sewage Commission wants to make the sewage plant more resilient and part of what is planned is to build a power plant that will have local air pollution emissions attached to it. He stated that if this was viewed from a cumulative impacts framework, there would be no support for a power plant with local air pollution attached to it.

Ms. Yoshitani stated that there was a recommendation coming out of the workgroup regarding existing cumulative hot spots and that the affected communities have added protection of any additional polluting infrastructure funded with public funds in a regulatory way that prevents other infrastructure, be it private investments or public.

Ms. Yoshitani discussed another area of the charge question. She stated that community climate resilience is a separate set of questions, but there's obviously a lot of overlap and similarity. She noted that when thinking about the infrastructure that needs to be built in communities that is equitable, positive multiplier effects for local economies are their goal for climate resilience. She stated that the idea is not to reinforce the cumulative burden in communities, but that communities end up stronger through community efforts or the federal government's efforts.

Ms. Yoshitani clarified that the impacts are not just in terms of weather-related disasters and that there are fires, flooding, and sea level rise. She stated that there are also the related economic impacts of climate disaster like the rising prices of energy, food, housing, and the transportation system. She noted that because the root causes and the impacts are so interrelated, the workgroup is asking for recommendations for an interrelated government approach.

Ms. Santiago shared that, in terms of funding access, one of the things that can provide access is for public supply of essential services and specifically with public utilities. She stated, for example, if they have a funding source for resiliency measures or mitigation measures, then that can be widely available to low and middle-income communities. She noted that public entities should have funding that is earmarked for resiliency measures like renewable energy or housing improvements and that will provide access, especially to low- and middle-income people.

Rachel Morello-Frosch said that, in terms of community participation, one approach would be trying to learn from states that have already been doing some of this work to engage communities in planning for climate impacts and enhancing community resilience. She asked are there lessons to be learned from California strategic growth council programs as they have sought to support community planning for climate change impacts through allocation of different kinds of grants and support directly for projects. She stated that there are potential models out there that could be scaled up from which federal programs could learn a lot without having to start from scratch.

Co-Chair Shepard said that, in terms of funding access, once we identify those disadvantaged communities through the screening tool, federal grants can be made specifically for community-based organizations to develop community planning processes and climate action plans very specifically. She stated that there has not been many municipalities, even when they have money, really reaching out to communities for that kind of planning. She noted that some years ago, EPA made grants available to states to develop environmental justice plans and some of the states that had the earlier programs really took advantage of that grant program.

Ms. Shepard stated that once there are state environmental justice plans or city advisory groups, you will find that the states then begin to develop EJ grant programs that fund things like community-based planning or community resilience plans. She noted that the National Institute of Environmental Health Sciences in the past develop grants that are community-academic-

partnership oriented. She shared that EPA some years ago had a CUP grant that stood for Community-University Partnerships. She explained that it was a grant that allowed communities to partner with academic institutions to begin gathering data to provide the kind of research that communities identified.

Ms. Shepard explained that a lot of these models have been in place through the federal government in years past, but they were discontinued. She noted that those approaches need to be brought back to begin to develop some more innovative interagency approaches. She stated that there has not been an approach where several agencies got together to develop more of an intersectoral approach. She explained that with the Interagency Working Group that's been established through CEQ, that would be an opportunity for DOT to get together with the HUD and EPA to look at transit hubs that can do transit-oriented development that may be in a flood zone. She noted that they are all kinds of ways for the agencies to come together to provide funds and have a more resources to pinpoint particular problems.

Vice-Chair Tilousi stated that one of the things they had trouble gaining access to were the FEMA funds for the homes. She noted that a lot of the homes were flooded and because these families on the reservation didn't have insurance for their homes, it was difficult for them to get any recovery. She stated that the tribe decided to insure all the homes in case this happened again. She also suggested that FEMA could do an assessment on estimated damage and give the funding directly to the tribe.

Ms. Yoshitani agreed that there are a lot of stories about the barriers that are put up by any of these programs to make low-income communities and disadvantaged communities go through unsurmountable obstacles to try to get access to even the small amounts of resources that are available.

Ms. Lopez-Nunez turned the topic to the Climate and Economic Justice Screening Tool. She explained that the definition given for basic things like climate, sustainability and housing were a big flag for them. She added that there were three thresholds: expected agricultural loss, expected building loss and population loss. She stated that a lot were missing like the overlays about flooding vulnerabilities, vulnerabilities to fires or the heat island effect. She noted that it should be a one-stop tool for everything, including what programs the communities qualify for.

Ms. Santiago stated that the potential impacts from natural disasters should be included in the tool. **Dr. Sheats** agreed that more indicators specific to climate, like the heat island effect and air pollution, should be included. **Ms. Santiago** added a climate threshold for water, both potable water or water for human consumption and for other needs. She stated, for example, the sea level rise can lead to saltwater intrusion into groundwater bodies. She noted that communities, especially coastal communities, that depend on groundwater will see a decrease in their supplies and droughts will impact all kinds of water bodies, superficial and groundwater.

Dr. Morello-Frosch concurred with the drought threat. She explained that in addition to seawater intrusion into groundwater resources, areas highly prone to drought and domestic well communities have wells that are running dry. She stated that data is getting better at predicting places where access threats are likely to be acute, particularly in the foreseeable future as precipitation diminishes and groundwater goes lower. She suggested contacting a group called

Toxic Tides based in California to explain their work in sea level rise and flooding threats to hazardous facilities and low-lying coastal areas. She also reminded them that places where you're likely to have groundwater getting pushed up more with sea level rise can reactivate toxics embedded in the soil in some of these legacy sites that haven't been adequately cleaned.

Kim Havey asked if they had looked at or considered having any health indicators as part of that screening tool. **Ms. Yoshitani** added that cumulative impacts of all of these different indicators should be included as well as include race as an indicator. **Ms. Lopez-Nunez** invited everyone to email or reach out to the group to give more feedback.

DFO Martin announced the break with the public comment period to follow.

1.4 Public Comment Period

On May 11, 2022, the WHEJAC held a public comment period to allow members of the public to discuss environmental justice concerns in their communities. A total of 23 individuals submitted verbal public comments to the WHEJAC and an additional 49 individuals had signed up to speak but were not in attendance. Each speaker was allotted three minutes.

DFO Martin welcomed everyone back from the break. She reminded everyone of the procedures for the public comment period. **Co-Chair Moore** reminded everyone that there are many staff members from various organizations on the call. He stated that the public comment period is a very important piece of the work of the WHEJAC Council. He explained that they prioritized hearing from people that have not testified before as a public speaker. He noted that if more than one person registers to speak from the same organization, the first one that registered will be heard first and then the others as time allows.

1.4.1 Melissa Miles - New Jersey Environmental Justice Alliance (New Jersey)

Melissa Miles stated that, before she was ED of an environmental organization, she was a parent experiencing the impacts of having children in a neighborhood burdened by the cumulative impacts of pollution and climate change. She stated that she and her children marched from the Ironbound Community Corporation in Newark, New Jersey, to the gates of the Covanta Essex incinerator a mile and half away in the snow. She said she did that because Covanta never takes a break from burning trash and poisoning the air.

She explained that they were accompanied by dozens of other children concerned about their health and their futures. Children should not have to defend themselves against the inaction of government bodies who fail to adequately protect them year after year and decade after decade. Due to the extreme danger they pose to communities, the EPA is legally obligated to review and revise standards for incinerators every five years under the Clean Air Act. But the EPA has repeatedly failed to update these standards. She explained that the EPA has not updated these standards in over 15 years since 2006. In the last 30 years, the EPA has only revised its incinerator standards twice, not the legally required six times. The EPA has failed to regulate incinerators, and this failure has exposed us to lead, other heavy metals, and particulate matter. It's also exposed them to the psychological harm of feeling like, even though they are organized and fighting back, decision-makers don't care about them.

She spoke about that, as a result of industries like Covanta, the Ironbound has been nearly ghettoized as wealthier white residents of Newark were able to move to the surrounding suburbs leaving behind many black and brown residents who were unable to move. As a matter of fact, some of the closest housing to the incinerator is low-income housing, where many of the neighborhood's longstanding black and Puerto Rican families live. EPA's failure to regulate incineration in an old, outdated, and unnecessary industry that robs states of both clean energy funding and their creativity to design new and better systems is nothing short of neglect of the communities that they have sworn over and over again to protect. They need urgent action. Will generations have to march against the same aging and outdated incinerator 20 years from now? She hopes that by speaking to the WHEJAC her community will finally see action and pressure EPA to regulate this dirty industry now.

1.4.2 Jonathan Smith - Earthjustice (New York, New York)

Johnathan Smith stated that Earthjustice represents environmental justice groups dealing with the scourge of waste incinerators. The vast majority, 80 percent, of these incinerators are in EJ communities. For decades, EPA has let these incinerators pollute more than the Clean Air Act allows. On a per-megawatt basis, incinerators emit more pollution than coal plants, and they can be some of the biggest local emitters. EPA admitted nearly 15 years ago that the current incinerator emission limits were not calculated the way that the Clean Air Act requires, and EPA admitted that these limits needed to be redone. The Clean Air Act deadline for EPA to update the standards passed over ten years ago, but EPA has not proposed or finalized any updates to the incinerator standards since. It is unacceptable for EPA to continue to delay fixing standards that allow too much pollution in EJ communities. He urged WHEJAC to call on the Biden administration to prioritize its long-overdue update of these incinerator standards.

1.4.3 Whitney Amaya - East Yard Communities for Environmental Justice (Long Beach, California)

Whitney Amaya called attention to the incinerator that has been burning trash for almost 35 years in her community, even though better waste prevention and resource management strategies exist. Agencies that are meant to hold these polluters accountable and that are meant to protect the air they breathe have failed them over and over. The EPA is supposed to update incinerator emission standards every five years, which, if they would have been doing their job, means they would have six revisions by now. But the EPA has only reviewed emissions standards once back in 2006, which is 16 years ago. Meanwhile, the incinerator in her community has been spewing out more toxic pollution than they're legally allowed to base on standards that they know aren't health-based.

She explained that, on top of this, the incinerator is able to work away without any repercussions to the dangers they're causing because they're able to exploit start-up, shutdown, and malfunction exemption loopholes. Their communities knew back then when they were flooded with trash burner proposals that incinerators are not the answer. They are false solutions, just like the new age pyrolysis and gasification incinerators are. Burning trash emits harmful pollutants and contributes to the poisoned air they're already breathing impacting our respiratory system, our reproductive system, and causing cancer. They need the EPA to stop ignoring their communities

and to do its job in protecting the environment and public health by updating the emission standards for incinerators. As the leading voice of environmental justice, she hopes that this body will make this a top priority and elevate this issue to the EPA and the Biden administration.

1.4.4 Ann Cass - Proyecto Azteca (San Juan, Texas)

Ann Cass stated that they have many problems in the Rio Grande Valley, and she doesn't feel that EPA is doing much about it. Finally, after 40 years, they were able to fix a sewer plant that was by a colonia because the youth leaders in the colonia took over. But FEMA is just really a problem. Every time they have a disaster claim, the Texas Rio Grande Legal Aid has done a great job in suing them, which is the only recourse they have. FEMA admitted that they have secret rules, such as not going up on roofs or underneath the house, to determine damage. A lot of them did not speak Spanish. A lot of them knew nothing about construction. The group finally got FEMA to use drones to examine the roofs.

She explained that colonias that have septic tanks are also troublesome. Every time it rains, they flood, and the fluids come up to their yard. Her county health department, TCEQ, and the water supply corporation says they don't have any money to put sewer in there, but they get absolutely no assistance from EPA. It's just very frustrating to get things to happen, and it just takes decades to get something moved.

1.4.5 Skye Wheeler - Human Rights Watch (New York)

Skye Wheeler stated that over the past two years, her group has become increasingly interested in how the climate crisis is worsening the maternal health crisis in the U.S., defined by inequities between black, indigenous, and other women of color on the one hand and white women on the other. She explained that pre-term birth rates, as one example, have generally been rising over the past years and are twice as bad for black women as for white women. Like other human and civil rights organizations, they are excited that WHEJAC is focused on how best to protect disadvantaged communities and how resources should be best allocated to make sure disadvantaged communities can best participate in federal disaster preparedness and relief programs.

She stated that, although her group strongly supports the efforts to promote an environmental justice approach to climate change, they also request a reproductive justice approach as well and explicitly press for resources to protect pregnancy and newborn health, as well as other sexual and reproductive health care to prevent the climate crisis from worsening the gap between who gets to have a healthy pregnancy and newborn and who does not. Her group recommends including comprehensive sexual and reproductive health as a central part of disaster preparation and response. This includes ensuring ongoing access to comprehensive contraceptive choice and access to safe abortion care as well as maternal, perinatal, and newborn healthcare, including lactation support. All these things were missing in the aftermath of Hurricane Maria in Puerto Rico, for example.

She explained that ensuring reproductive justice organizations, doulas, midwives, and lactation consultants are properly equipped and resourced to provide emergency support, including through government grants, is key to promoting reproduction justice. They would also like to see

frontline maternal health workers, like doulas and midwives, included in planning for disasters. They should be properly compensated for this work as often these lifesaving workers are poorly or undercompensated for their work, especially when they work in communities marginalized by historical and current racism.

She added that extreme heat exposure is an ongoing health hazard. But the impacts on pregnancy health are poorly understood by both pregnant people and families and providers. Public health campaigns on the dangers of extreme heat should include pregnant people. Subsidized assistance for cooling devices or improved housing should include pregnant people as well as other "vulnerable populations." Pregnancy accommodations at work, such as additional bathroom breaks or water breaks for pregnant people, should be better protected.

1.4.6 Sneha Ayyagari - The Greenlining Institution (Oakland, California)

Sneha Ayyagari stated that Greenlining has over a decade of experience providing input on the development and implementation of California's [CalEnviroScreen mapping tool](#) that was used to inform the CEJST's tool. They also have deep relationships with California and national environmental justice communities and groups. She emphasized four points in regard to the tool.

She noted that, number one, the CEJST should use race as an indicator. Race is the number one predicting factor for proximity to citing near hazardous locations. Low-income communities of color are disproportionately burdened by poverty and pollution. If the CEJST aims to address these climate and economic disparities, it must use race as an indicator and, at the very least, should use proxy indicators for race and use an analysis that ensures that ratings are predictive of racial and economic burdens while considering cumulative impacts.

She went on to explain number two. The CEQ's process for engagement with frontline communities should be stronger, should provide transparency into the process for working with frontline communities, and explain why certain feedback is included or not. The CEQ should also provide funding for technical assistance and capacity building, particularly for communities so they can easily participate in the development and implementation of the tool.

She explained number three. The CEQ should be clearer about how different states and federal tools can coordinate in finding disadvantaged communities. Having multiple tools can lead to inconsistent definitions and duplication. Community-based organizations in local government agencies do not always have the capacity to track multiple comment periods for each tool. Combining and streamlining these processes can help develop better tools for communities to use their time and input. They also want to ensure that there's updated data for rural, tribal, and island communities where there's historically poor data and recommend that agencies work to eliminate algorithmic bias in climate investment.

She concluded with the last point. The tool should include indicators for climate change risk, adoptive capacity, and sensitivity data to make sure that they identify the most climate-vulnerable communities, reduce disparities, and improve federal disaster relief programs for the communities that need it the most. California is working on a streamlined, comprehensive, and accessible mapping platform that identifies communities that are most vulnerable to climate change impacts. A similar approach can be implemented at the federal level to address past

injustices and ensure a more equitable future moving forward. She stated that she will provide detailed written comments on the tool.

1.4.7 Vithal Deshpande (City of Somerville, Massachusetts)

Vithal Deshpande stated that his city, Somerville, is located near the Atlantic Ocean and is one of the densest cities in the United States with a population of over 80,000 population in an approximately four and a half square mile area. Flood incidences are expected to increase in Somerville from this decade onwards. This will be an additional burden on the local disadvantaged community. This will be true with other disadvantaged communities sharing similar geography and other demographic characteristics across the United States. The U.S. EPA has developed environmental justice indexes. They are related to ongoing pollution issues and don't address the wider environmental impact issues, such as extreme weather conditions and floods. There are several actions required to integrate the EJ policy on data collection, development, public education, and more.

He stated that, as the saying goes, unless we measure, we can't manage. Hence, he proposed improvising the existing system and include data collection related to the climate change impacts in the EPA's EJ indexes. This should provide an additional layer of information about the impacts that EJ communities and the local governments face. This will formalize the strategies for the local to national level to address adverse climatic impacts. The climate change effort should not be presented or functionally be separate from these other efforts. This should include others with expertise in their field in the important conversation. Disaster relief programs are too complicated, require too much paperwork, and present too many opportunities for conflicts due to concerns about individuals issuing duplicate benefits. So, it needs to be simplified also. He recommended that FEMA, HUD, and other agencies coordinate on this topic to ensure resources are directed and coordinated towards the communities that really need it.

1.4.8 Paul Gallay - Columbia University Climate School Resilient Coastal Communities Project (New York, New York)

Paul Gallay stated that his group interviewed 10 to 12 organizations within the New York metro area as to what they think the answers are as to what type of support is needed for disadvantaged communities to participate more effectively in federal disaster preparedness. The organizations answered that only through a fundamental systemic change in these processes can communities, governments, and academic institutions working in true partnership foster just and restorative resilience projects.

He explained that communities are considering whether to decline to participate in future planning processes if the government does not show how their participation can actually foster change. Those communities ask, will I be heard and supported? Will my concerns become your concerns? Will anything change because I took the time to engage? And will that change take root and grow over time? Communities need to be brought into the actual decision-making process and ultimately be asked to share leadership on project design with governments. Government expertise and community expertise need to work together. Governments should help build awareness, identify, and reach out to at-risk, marginalized, and disempowered communities, build capacity, provide guidance as to how average communities can access the

resources they need to protect more effectively, and most importantly help communities build their own table, support the creation of their structures to assure that they will have meaningful opportunities to form input into government's resilience planning.

1.4.9 Angelle Bradford - Sierra Club Delta Chapter (Louisiana)

Angelle Bradford stated that, when she reflects on the many years of hurricane and tornado responses in south Louisiana, she first thinks of the relief programs and how heavily means-tested they are. South Louisiana folks, right off the bat, know that these processes are discriminatory towards those who do not either say the right thing with the staff member that screens them or those of us who are renters versus homeowners expect to receive less if any assistance at all. In the days after Hurricane Ida last year, it felt like the lessons from Hurricane Katrina in 2005 were just not apparent nor taken into account. The federal systems do not integrate well with the state-level systems. And, as a result, there is so much room for confusion, misinformation, and the appeals process for financial support becomes the default for so many folks in need of assistance.

She noted that the truth is, however, you will not be able to indefinitely afford to bail out Louisiana as they set records for hurricanes and climate change or any of the south just as you will not be able to indefinitely bail out the west with wildfires. Since this is a reality, the insurance programs for floods need to be affordable and realistic. The strength of structures that will be impacted by tornados needs to be fortified by codes and requirements. And you need to work with other agencies to build in more safeguards for renters, not just homeowners, as a lot of south Louisiana communities and families are renters, not homeowners. You have to work with the states to create the best, safest housing that lives in harmony with the land and water but also with the realities of climate change and extreme weather. Everything from the building codes and where they are allowing folks to live, including the danger zones, has to be made as safe as possible if lived within at all.

1.4.10 Julia Cohen - Plastic Pollution Coalition (DC)

Julia Cohen stated that the production, transportation, use, and disposal of plastic and the extraction and refining of its petrochemical ingredients are major drivers of the climate crisis in the U.S. and around the world and most greatly impact EJ communities. The U.S. plastics industry's contribution to climate change is on track to exceed that of coal-fired power plants in this country by 2030. Increased frequency, incidence, and severity of extreme weather and storms, sea level rise, coastal erosion and ocean acidification, hotter temperatures, bigger wildfires, more droughts, freshwater insecurity, and other dangerous phenomenon imperil people and the ecosystems we rely on to survive.

She continued with much of the U.S.'s plastic and petrochemical-producing industrial plants and other infrastructures along the plastics pipeline are sited in historically underserved, BIPOC, rural, and low-income communities that are also worse hit by the accelerating effects of the climate crisis. Hurricanes, flooding, and dangerous heat are affecting Cancer Alley. The extreme flooding, droughts, and massive shifts in precipitation are affecting the Ohio River Valley, where plastic and petrochemical production, especially fracked gas, is still growing. Climate change increases the vulnerability of plastic and petrochemical infrastructure to flooding, fires,

explosions, and other disasters that can and have claimed the lives of many people. At least one-third of all hazardous chemical facilities in the U.S. are at high risk of experiencing disasters as a result of climate-driven floods, wildfires, and storms. Residents of frontline communities face serious physical and emotional health risks linked to constant exposure to stress and chemicals.

She ended with frontline communities living near landfills, illegal dumps, and incinerators are constantly subjugated to polluted air, soil, and drinking water. Near these landfills, they're experiencing constant truck, train, and barge traffic and stored waste. Hurricane Ida's the most recent example of worsening storms affecting these communities, and the greater risk of fire and explosions are increasing as well. So, preventing the deadly effects of plastic and petrochemical production in the climate crisis will save lives. We need to stop the petrochemical expansion now, and we need the EPA and other government agencies to include the entire plastic supply chain and life cycle in all EJ and climate efforts.

1.4.11 JV Valladolid - ICC (Newark, New Jersey)

JV Valladolid stated Newark is home to a rate of asthma three times higher than anywhere else in New Jersey, home to four other superfund sites, and also home to already three fracked gas power plants. To live in an environmental justice community is to wake up to an unbearable stench of burning garbage and to encounter potholes and the sounds of diesel trucks moving in and out to be able to access industry. We know all too well the ways in which her community is impacted and the way that their children are sacrificed on a daily basis. We understand all too well that they are being exposed to emissions that are known to be cancer-causing, cause cardiovascular issues, cause reproductive issues, and this is just a short list of the cumulative impacts that they are concerned about.

She explained that currently, Newark is fighting a fourth gas power plant, the Passaic Valley Sewerage Commission, utilizing FEMA funds in the name of resiliency and further harming her community and putting them at risk. They are asking that the EPA move to prioritize standards on waste incinerators like the 30-year-old Covanta garbage incinerator and community, which is now over ten years out of compliance with the Clean Air Act. They're looking to leadership like yours to help them move that the EPA prioritize communities like hers. The EPA's failure to update incineration standards sends a clear message that their lives don't matter as much. They are looking to your support in lifting their voices to the administration and ask that the EPA consider communities like hers for their benefit in the future.

1.4.12 Sebastian Caicedo - Florida Rising (Miami, Florida)

Sebastian Caicedo stated that his community has dealt with an incinerator next to their homes for the past 20 years. They have talked to many residents that have been affected in so many ways. He explained that there are nine public schools in this community alone where thousands of children are exposed to many potential health issues, some of which are headaches, nausea, dizziness, and trouble breathing. Now Miami-Dade County is considering building a bigger one at the same location or a location nearby. This can become a bigger problem for the entire community of Miami as this could and will dictate the future of the environmental policies for our county. They, the residents of Miami-Dade County, deserve better. His children deserve better, and their children hopefully will deserve better. They are asking for your assistance on

that.

1.4.13 Rebeca Velazquez - Mujeres Luchadoras Progresistas (Oregon)

Rebeca Velazquez (through an interpreter) stated farmworkers face climate impacts every day. She lives in Oregon and is out in the hot and cold weather. In 2020, there were massive fires where people had to be evacuated. She explained that she and her husband had to stop working for two weeks because of the air contamination from the fires. Because they could not work, it caused them a lot of stress and fear because bills could not be paid. There was no financial help. She asked the federal government to guarantee help arrives to all the affected people without their work or their immigration status.

1.4.14 Francisca Aparicio - Alianza Nacional de Campesinas (Oregon)

Francesca Aparicio (through an interpreter) stated she is also a farmworker in Oregon. During the summer of 2020, the fires affected the farm working community and the community that works outdoors. Despite the heat and the smoke, the farmers went out to work in the field. As a community worker, she had the opportunity to assist and listen to the community, taking all the necessary equipment so they could be protected from the smoke, like masks and other resources. Farmworkers did not stop working because they needed to work to provide for their families. The farms were full of smoke, and some farmworkers were working without any protection whatsoever or adequate protection to protect themselves from the contaminated air because of the smoke that was unbearable. The employers don't have the resources to protect us. People have passed away in their work areas because of the extreme heat.

She asked for laws to protect the workers that work outdoors, for example, the gardeners, the construction workers, the farmworkers, et cetera. They need laws that will protect and for the employers to comply. The farmworkers do not have training on how to take care of themselves in extreme temperatures. It is also very important that the federal resources come to the communities. She invited anyone, if they are willing, to accompany one of the workers who work outdoors so they can understand the need that the community has.

1.4.15 Elia Cordero - Mujeres Luchadoras Progresistas (Oregon)

Elia Cordero (through an interpreter) stated that she also works in Oregon as a farmworker. She explained that because of the pandemic quarantine, they had to stop working for about two months. Financially, they had a hard time because the rent and bills don't stop coming in. When they were able to finally go back to work, she was not able because she had COVID. She had to stay home for another month, and her rent and bills were behind. She explained that, as a farmworker, they have a salary that is not enough to save. When she went back to work, she was full of debts and depressed because she did not know how she was going to cover her debts. Two months later, the fires came, and they had to stop working for two weeks as well.

She explained that the biggest tragedy of all was not being prepared to survive through all these disasters. They started evacuating people, and they didn't have enough places for people to stay. The government is not ready, even though they know that this happens every year. To top it off, they had a freeze. Trees came down and broke the electricity cables. For ten days, they did not

have electricity. They couldn't cook, bathe, or use the heater. They don't have community assistance. She asked for help and resources for the farmworkers. They are the most vulnerable and affected ones.

1.4.16 Leticia Pascual - Mujeres Divinas (New York)

Leticia Pascual (through an interpreter) stated that she lives in the north part of New York and works in an apple field. The fieldworkers have to deal with the cold weather. The climate is below zero. If they don't trim the trees, the fruit will not grow. This year there was a lot of wind and snow. They were unable to work because the wind would make the snow blow into their faces, and they couldn't see very well. One day, the temperature went up and the snow became ice. They couldn't work either because of the dangerous ice. She would like programs to help the farmworkers have funds when they are unable to work, for the boss to give this information, and for the agencies to speak Spanish.

1.4.17 Gina Romero - Florida Rising (Miami, Florida)

Gina Romero (through an interpreter) stated that she is speaking out about the incinerators in her community. EPA has not regulated the incinerators, and this has made many communities at unnecessary risk. She explained how the air is not pure which causes them to be nauseous, gives them asthma and dizziness, and affects the brain and health. They live with animals, like rats and snakes. Her city is in the center of contamination. This is a community where 11 municipalities come and throw their trash so it can be burned. There is a mountain of ash that constantly come in the windows and doors. Burning trash gives off carcinogens that are toxic, and their residents are constantly being exposed to these ashes. The incinerator is 0.2 miles away.

She explained that the population has increased since this incinerator started. There are nine schools. At the present time, there 51,800 residents that are living here. It's 710 square miles. The problem is that the company wants to renew a contract for 20 more years. There are 600 to 800 diesel trucks that come through the neighborhood daily. The traffic is chaos. The smells are unbearable with the chemical, toxic gases.

She asked the EPA to intervene and do something. This does not support the executive order on January 2021 regarding public health and the environment and the restoration of science to attack the climate crisis in the country.

1.4.18 Aditi Varshneya - Global Alliance for Incinerator Alternatives (New York)

Aditi Varshneya urged WHEJAC to take action against solid waste incineration and call on the EPA to take overdue regulatory action to protect communities forced to breathe in the dioxins, mercury, lead, and particulate matter created by waste burning facilities in our neighborhoods.

She explained that 80 percent of municipal solid waste incinerators are located in low-income communities and in communities of color. The EPA is aware that incinerators are hazards to human health, and they are legally obligated to review and revise the standards for incinerators every five years under the Clean Air Act. However, the EPA has repeatedly failed to update these standards, exposing families to the slow violence of toxic air pollution and its long-term,

multigenerational health impacts, which include cancer, respiratory illness, and cardiovascular disease.

She described why incineration's devastating toll on human health is expensive. Baltimore's Wheelabrator incinerator, for example, cost the city \$55 million in emergency hospital visits, medical treatments, and lost workdays due to health problems related to it each year. The EPA's current standards do not meet Clean Air Act requirements, and they need to do right by frontline communities and by other young people by actually following through on their legal obligations.

She explained that she lives on river opposite of the Covanta incinerator in Newark (mentioned earlier). So, her community's trash gets burnt at a toxic incinerator just across the river in another working-class black and brown community. They're angry that they are forced to essentially poison families that look like theirs with their incinerated waste because the federal government has failed to do what it promised.

She ended with it's the EPA's responsibility to make sure that incinerators do not continue to operate like this. Waste incinerators are also the dirtiest form of energy on the grid today. Incinerators emit 3.8 times as many greenhouse gases compared to the rest of the energy units on the grid. So, moving away from incineration is not only key to protecting community health but also building a more resilient energy system. She urged them to make incineration and the frontline communities forced to live with these dangerous facilities a priority.

1.4.19 Odette Wilkens - Wired Broadband, Inc. (New York, New York)

Odette Wilkens stated wireless radiation from cellphones, cell towers, and 5G antennas placed in close range to homes, schools, medical facilities, and businesses have injured people. They are electromagnetically sensitive disabled. 5G and cell towers are being forced onto residents without notice, without their consent, and with the FCC telling the communities that their hands are tied. She explained that the number of people suffering from wireless radiation is relatively high. People are sleeping in their cars, sleeping in tents away from their homes, and evacuating their homes, including Pittsfield, Massachusetts, where a cell tower was making residents so sick that they evacuated their homes and children were vomiting in their beds. There has been no safety testing of 5G.

She noted that there are hundreds of grassroots organizations trying to protect themselves. They are all being ignored by the FCC, the FDA, HUD, EPA, and there may be others. There are a number of cases regarding the deployment of 5G. The FCC has also refused to update its wireless safety emission guidelines since 1996 and, in 2019, decided that the guidelines did not need to be updated. She asked, would you board a plane whose safety guidelines have not been updated since 1996? In 2011, the WHO classified it as a possible human carcinogen. And now, with updated scientific assessments, in 2018 it supports the conclusion that wireless radiation is a human carcinogen. Wireless is not clean energy. She stated that the FCC, FDA, HUD, EPA, and other agencies need to protect the health of the American public that they have been charged to do.

1.4.20 Naomi Yoder - Healthy Gulf (Texas)

Naomi Yoder addressed the support needed for disadvantaged communities to participate in federal disaster preparedness or relief programs. She explained that people need money to be available to them regardless of their income, race, color, home ownership status, et cetera. People who are undocumented, underemployed, unemployed, and unhoused are especially at risk, and some cannot qualify for a bank account. So, they need cash payments to be made available. Assistance needs to be available for anyone affected, not only people that are under a mandatory evacuation order. There were thousands of people in Orleans Parish who were displaced without any type of financial assistance. There should be no discrimination in assistance payments. Multiple journalists have reported that low-income people and people of color receive less money, and their awards take longer to arrive than those of more affluent and white recipients of awards. If FEMA can't dispense those funds equitably, please move this job to another agency or outsource it so that the funds are dispensed equitably and expediently.

She added that housing for people that are displaced is essential. In many cases after Hurricane Ida, it took four months or more for people to get a FEMA trailer or adequate housing. She will submit the rest of her comments on the docket.

1.4.21 Dave Arndt - Private Citizen (Baltimore, Maryland)

Dave Arndt commented on the intersection of climate, environmental, and social injustice. He explained that, unfortunately, all this injustice is burdened on the black, brown, and low-income areas. This is really all done by plan and design, which he didn't know about until recently. In the Brooklyn, Cherry Hill, and Curtis Bay neighborhoods of Baltimore, there are two incinerators within five miles, three RMP facilities, a chemical factory, a working port that drives heavy-duty truck traffic through the neighborhoods, plus several very large distribution centers which amplifies the truck traffic. These neighborhoods are in low-lying areas that are on the Baltimore Harbor, an area known for nuisance flooding and tidal surges caused by hurricanes and nor'easters. There's also a new phenomenon of rapid flooding due to impermeable surfaces, old storm drainage, and lack of trees. Unfortunately, this area is struggling with basic services, so there is no disaster preparedness let alone relief and community resilience planning.

He stated that, if a disaster happened today, residents are on their own. They don't even get warnings or notifications of what they should do, such as stay in place or evacuate. This all takes time, money, and expertise, which is not available to these communities. These neighborhoods are designated really as sacrifice zones. For decades, companies have profited while the health and wellbeing of the residents were of no concern. The first step that the federal government can do is not only to allocate funds but to drive a pilot program to show how to implement a community-driven plan to reimagine neighborhoods to be model communities of environmental, social, and climate justice. The second thing is to do it now. Finally, all Americans need to be aware of and understand systemic racism, sacrifice zones, and climate-induced disaster risk and preparedness.

1.4.22 John Mueller - Private Citizen (Tulsa, Oklahoma)

John Mueller stated that he has submitted comments about fluoridation at five previous

WHEJAC meetings and has spoken at three of them. He asked the government to provide safe drinking water. Fluoridated drinking water imposes a higher risk of harm to health in environmental justice communities and can increase the leaching of lead from lead pipes and plumbing fixtures. He also asked to increase Medicare reimbursement levels so that more dentists will provide desperately needed oral health care in disadvantaged communities and ban the addition of fluoridating chemicals to public water supplies. Banning the addition of fluoridation chemicals will have zero funding requirements forever. He had previously submitted a 2015 report on fluoridation and environmental justice to the Environmental Justice Interagency Working Group. The authors of that report from the Fluoride Action Network have been drafting a 2022 update to that report in light of the current peer-reviewed science published since 2015. He will be submitting additional material and updated report upon its release.

1.4.23 Joni Arends - Concerned Citizens for Nuclear Safety (Santa Fe, New Mexico)

Joni Arends asked that, with the fires around EJ communities and the wealthy areas, will there be equitable resources in both locations to rebuild, restore the forest and its waterways, and replace livestock, et cetera? He explained that, related to the wildfires, there is open burning and open detonation of hazardous waste and depleted uranium at Los Alamos National Laboratory. Pollutants from LANL open burning and open detonation have been found in the soil and in surface and groundwater that flows to the Rio Grande.

He explained that the National Academy of Sciences conducted a review of the open burning and open detonation activities at Department of Defense and Department of Energy sites and made recommendations for alternatives to open burn and open detonation, such as static denotation chambers that capture and treat toxic emissions. Concerned Citizens for Nuclear Safety request that the Board supports the National Academy of Scientists' recommendations for alternatives to open burn and open detonation as a matter of homeland security. They also request that the Board review the equity issues related to emergency preparedness, response, and distribution of relief from these two fires in northern New Mexico.

DFO Martin reminded everyone that the public has until Wednesday, May 25th to submit any public comments in writing via email or the form that's on the website. **Co-Chair Moore** reminded everyone that redefining environmentalism and conservationism, which actually took place at the First People of Color Summit, is the combination of the testimony that they've heard today and the ongoing testimony that they've heard since the existence of the WHEJAC Council and beyond. He explained that the first is that they've heard legacy environmental justice communities testifying over and over and over to other government entities, including the NEJAC and other federal advisory committees. Secondly, they've heard of legacy environmental chemicals that the people have been consistently impacted by. Then, again, they've heard about rural communities, farmworkers, and other workers. That's what's the redefinition of environmentalism and conservationism and the intersections between environmental and economic justice. Lastly, he stated that one of the most difficult challenges for grassroots communities has been running proactive and reactive agendas at the same time. That's what the communities are consistently faced with. Systemic racism is the issue. Environmental and economic justice is the goal. **DFO Martin** announced it was time for a break.

1.5 WHEJAC Business Meeting Reflection & Conversation

The WHEJAC will use this time to reflect on the meeting proceedings and the public comment period, discuss and deliberate action items, and finalize the next steps. **DFO Martin** welcomed everyone back from the break and turned the meeting over to Co-Chair Shepard.

Co-Chair Shepard stated that she's glad to hear about Ms. White-Newsome's appointment and can't wait to meet her at the next meeting. She stated that she enjoyed the presentation from the Climate Resilience Workgroup and informed the members that more people are needed to join that group. She noted that there was a robust public comment period hearing some similar issues they've heard before, but also some newer ones. She stated that they will certainly ensure that a process has been developed to follow up on those public comments.

Ms. Shepard explained that the first part of the business meeting is going to focus on the Climate and Economic Justice Screening Tool. She stated that they want to discuss whether they need to move the June 29th-30th meeting to July. She reminded everyone that they are not going to discuss actual recommendations but discuss whether or not they want to take additional time to provide comments to CEQ from either the WHEJAC as a group or focus on individual comments to CEQ by the May 25th deadline.

Ms. Shepard informed everyone that CEQ will continue to update the tool over the next several months and that would allow WHEJAC to vote on and approve recommendations at future WHEJAC meetings and submit them to CEQ. She stated that the Screening Tool Workgroup can use some additional time to develop draft recommendations from all of the comments that have been shared in the public meetings and also incorporate comments from the public. She stated that in order to give the Screening Tool Workgroup more time, they would have to consider moving the June 29th-30th public meeting.

Ms. Shepard explained that moving the meeting out until July will allow the workgroup additional time to finalize the draft recommendations for the final WHEJAC vote and the transmittal to CEQ. She noted that if that is chosen, DFO Martin could send out a poll to find a new meeting day.

Dr. Sheats explained that he thought the timeline to submit was sometime in June. He stated that there are several meetings scheduled for this month and the next. **DFO Martin** confirmed the dates. **Dr. Sheats** recommended moving the meeting to July. **Dr. Morello-Frosch** wanted to get access to the public comments and agreed that moving the meeting might be best. **DFO Martin** stated that they needed time to draft the recommendations. She stated that she would share the public comments received. She stated that there is another set of recommendations that the staff has worked on for the Scorecard for J40 and for the Climate and Economic Justice Screening Tool as well as additional comments for the Climate Resilience Workgroup. She noted that all three workgroups have meetings through June and those recommendations need to be seen by the whole body for review before going final. She explained that pushing the meeting to July would give the body time to review and at that July meeting all the recommendations could be finalized. **Co-Chair Shepard** asked DFO Martin to send out a poll to set the meeting date. **DFO Martin** confirmed.

Co-Chair Shepard asked for any reflections on the public comment period. She commented that she thought the incinerator in Newark was a little bit more under control, but it sounds like it's still out of control and out of compliance. **Dr. Sheats** stated that it's not only the incinerator in Newark, but there are also incinerators in Camden and Rahway that they are concerned about. He proposed that WHEJAC actually write a letter to the appropriate entity urging them to update the incinerator standards as soon as possible. He volunteered to work on that letter and asked for help writing it.

Co-Chair Shepard asked if the NEJAC has perhaps done a letter or anything on this issue? She stated that perhaps there have been public comments at the NEJAC meetings as well. She suggested connecting with the NEJAC to find out if they've done any letters and maybe there could be something combined effort. **DFO Martin** stated that the NEJAC's DFO is Fred Jenkins, and they can communicate with him. She stated that the NEJAC chairs are interested in wanting to work with the WHEJAC and this may be one of those issues they could work on together. She stated that she would give an update at the next full committee meeting on what they learned. **Co-Chair Shepard** agreed.

Juan Parras stated that he was not surprised by the farmworker's issues because of climate change. He stated that it reminded him of the days that Cesar Chavez was protesting and trying to address issues impacting farmworkers. He explained that, as the climate changes and it gets hotter and colder, those are going to be the primary ones that are being impacted. He stated that farmworkers supply a lot of needs, like food and harvesting, that everyone takes for granted. He explained that when you live it and work in it every day, you hear it louder and clearer, and it also has a lot of impact on immigrants. He stated that a lot of the populations that do this are migrant workers that are seasonal workers that come and go, but yet they're being impacted by it.

LaTricea Adams stated that the comments about farmworkers' maternal and children's health resonated with her. She reminded everyone that she proposed a special workgroup around maternal and children's health and was suggesting that again.

Ms. Belen-Power stated that she was also struck by the number of incinerator-affected communities that were all testifying across the country. She thought the public speakers weren't really testifying against the incinerators, but against EPA and EPA failing to do its job for 16 years. She stated that the intersection of issues is evident and climate change is adding a layer to it. She noted that there are also pre-existing issues in the community like maternal health, hazardous material, and labor conditions.

Chair Shepard asked DFO Martin if there is any sense that the EPA has been thinking about updating incinerator standards? **DFO Martin** stated that she can get someone from EPA to get an answer and an update.

Ms. Santiago stated that she heard quite a few comments about FEMA and failures in disaster relief to overburdened and disadvantaged communities. She suggested sending them a letter or meeting with them to talk about how they need to consider reasonable alternatives to comply with NEPA and then help provide real resilience in communities impacted by disasters.

Co-Chair Shepard asked that when thinking about Scorecard, would seem to be something that would be consider?

Vice-Chair Tilousi said that she also heard a lot about the incinerators, and she thinks the problem is there's no enforcement. She requested further research on that to see whether that's the situation and to provide the proper information if this body decides to do a support letter. She stated that lack of enforcement on polluting companies might be a trend going across the country.

Co-Chair Shepard stated that it's definitely a trend in most states. She explained that, when they're cutting their budget, they cut the enforcement personnel in the state regulatory agencies. She shared when she and others were in NEJAC they had an enforcement roundtable. She stated that they went on a roadshow to a variety of states and brought all of those regional officials there and had community residents come and talk about the lack of enforcement. She stated that it sounds like NEJAC needs to make something like that happen again because this was very helpful. She shared going to one in North Carolina with a big issue for the CAFOs at that time and, unfortunately, that issue continues today.

Ms. Shepard stated that the Council has been asked to evaluate how the administration is advancing environmental justice. She stated that the bedrock of that is certainly enforcement and what's been done there. She noted that that is not something they have had a lot of discussions about in the workgroups but that is a bedrock issue if they're going to talk about advancing environmental justice throughout all government policies.

Co-Chair Moore stated that one observation was that, when people were testifying, they really were kind of homing into recommendations and suggestions about how to move forward. He noted that there was a report that was put out by the NEJAC council during that time on enforcement. He stated that unfortunately, there are recommendations in that report that still are alive and well today as they were then. He also supported bringing the chairs from both councils together to work on issues.

Dr. Sheats stated that Mr. Logan (through a text) wanted to join whatever group that is formed to write the letter about the incinerator and echoed the remarks that were made about the incinerators.

Mr. Parras noted that in all the time that they've had meetings with the national EPA, they've never had meetings with the regional administrators. He asked if there is a possibility of actually hosting or having a meeting with all regional administrators and seeing how connected they are to all the issues that have been brought up over the past and what they've done? He suggested some kind of report card from all the regional administrators or at least a conversation with them about issues impacting communities. **Co-Chair Shepard** agreed.

DFO Martin replied that that's a specific EPA issue. She explained that, since the WHEJAC reports to the CEQ, that can be a recommendation put forward through CEQ to the IAC since EPA is a part of the IAC. Or that's a recommendation to the NEJAC to do that. She stated that since they're dealing with multiple federal agencies, it wouldn't just be EPA regional administrators; they would be dealing with all of those federal agencies which all have different

regions which are different from EPA regions. **Chair Shepard** stated that she tends to forget that a lot of the federal agencies have regional offices. She asked if all of them have regional offices or just some? **DFO Martin** answered that they all have regional offices, but they're different than EPA's ten regions.

Ms. Belen-Power stated that she is hearing the same theme from the public commenters, like the farmworkers and the incinerator issue. She agreed that there's a huge disconnect between experiences on the ground and what they're hearing from the administration about Justice40 being implemented. She stated that there needs to be -- either through tours or through meeting with the administrators -- some way to connect what's happening on the ground.

Co-Chair Shepard stated that she read an article that demonstrates Texas not using the resilience money equitably. She reiterated the top concern of EJ communities; will the money actually get to the disadvantaged communities? She stated that they are seeing that play out in real time. She stated that she wonders whether the agencies are really considering what they're going to do in that instance.

DFO Martin noted that those issues should be raised when they meet with the IAC. She stated that all of those agencies that were mentioned are a part of that. She stated that some of those topics should be raised with them, and they need to start having those conversations on how to work through some of these issues. **Co-Chair Shepard** reminded everyone that the meeting was the next day, and those agencies will be there, and they can bring up some of these issues to them in person.

Lucas Brown, U.S. Digital Service, stated they do anticipate releasing the tool this summer. He stated that it would be updated once a year after its initial release. He stated that he has heard in previous conversations a very strong desire from the WHEJAC to move very quickly to getting agencies using the CEJST to direct benefits to disadvantaged communities, to issuing updated guidance to Justice40 in the CEJST and to move as fast as possible on that.

Mr. Brown stated that he wonders if there was a possible way to get the best of both worlds of having time for the Council to put together the suite of full recommendations and also have some early feedback to help his agency get to Version 1.0. He stated that with the Scorecard Working Group, they split the recommendations into two reports. He stated that there could be feedback on items that could go into Version 1.0 and do a quick public meeting to approve them and then spend more time and research on the things that are a little bit longer-term, 2.0, like collecting new data sources and things that wouldn't be available this summer. He stated that he wanted to open up the conversation about how to meet both goals of having time and space for the recommendations and moving quickly towards Justice40 and CEJST implementation. **Co-Chair Shepard** asked what that deadline would be? **Mr. Brown** answered that there is no firm deadline, but would prefer it be earlier rather than later, maybe the end of June. He admitted that he hadn't run this past his colleagues, so this is him speaking with his sense of the timelines. **DFO Martin** replied that that is a conversation they should have with the workgroup.

Dr. Morello-Frosch appreciates the desire to incorporate their recommendations in this Version 1.0 and to try and accelerate it. She stated that she is also concerned because they did a lot of hurry up and wait previously. She stated that the Council is asking for an extra two weeks

to a month to be able to do due diligence, particularly to incorporate the feedback. **Mr. Brown** acknowledged that that timeline is extremely reasonable and that there has been some hurry up and wait in the past and that has been really challenging. **Co-Chair Shepard** stated that the workgroup will be taking this up tomorrow and making some decisions about the timing going forward.

Amanda Aguirre, Senior Advisor to CEQ Chair, stated that she and Mr. Brown will be at that meeting. She stated that she doesn't anticipate having a deadline by the meeting because several EOP partners have to decide on a series of policies and other updates related to the tool. She will keep in touch with the workgroup about the deadline.

1.6 Closing Remarks & Closing

Co-Chair Shepard reminded everyone that this is DFO Martin's last meeting. **DFO Martin** thanked everyone and said that she will miss everyone and that it has been a great experience and that she has really enjoyed working with everyone. **Co-Chair Shepard** introduced Victoria Robinson who will replace DFO Martin. **Ms. Robinson** introduced herself and stated that she has been quite impressed with the work that DFO Martin and her team have been doing to fully support the Council's efforts and the workgroup's presentation. She stated that she looks forward to working with everyone.

Co-Chair Shepard thanked everyone for their hard work in preparing and running the meeting. She introduced Amanda Aguirre to give a few closing remarks. **Ms. Aguirre** stated that, on behalf of CEQ and the entire Environmental Justice Team, everyone has their sincere appreciation and gratitude. She acknowledged DFO Martin's hard work. She reiterated CEQ's commitment to pushing this ambitious but long overdue environmental justice agenda forward. She reminded everyone that the comment period for the screening tool is still open until May 25th.

Co-Chair Moore thanked DFO Martin and everyone for a fruitful meeting.

Vice-Chair Tilousi stated that what's happening across the country seems to be getting worse and she is always committed to trying to move things faster. She stated that people in the communities are still suffering as heard again today. She stated that the more that they set timelines and goals and objectives to move forward, the more they will see some goals being accomplished. She stated that this is what she would like to see in the new team that has been brought on board and she looks forward to trying to remain on track and move forward.

DFO Martin stated that, even though she will be moving offices, she will still be around. She stated that it has really been a great experience helping build this Council. She thanked everyone for their time and efforts, and she adjourned the meeting.

[THE MEETING WAS ADJOURNED]

APPENDIX A: Attendee List

First Name	Last Name	Organization
Sara	Adelsberg	Deloitte
Fran	Aguirre	Unite North Metro Denver
M. Carlo	Altman	USDA/NRCS
Susan	Alzner	shift7
Whitney	Amaya	East Yard Communities for Environ Justice
John G.	Andrade	Old Bedford Village Development, Inc.
KT	Andresky	Breathe Free Detroit
Patrick	Andrews	FEMA
Stephanie	Anthony	Louisiana Democracy Project & La. NAACP
Francisca	Aparicio	Alianza Nacional de Campesinas
Joni	Arends	Concerned Citizens for Nuclear Safety
JoAnn	Armenta	Purpose Focusd Alternative Learning
Dave	Arndt	Self
Natasha	Arreola	Allianza nacional de campesinas
Magdalena	Ayed	The Harborkeepers
Sneha	Ayyagari	The Greenlining Institute
Sarah	Bailey	Flint Public Health Youth Academy
Richard	Baldauf	US EPA
Adrienne	Bandlow	Department of Commerce
Erica	Bannerman	Government
Ellen	Barfield	Beyond Extreme Energy
Nastassia	Barnes	FEMA
Edlynzia	Barnes	U.S. EPA
Claire	Barnett	HEALTHY SCHOOLS NETWORK
Sean	Bath	NOAA
Kathryn	Becker	NM Environment Department
Hormis	Bedolla	Alianza Nacional de Campesinas
Casandia	Bellevue	Earthjustice
Mitchell	Berge	Private Citizen
Dr. P. Qasimah	Boston	Tallahassee Food Now
Angelle	Bradford	Sierra Club Delta Chapter
Andrea	Braswell	Center for Environmental Health
Laura	Brethem	University of Minnesota - Graduate Student
Emily	Brooks	USGS
Janice	Brown	NA
Doug	Brune	USEPA Region 7
Margot	Bucklew	Nonpoint Source Management Branch

Dominique	Burkhardt	Earthjustice
Michael	Burns	Community and College Partners Program
Mike	Buza	Sierra Club: Nepessing Group
Sebastian	Caicedo	Florida Rising
Rev. James L	Caldwell	Coalition of Community Organizations
Stacey	Callaway	Ecology
Shashawnda	Campbell	South Baltimore Community Land Trust
Karen	Campblin	VSC naacp ktcPLAN
Morgan	Capilla	US EPA
Ari	Caramanica	USDA
Elvira	Carvajal	Alianza Nacional de Campesinas
Ann	Cass	Proyecto Azteca
Ester	Ceja	Idaho Transportation Department
Brian	Chalfant	Pennsylvania Department of Environ. Protection
Lois	Chang	CEEJH
Roxana	Chavez	Alianza Nacional de Campesinas
Claudia	Clifford	TCEQ
Stephanie	Coates	EDF
Julia	Cohen	Plastic Pollution Coalition
Deborah	Cohen	USEPA
Kimberlie	Cole	Strata-G LLC
Jasmin	Contreras	EPA
Elia	Cordero	Mujeres Luchadoras progresistas
Helen	Cortes	USDA FS
Farrah	Court	TCEQ
Justin	Cowling	American Academy of Nursing
Kelly	Crawford	DOEE
Bria	Crawford	Environmental Protection Agency
Jasmine	Crenshaw	Earthjustice
Rebecca	Curry	Earthjustice
Molly	Daniels	Environmental Incentives
Bryan	Davidson	Tennessee Department of Environment and Conservation
Dawn	Davis	INL
Rachel	Davis	Ministry of the Sisters of St. Joseph of Peace
Vithal	Deshpande	City of Somerville
Shantray	Dickens	FAA Civil Rights
Katharine	Donnachie	Private Citizen
Cece	Donovan	EcoLogix
Kevin	Doran	Western Governors' Association
Lori	Dowil	Corteva
Melinda	Downing	U.S. Department of Energy
Martha	Duggan	NRECA

Jeannie	Economos	Farmworker Association of Florida
Chris	Elder	GSA
Amanda	Eller	Emerson Collective
Tania	Ellersick	USDA Forest Service
Norman	Emerson	Emerson and Associates
Lena	Epps-Price	US EPA
Michael	Esealuka	Healthy Gulf
Carole	Excell	Waverley Street
Cathy	Eylem	P&G
Ericka	Farrell	EPA
Nicolette	Fertakis	EPA
Timothy	Fields	Senior Vice President
Kate	Fishler	EPA
Blanca	Flores	Alianza Nacional de Campesinas
Victoria	Flowers	Oneida Nation
Mariana	Fontaine Osegura	Alianza Nacional de Campesinas
Florence	Francis	GSA
James	Free	US DOC NOAA
Lauren	Frelander	ATSDR
Claudia Araceli	Fritz	Center for Neighborhoods
Paul	Gallay	Columbia Climate School
Emily	Gallo	HNTB
Anushi	Garg	University of Maryland
Danny	Garza	Mexican American Political Association
Beatriz	Gatica	Mujeres Divinas
Venu	Ghanta	Duke Energy
Olivia	Glenn	U.S. EPA
Leo	Goldsmith	ICF
Sheryl	Good	EPA Region 4
Amelia	Gooding Cheek	IERG
Vanessa	Gordon	USDA
Genesis	Granados	Air Alliance Houston
Justin	Gray	HUD
Daria	Grayer	AAMC
Manna Jo	Greene	Hudson River Sloop Clearwater
Ardie	Griffin	Emerald Cities Collaborative
Elisabeth	Grinspoon	USDA Forest Service
Grant	Gutierrez	Dept. of Ecology
Brandi	Hall	ADOT
Yvonka	Hall	Northeast Ohio Black Health Coalition
Stephanie	Hammonds	WVDEP-DAQ
Ben	Harms	USDA Forest Service
Leah	Harnish	American Waterways Operators

Clea	Harrelson	NSF
Emily	Harris	FCCAG
Jill	Harrison	University of Colorado Boulder
Declan	Hayes	EPA
GRO	Health Center	GRO Health Center
Tom	Helme	Valley Improvement Projects (VIP)
Carey	Hengstenberg	Vermont Department of Environ. Conservation
Jenelle	Hill	EPA
Jack	Hinshelwood	VDH
Janice	Horn	Tennessee Valley Authority
Melissa	Horton	Southern Company
Jennifer	Hosler	University of Maryland, College Park
Lee	Ilan	NYC Mayor's Office of Environmental Remediation
Yvonne	Ivey	Booz Allen Hamilton
Zainab	Jah	National Birth Equity Collaborative
Julie	Jimenez	Private Citizen
Victoria	Johnson	Jacobs Engineering
Cassandra	Johnson	MDEQ
Doris	Johnson	DEEP
Tara	Johnson	USEPA
Nicole	Johnson	SLR International Corporation
kim	jones	EPA
Danielle	Jones	Mecklenburg County Air Quality
Sean	Joyner	U.S. Depart of Housing and Urban Development
Miriam	Juarez	Alianza Nacional de Campesinas
Kira	Kaufmann	USFS
David	Kay	Cornell
Zach	Keith	The Williams Companies, Inc.
Joseph	Keller	APA
Danielle	Kelton Sopko	Private Citizen
David	Keys	Calthos
Chet	Kibble	Environmental technical services
Rabi	Kieber	US EPA R2
Denae	King	Texas Southern University
John	Kinsman	Edison Electric Institute
Suzanne	Kline	CA State Water Board - Drinking Water - SAFER
Abby	Klinkenberg	Bureau of Reclamation
Elizabeth	Kloekner	academic
David	Kluesner	U.S. EPA Region 2
Renee	Kramer	North Carolina Depart of Environmental Quality
Fran	Kremer	USEPA
Emma	Kurnat-Thoma	Georgetown University NHS

Deb	Kutska	Cook County Depart of Environment & Sustainability
Paul	La Farga	San Diego Association of Governments (SANDAG)
Kim	Lambert	U.S. Fish and Wildlife Service
Katie	Lambeth	EGLE
Zulima	Leal	North American Development Bank
Brian	Lewis	CDC
Keisha	Long	SC DHEC
David	Lonnberg	shift7
Olivia	Lopez	Ocean Conservancy
Michelle	Lovejoy	Environmental Defense Fund
Yaitza	Luna-Cruz	NASA HQ
Caitlin	Macomber	WRI
Krista	Mantsch	GAO
James	Markoe	US Bank
Linda	Martin	Private Citizen
Brendan	Mascarenhas	American Chemistry Council
John	Mataka	Grayson Neighborhood Council
Alexandria	McBride	Waverley Street Foundation
Mary	McCarron	Ohio EPA
Wendy	McCarville	USAF
Caitlin	McHale	National Mining Association
Benjamin	McKenzie	CDC/ ATSDR
Reginald	McKinley	EPIC
Ameesha	Mehta-Sampath	US EPA Region 2
Danielle	Mercurio	VNF
Sarah	Merrill	SAVERGV
Melissa	Miles	New Jersey Environmental Justice Alliance
Melissa	Minor	General Services Administration
Amir	Mirsajedin	CDC
Lena	Moffitt	Evergreen Action
Chris	Moore	Eastman Chemical Co. - Kingsport, TN
Karli	Moore	Stanford University
Daisy	Morgan	USDA Forest Service
Bri	Morris	NAACP General Member
Terrence	Mosley	DOE
John	Mueller	Private citizen
Melissa	Muroff	Delaware County District Attorney's Office
Knowledge	Murphy	Multnomah County/Office of Sustainability
Christine	Murphy	American Academy of Nursing
Ayako	Nagano	NEJAC
Jake	Narciso-Stevens	Climastry
Christina	Ndoh	US EPA

Pedro	Nieto	USDA
Gregory	Norris	ACES 4 Youth- Area Consortium of Educati
Avriel	Null	Tennessee Valley Authority
Yamiles	Nunez	Alianza Nacional de Campesinas
Maya	Nye	Coming Clean
Francisco	Ollervides	Ocean Conservancy
Mary	Olson	shift7
Laura	Olson	Jacksonville State University
Rachel	Olugbemi	US EPA - Region 01
Alex	Owutaka	US EPA
Anthony	Paciorek	Michigan United
Sarah	Packer	Center for Environmental Health
sangha	Padhy	Ramapo college
Anthony	Pahnke	Alianza Nacional de Campesinas
Marla	Painter	Mountain View Community Action
Leticia	Pascual	Mujeres Divinas
WILLIAM B	PATTERSON	East Bay Municipal Utility District (EBMUD)
Nestor	Perez	Earthjustice
Pamela	Perez	California State University Northridge, CSUN
Carina	Perez Europa	Oregon Physicians for Social Responsibility
Sophie	Pesek	RFF
Edith	Pestana	CTDEEP
Andrew	Pike	Virginia Department of Transportation
Melanie	Plucinski	Native Organizers Alliance
Deneine	Powell	City of MKE
Diane	Prather	USDA FS
Marguerite	Pridgen	CSH
Hugo	Prieto	ECA, Energy Coordinating Agency
Lela	Rainey Brown	Northwest Area Indian Health Board
Elise	Rasmussen	Washington State Department of Health
Brian	Redder	AMWA
Dawn	Reeves	Inside EPA
Maria	Renteria	Alianza Nacional De Campesinas
Forest	Replogle	Mid-Region Council of Governments
Abdiel	Reyna	Texas RioGrande Legal Aid
Derek	Rice	None
Caroline	Ridley	US EPA ORD
Eletha	Roberts	EPA
Christina	Robichaud	US EPA
Victoria	Robinson	U.S. EPA
Martina	Roes	DZNE
Madeleine	Rohrbach	AAN
Marlene	Rojas	Alianza Nacional de Campesinas

Gina	Romero	Florida Rising
Jena	Roscoe	Operation HOPE
Adrienne	Runnebaum	The Giving Grove
Abby	Ruskey	University of California - Merced
Dagmara	Saini	City Of Stockton
Andrea	Salazar	Michaels Energy
Elyse	Salinas	US EPA
Isabel	Segarra Trevino	Harris County Attorney
Mario	Sengco	U.S. EPA
Helen	Serassio	EPA
Kathryn	Sessions	Health and Environ Funders Network (HEFN)
Khalil	Shahyd	Natural Resources Defense Council
Donna	Shanklin	ACES
Nayyirah	Shariff	Flint Rising
Natalie	Shepp	Pima County Department of Environ Quality
Christopher	Shuey	SRIC and UNM-CEHP
Maria	Sisneros	US EPA region 6
Carolyn	Slaughter	APPA
Jonathan	Smith	Earthjustice
Megan	Smith	Shift7
Chris	Snyder	Passero Associates
Dan	Solitz	Private citizen
Jessica	Specht	FEMA
Gianna	St.Julien	Tulane Environmental Law Clinic
Joyce	Stanley	US Department of the Interior
Susan	Stilson	EPA
Robyn	Strickland	Oklahoma Corporation Commission
Feleena	Sutton	Aera Energy
Crystal	Swazy-Wallace	USDA
Theresa	Taylor	US Dept. of Interior - Bureau of Reclamation
Lorraine	Thiebaud	CalNEHJ
Nicholas	Tobenkin	Quanta Services
Mily	Trevino-Sauceda	Alianza Nacional de Campesinas
Raina	Turner-Greenlea	Black Sustainability, Inc.
Marisa	Valdez	AES Clean Energy
JV	Valladolid	ICC
Aditi	Varshneya	Global Alliance for Incinerator Alternatives
Jumana	Vasi	Midwest EJ Network
Gloria	Vaughn	EPA
rebeca	Velazquez	Mujeres luchadoras Progresistas
Marline	Vignier	HHS/OASH
Cristina	Villa	Department of the Interior
Cliff	Villa	University of New Mexico

Randi	Walker	NYS Department of Environ Conservation
Carla	Walker	World Resources Institute
Walter	Walker	Greeley and Hansen
Tiffany	Wallace	USDA/FPAC
Stephen	Walls	NRDC
Margaret	Walls	Resources for the Future
Brett	Walton	Circle of Blue
Roxanne	Welch	USEPA
Kimberly	Wells	EEG
Sharad	Wertheimer	Woonasquatucket River Watershed Council
Jabbar	Wesley	Spire Inc.
Skye	Wheeler	Human Rights Watch
Chad	Whiteman	U.S. Chamber of Commerce
Wesley	Wiggins	U.S. EPA
Odette	Wilkens	Wired Broadband, Inc.
William	William	US EPA
Jane	Williams	California Communities Against Toxics
Beattrra	Wilson	usda
Stiv	Wilson	Peak plastic foundation
Monica	Wilson	GAIA
Michael	Wohlstadter	East-West Gateway Council of Governments
Leah	Wood	Washington State Department of Health
Janene	Yazzie	NDN Collective
Naomi	Yoder	Healthy Gulf
Chris	Young	NACD
Rachel	Zander	Department of Natural Resources
Gregory	Zimmer	GFL Environmental Inc.
Pamela	Zimmerman	DOE Hanford
Ronald	Zorrilla	Outdoor Promise
Steven	Zuiss	Koch

APPENDIX B

Online Submitted Written Public Comments

Northeast -1

Maine, Massachusetts, Rhode Island, Connecticut, New Hampshire, Vermont, New York, Pennsylvania, New Jersey, Delaware, Maryland, DC

Full Name (First and Last): Odette Wilkens

Name of Organization or Community: Wired Broadband, Inc.

City and State: Forest Hills, NY

Brief description about the concern: Please see submission being sent by email on 4-15-22. Fiber optics to the premises is a superior service and is "future-proof" as Tom Wheeler, former FCC Chair, testified in Congress in March 2022, and will best serve unserved and underserved communities in bridging the digital divide to achieve digital inclusion and digital equity, while preserving the health of residents in those communities.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

A major component that should be added to the Climate and Economic Justice Screening Tool is a metric to measure in those Communities (1) the level of electrosmog generated, or that would be potentially generated, from wireless infrastructure in unserved and underserved communities and (2) the amount of fiber optics deployed, and needed to deploy, in unserved and underserved communities to close the digital divide.

Full Name (First and Last): Cecelia Doucette

Name of Organization or Community: Massachusetts for Safe Technology

City and State: Ashland, MA

Brief description about the concern: Today's wireless technology consumes inordinate amounts of energy, and the constant pulsations of radiofrequency microwave radiation biologically harms children, adults and the environment.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

Include responsible technology deployment with fiber-optics to the premises, with Ethernet connections indoors to devices. Ensure the Climate and Economic Justice Screening Tool includes responsible technology. Thank you for accepting public comment on the Climate and Economic Justice Screening Tool, and for the work you are doing to ensure parity in all of our communities. Please include in your tool responsible deployment of technology. Here in Massachusetts wireless radiation has become an environmental and racial justice issue. For example: The wireless industry targeted Worcester, an environmental justice community, for their utility "smart" grid program. They installed toxic electric meters that pulse wireless radiation at ratepayers 24x7 and many have become ill. In Brockton, Massachusetts, another underserved community, Verizon launched a 5G test pilot, radiating citizens at close range with small cell antennas. Sprint then gave Brockton school children tablets that emit wireless radiation at the students, with no safety instructions. Industry is prone to installing cell towers at close range in underprivileged areas. Savvier towns are updating their zoning by-laws to prohibit wireless communication facilities in residential and other sensitive areas. Following a two-year

investigation, the Pittsfield, MA Board of Health issued this month a groundbreaking Emergency Order to Verizon to remove a cell tower that made 17 children and adults sick and caused the pollinators to disappear. As you are likely learning, wireless technology wastes inordinate amounts of energy too, and inflicts great harm to the environment. I welcome you to read the attached submission to the Massachusetts Senate Committee on Ways and Means. It lists 10 top reasons why investment in any further wireless infrastructure buildout should be stopped, and why every citizen should have access to hard-wired internet to the premises and be taught to simply use cables and adapters indoors to their devices for far superior internet service. We realize wireless radiation harms are new to many, and I would be honored to speak with you and your colleagues further to help connect the dots on this urgent issue. We cannot continue to allow the wireless industry to immerse our society in electrosmog, we must take responsibility at the federal level and we look to your leadership.

Last year, the Department of Energy asked for responses to an RFI on a potential Strategic Uranium Reserve, our groups responded. We understand the DOE may be now moving towards an RFP. We would like to reiterate that a SUR will put communities, especially Indigenous Communities whom we work to support, at serious risk of harm, including to their cultural resources, health and drinking water. Attached to this email are 10 letters and resolutions from communities and tribes opposed to a SUR as a result of operations that could ramp up if a reserve program is implemented according to the limitations outlined in the RFI last year (e.g. existing facilities on federal land sacred to tribes/connected to tribal resources, and uranium produced from alternate feed processing adjacent to a tribal community), and a letter from the community raising the need for urgent regulatory actions in the face of uranium mining threats brought about by a SUR. We consider this to be a serious environmental justice issue. A SUR, will effectively subsidize uranium operations that are already causing harm to communities. This is in direct conflict with the commitments President Biden made to tribal communities during his first week in office.

We would like to request a meeting to discuss concerns around a SUR and protections that must be advanced for domestic uranium mining. Blaine Miller-McFeeley

Dear White House Council on Environmental Quality,
The draft environmental justice screening and mapping tool that aims to identify communities that are underserved and overburdened with pollution. Better identifying such communities would allow for more equitable and effective investment, program implementation, and environmental enforcement, improving outcomes for climate, conservation, and public health policies. The National Wildlife Federation commends CEQ for bringing attention to the need for improved analytics that can help target investments, programs, and enforcement to where they are most needed. We also have suggestions for improvement, which we have submitted to the docket -- Please see the attached. You may also be interested in this *Baltimore Sun* op-ed from Dr. Sacoby Wilson, head of the Center for Community Engagement, Environmental Justice and Health at the University of Maryland, who recently issued a report in collaboration with NWF that offered detailed EJ screening and mapping tool recommendations. Thank you for your work to promote environmental and climate justice! Please feel free to reach out with any questions.

Dear White House Environmental Justice Committee,

On behalf of the City of Somerville, we would like to submit the following comments to the White House Environmental Justice Advisory Council (WHEJAC) for members' consideration: Somerville is one of the highly-dense Cities in the United States, with a population of above 80,000 in an approximately four and a half square mile area. Due to its proximity to the Atlantic Ocean, 5-foot flood incidences are expected to increase in Somerville from this decade onwards. This will be an additional burden on the local disadvantaged community. The USEPA has developed 12 Environmental Justice Indexes. They are related to ongoing pollution issues and don't address the broader environmental impact issues such as extreme weather conditions and floods. We propose improving the existing system and including data collection related to climate change impacts in the EPA's EJ Indexes. What type of support is needed for disadvantaged communities to participate in federal disaster preparedness or relief programs?

We propose a disaster preparedness education throughout school programs, target preparedness, and mitigation investments in communities with disadvantaged populations. Providing more targeted outreach after disasters is essential to assist underprivileged people with relief programs. FEMA has done some work in this space through their ICPD program on efforts like the Emergency Financial First Aid Kit, but this has seen limited adoption by organizations around the country: <https://www.fema.gov/emergency-financial-first-aid-kit> How can Federal disaster relief and aid programs better serve disadvantaged communities that have historically received fewer federal benefits? They can start by limiting the distribution of aid and relief to populations that don't need it. Disaster relief programs are too complicated and require too much paperwork. They potentially generate conflicts due to concerns about individuals receiving duplicative benefits from federal/state agencies or insurance. Too much effort to prevent fraud, waste, and abuse ultimately leads to extensive waste. What process steps and information would help eliminate these disparities? Consider implementing user-centered design approaches to disaster aid, similar to what has been done with other safety net initiatives. In addition to the above specific suggestions, we suggest having greater coordination with FEMA, HUD, and other agencies. Thanks Vithal Deshpande

Full Name (First and Last): Skye Wheeler

Name of Organization or Community: Human Rights Watch

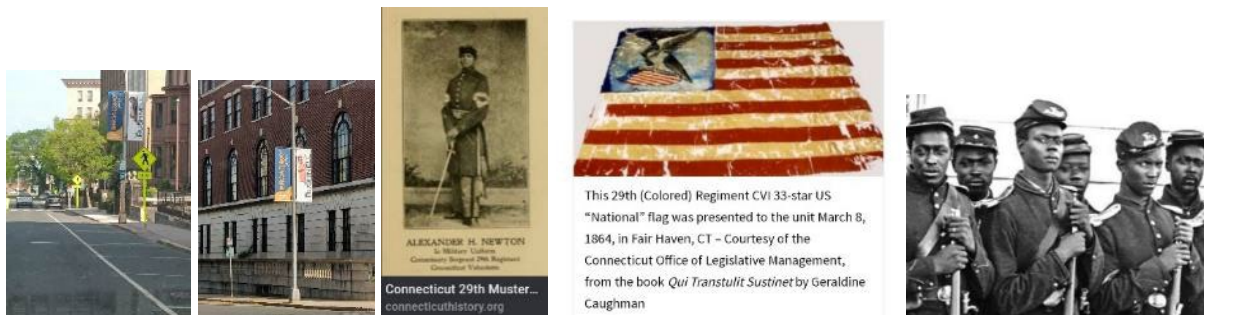
City and State: Washington DC

Brief description about the concern: This maternal health crisis is rightfully a priority concern for the US government. Preterm birth rates, as just one example, have generally been rising over the past years, and are twice as bad for Black women than for white women. However, our view – echoed by many academics and health workers working in the intersection between maternal and environmental health – is that there is not yet adequate attention on the environmental health impacts on pregnant people. Epidemiological literature shows exposure to extreme heat, hurricanes, wildfire smoke and other climate change impacts and climate change-related disasters is linked with preterm birth and other adverse birth outcomes. Like other human rights and civil rights organizations, we are excited that your questions focus on how best to protect disadvantaged communities and how resources should be allocated to make sure they can best participate in federal disaster preparedness and relief programs. We strongly support your efforts to promote an environmental justice approach to climate change-related and other disasters in the US. However, we also request that you promote a reproductive justice approach as well and explicitly press for resources to protect pregnancy and newborn health to help prevent the climate crisis worsening the gap between those who get to have a healthy pregnancy and newborn and those who do not.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

We would like the WHEJAC to consider recommending the following to government leadership on climate change and other environmental justice issues: Ensuring access for all women and girls to comprehensive sexual and reproductive health is a central part of disaster preparation and response. Ensure ongoing access to comprehensive contraceptive choice for all women and girls, access to safe abortion care for women and girls, and maternal, perinatal, and newborn health care, including lactation support. This includes, but is not limited to, people living in shelters and in displacement after disaster. Undocumented people should also be able to access emergency health services. Ensure that reproductive justice organizations, doulas, midwives, other community birth workers, and lactation consultants are equipped with information and access to authorities managing disaster preparedness, response and recovery and are financially resourced to provide support to pregnant people and other community members, including in response to domestic violence and gender-based violence. Grants for community-based reproductive justice organizations, birth workers and other relevant groups should include help to pregnant people and community members prepare for disasters and help families and pregnant or postpartum people during disasters and recovery periods including by linking them to emergency assistance and other resources, including for survivors of domestic violence. Ensure organizations receiving government grants provide reproductive justice training and implicit bias training for disaster and recovery staff. Find other ways to “mainstream” reproductive justice in disaster and recovery work. Fund studies to improve understanding of (a) how disasters in the US impact maternal and newborn health, (b) what interventions may better protect maternal and newborn health from disasters, and (c) inequitable exposures and impacts for already-marginalized communities. Reproductive justice organizations, doulas, midwives, and others serving low-income and other at-risk communities should be included in disaster planning and resilience-building, including community awareness building campaigns. However, these individuals and organizations should be appropriately compensated for helping prepare communities for disasters. Frontline maternal health workers like doulas do lifesaving work in low-income communities or communities marginalized by historical and current racism but are often poorly compensated. Public health campaigns on the dangers of extreme heat should include pregnant people, should be available in multiple languages and for people with disabilities. Subsidized assistance, for example to support access to cooling devices or improved housing, should include pregnant people as well as other populations at-risk from environmental health hazards and climate impacts. Pregnancy accommodations at work, for example additional bathroom breaks or water breaks for pregnant people working in hot indoor or outdoor environments, should be protected. Ongoing work by the Department of Labor to design a federal heat rule, the “Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings Rulemaking” process, should fully include heat impacts on pregnancy health and the final rule should be strong enough to protect pregnancy health. Thank you so much for your reply. By all accounts, the vandalism and ATV motor cross riding, inside OLD NORTH CEMETERY, is beyond disgrace. So again, thank you for your quick, thoughtful response. We are also looking forward to hearing from you about the flags to be placed on the light posts on Main Street. The CT Freedom Trail has these flags, which will be a monumental historical attraction, on the 6 light poles, on Main Street. In my previous email, I also mentioned that we would like to want the banners of the 29th Colored Volunteer Infantry Regiment, also placed on these poles. Truthfully, this should not be a problem to anyone, especially since you have banners on the light posts, surrounding Bushnell Park. Mark, it's these small, respectful recognitions, that will improve to be big for the renewed landscape of the community. Furthermore, these light poles are directly across the street from Sand Everywhere School, the predominantly Black, segregated, elementary school. I'm not sure if the City of Hartford sees the value of the North End, but our young Black students deserve the opportunity to learn about the Black Civil War Heroes, buried across the street, from their school. With that said, we believe

that these banners should be displayed on the light posts, by June 17, 2022. In fact, this show of reference and support, is warranted to commemorate Connecticut's first year of Juneteenth becoming a state holiday. To that point, the CT Freedom Trail Commission is presenting their plaque to the 29th Colored Volunteer Infantry Regiment on June 18th. And frankly speaking, we have 30 days to accomplish this task (fence closings and banners on Main Street). Without making any excuses, this is a very realistic timeframe. In addition to the above, our group also has a few suggestions and improvements, for the cemetery. #1. It should only be open from dusk to dawn, just like the other parks and cemeteries in the city. Even more importantly, cameras should be installed at the front entrance to identify, and to help, the homeless person(s), living in the cemetery. We think cameras should also be placed at the former back entrances on Mather and Bethel Streets. In addition, the city should invest in signs informing everybody that the cemetery is on the NATIONAL HISTORIC REGISTRY. People need to know that security cameras are installed in several locations around the national monument. There should also be visible signs that informs the public that, any violators will be prosecuted. #2. We would also like to know what happened to the approximately \$1.5 million dollar grant that was given to Hartford to restore Old North Cemetery. It was about 10 years ago, but there is no obvious renovations, or upkeep of any past renovations. These funds, and other available funds are critically important for our proposed renovations and restorations. Again, we sincerely appreciate working with you, and the City of Hartford, in our mission to restore Old North Cemetery to its well-deserved, national glory and prominence. As you do know; this historic landmark is on the National Registry of Historic Sites. Therefore, taking the necessary steps to make the cemetery, as such -- will attract scores of visitors. Mark, we can meet with you to give you pictures of the 29th CV Infantry Regiment, so you can get them transferred into Bushnell Park, light post size, banners. Please let me know your available times, early next week. Again, we are so excited and grateful for our partnership with the great city of Hartford, Connecticut.



Southeast -2

West Virginia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Arkansas, Louisiana, Florida

Full Name (First and Last): Antonio Alarcon

Name of Organization or Community: Moder 45 Doral

City and State: Doral ,FL

Brief description about the concern: There is a very powerful nauseating odor. We were celebrating my son b_ day but we hat to ho back inside the strong odor and ash was so strong that make it impossible to be outside please we need help. Incinerators

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:
Please help us removing incinerator of Covanta from our back yard.

My name is Corylee Gutierrez, I live in Doral Fl 33178, There is a very powerful nauseating odor. We were planning to be outside in the backyard with friends and it is impossible to be outside. We fear for our health. You have to do something about this for this makes it impossible living in Doral. " Please take urgent action ! Regards Corylee Gutierrez. Incinerators

Full Name (First and Last): Guillermo E Lefeld

Name of Organization or Community: Vintage Estates Community

City and State: DORAL, Florida

Brief description about the concern: We have been suffering from very intense air pollution (intense odors) that have been getting worse and worse and our local representative don't seem to care. Our life quality have been affected as sometimes cannot be outside due to the intense nauseating smell coming most likely from an old garbage incinerator nearby. This is really affecting the lives of a great deal of people and politics or some other interests seem to be on the way.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

We need the White House Council to know that local governments, specifically the county and the county commission are hurting the people of city of Doral in Florida by not paying attention to a big issue. This is not a partisan thing, it is the health of tens of thousands of Americans being at risk for the negligence and who knows what type of interest of the county leadership. We need federal legislation to protect our citizens from negligent local governments that endanger their lives. We need action! This is getting worse.

Full Name (First and Last): Kay Zadra

Name of Organization or Community: Vintage Estate

City and State: Doral Florida

Brief description about the concern: The smell is strong and the air is polluted

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

Please shut down the garbage burner in Doral Fl because it is killing out families

Full Name (First and Last): Cesar Abarca

Name of Organization or Community: Doral Environmental Justice Community

City and State: Doral, Fl 33178

Brief description about the concern: We live under constant exposure to nauseating odor, particle matters , and ashes. Our community is just 300 meters from the Covanta garbage incinerator. Our population in the nearby area are 50000 people. We visited Covanta and found they are not monitoring and controlling the (HEP) nor they have been audit by EPA Our social life is disrupted by this contamination. Our health is under threat by the contamination. Our investment risk is very high(high)

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

-We don't want a ZGarbage Incinerator in our area, -EPA should give an opinion on the Miami Dade County plans to build a new incinerator in Doral Environmental Justice Community. Distance standards for a Covanta should be no less than 3 from residential areas -MDC Covanta standards are set based on the age of the Garbage Incinerator not on the hazard they are for our community.

-ZEPA is not implemented operationally the institution guidelines regarding Recycling, etc.

Full Name (First and Last): Josef Correia

Name of Organization or Community: Pinnacle at Park Central

City and State: Doral, Florida

Brief description about the concern: The continuance use of incinerator in Doral is no longer acceptable. First the technology is outdated, there are newer methods for zero waste and this is what we need to strive for, just as we are doing with the zero emissions from cars by moving to hybrid vehicles and electric vehicles. Second of all, when the incinerator was built, the area around it was industrial, then by the same county (Miami Dade) that approved the incinerator, also approved residential construction around the incinerator. They obviously do not care about the health of the residents of Doral or any cities near us. The emissions from the incinerator and ash travel from miles, therefore impacting a lot of residents and commercial area.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

We advise for you to look into it and realize that incinerator technology is outdated and that there are better methods that not only produce more energy recovery but also do not impact the health of humans and earth. It's time we the country's resources to be truly green as possible instead of just letting some counties and areas profit from business deals that only produce income for them and literally DO NOT CARE about human life and/or planet.

Full Name (First and Last): Raul Arias

Name of Organization or Community: Landmark

City and State: Doral, Florida

Brief description about the concern: Here in the city of Doral, and specifically in the Landmark community, we have been severely affected by the Covanta Waste Management site that causes terrible odors and diseases through all the population that is emanated daily by this place. Our communities have been asking for years to move this facility our of Doral where it doesn't affect citizens that live around, but we haven't been heard, but surprisingly there's a plan now to not only leave the current facilities but build another trash management plant right next to Covanta which will generate more problems and bad quality of life for all of us citizens of Doral city. Incinerators

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

The renewal of the lease of Covanta needs to be not extended and the permissions for the creation of a new facilities here in Doral need to be revoked. This is affecting all residents in this city, and it's a severe health problem for anyone that lives in this city.

Full Name (First and Last): Eduardo Moreno

Name of Organization or Community: Landmark at Doral

City and State: Doral, FL.

Brief description about the concern: The Doral community has grown significantly while a Waste Incineration Plant operated by COVANTA contaminates de air with bad odors and ashes.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

Remove the COVANTA plant from the city of Doral and build a new, updated one on another location.

Full Name (First and Last): Claudia Martinez

Name of Organization or Community: Covanta

City and State: Doral

Brief description about the concern: Smells bad.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:
Contaminating.

Full Name (First and Last): 27 Names used the same public comments

- Odel Torres
- Pilar
- Veruschka Jaimes
- Jorge Andrés Besereni Karaz
- Fabio Vitale
- Raul Arias
- Juan De Maqua
- Sui Jim
- Juan De Maqua
- Margarita Wong
- Hector Villalobos
- Marlon Pareja
- Dirla Pareja
- María Casado
- Maria Abreu
- Eduardo Briceno
- Javier Guerra
- Lucia Sirah
- Jose Ginestra
- Jose Antonio Grullon Matias
- Orlando salas
- Yasmin Balzan
- CARMEN TABARES
- María Obediente
- Elimer Gonzalez
- Vivian Ginestra
- Roberto Fernandez

Name of Organization or Community: Landmark of Doral, Fl

City and State: Doral, Fl

Brief description about the concern: To whom may I concern, I am a resident of the Landmark community in Doral, right west from the Covadonga recycling plant, located just southwest of the plant. I am someone that love this community. We have spent many hours dealing with this facility, especially when the smell is too strong. Years ago people usually talked to the plant folks and most of the time the smell went away. The Covanta Incinerator facility was established back in 1982, a first class facility capable of using waste disposal to produce energy, however after forty years their technology is no longer the greatest. They can't no longer control the smell with just a phone call. I believe none of you are driving a 40-year-old car, it is time to put this beast to sleep, it had surpassed it's useful life and new technology shall replace it. Please help us by telling the county not to make a huge environmental mistake, we asked the county before October 1, to cancel the renewal permit, this action will give Doral residents a cleaner air, without the smell, the heavy traffic of garbage trucks, and environmental violations. Of course, the county is trying to pass a new resolution to build a new facility right by the

same location. We are asking all of you to please ask the county to reconsider relocating the new plant somewhere else in the county and spare Doral residents of having this new plant in our backyard. If this is a great recycling facility, I am sure any city would love to have it in their neighborhood. Just remember waste disposal is not a Doral problem, it's a countywide problem. Lastly we ask you to urge the county to look for other recycling options that may work better and cost much much less. Thanks for the opportunity.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:
Stop construction of the new recycling plant in Doral, FL and find new recycling methods that don't affect the quality of air.

Full Name (First and Last): Heli Valero
Name of Organization or Community: Florida Rising
City and State: Doral, Florida

Brief description about the concern: We live at Doral, FL, when we bought, we already know about the trash problem but we never expected that the city will approved 20 more years and a new plant inside the old one, it's insane that this can happened to us. Covanta incinerator problem

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:
Please revoke any authorization and find another place to build the new factory, far away from Doral, we are alone in this battle, we need to breathe clean air for our children and ourselves. As a father I beg your help. Thanks.

Full Name (First and Last): Giselle Ojeda
Name of Organization or Community: Landmark Doral
City and State: Doral, Fl

Brief description about the concern: Waste is creating environmental issues causing allergic reaction to residents and health hazards. There is a Coventa waste company located just northeast of our community. The air is polluted causing bad smell, allergies and water contamination. Incinerators

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:
Remove plant or make it environmentally safe. To relocate the plant as their lease expires at the end of the year. Local politicians want to keep it. However is causing a health hazard for all of us, including kids and pets.

Full Name (First and Last): Renatta Barzana
Name of Organization or Community: Landmark at Doral
City and State: Doral Florida

Brief description about the concern: I am asking all of you to please ask the county to reconsider relocating the new plant somewhere else in the county and spare Doral residents of having this new plant in our backyard. If this is a great recycling facility, I am sure any city would love to have it in their neighborhood. Just remember waste disposal is not a Doral problem, it's a countywide problem. Lastly, I ask you to urge the county to look for other recycling options that may work better and cost much less. Incinerator

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

I am asking all of you to please ask the county to reconsider relocating the new plant somewhere else in the county and spare Doral residents of having this new plant in our backyard. If this is a great recycling facility, I am sure any city would love to have it in their neighborhood. Just remember waste disposal is not a Doral problem, it's a countywide problem. Lastly, I ask you to urge the county to look for other recycling options that may work better and cost much less.

Full Name (First and Last): Maria Evangelista

Name of Organization or Community: Vintage Estates

City and State: Doral Florida

Brief description about the concern: Constant exposure to trash odor. This situation is getting stronger every day and sometimes we have to cancel our kids swimming classes because of this nauseating odor.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

Remove the garbage incinerator

My mom has lived in Louisa, VA 23093 for 60 years. I have been trying to get help, but it was difficult due to COVID. I have included photos and videos of the emissions, smoke, ash and dust coming from the plant. You also see how close they are to us. (Not sent to WHEJAC) They are currently operating off a temporary permit and try to get a permanent permit. I apologize for the difference format. The letter below is what I sent to DEQ: I have recently learned that a permit application is pending regarding the Boxley Zion-Crossroads asphalt plant in Louisa. I would like to request a formal public notice and an opportunity for public comment on the pending permit application. Given the plant's proximity to my property and home (just 50 feet away), a public comment opportunity would allow me, my family, and neighbors to voice our concerns. Some of the harms I plan to share, experienced as a direct result of the Boxley Zion-Crossroads asphalt plant, are: ODOR: The plant emits an odor that not only smells like tar and chemicals, but also threatens my own and my family's health. The plant's fumes have caused my mother to suffer headaches and caused me to experience a burning sensation in my nose and throat. When I sought medical advice about these ailments, my nurse informed me that the plant's emissions are hazardous, and recommended that my mother and I double mask, limit time outdoors, and change clothes after being outdoors. NOISE: When the plant operates, it generates a loud, persistent hum, audible from inside my home. The trucks entering and exiting the plant also produce excessive noise by beeping when backing up, using air brakes, and slamming their tailgates. DUST: The plant's operations generate a considerable amount of dust that comes onto my property, caking the ground, our cars, and everything else in a layer of dust. The odor, noise, and dust created by the plant are prohibiting me and my family from able to enjoy our property. We are no longer able to work from home and cannot host cookouts or invite family over. Thank you for your consideration. Please reply to this email so I can be sure that DEQ has received it. We need help and assistance. I am very concerned health wise, environmental and also my mom feels she is being push out of her home. She have worked hard to buy her land and build her home. How would anyone feel you cannot go outside to breath fresh air and cannot be able enjoy your home? It is a strong statement made when Tamera Thompson made she have worked DEQ for 30 years and never seen a facility built this close to a home or business. Why our local supervisor not respond to anyone? I am sure they wouldn't want this in their back yard. Your assistance will be greatly appreciated. Thank you, Theresa Coffey

Midwest -3

Ohio, Indiana, Michigan, Illinois, Missouri, Wisconsin, Minnesota, Iowa,

Kansas, Nebraska, South Dakota, North Dakota

“The Department of Defense currently operates 38 toxic burn sites in the U.S., mostly in low-income, rural communities. At these sites, the military collects excess, obsolete, or unserviceable munitions, including bullets, missiles, mines, and the bulk explosive and flammable materials used to manufacture them, and destroys them by adding diesel and lighting them on fire, or by blowing them up. Last fiscal year, the Department of Defense destroyed 32.7 million pounds of explosive hazardous waste on U.S. soil using these methods, known as open burning and open detonation.” Laura Olah / Safe Water Around Badger

My name is Katherine Andresky, I live in Detroit, Mi, anishinaabe territory, near the now closed Detroit incinerator and I'm a member of BFD. I'm here today to urge you to prioritize regulation of solid waste incinerators and chemical recycling facilities by calling on the EPA to take long-awaited regulatory action to protect communities like mine across the nation. Because the EPA has failed to regulate incinerators, it exposed my neighbors and family to unnecessary risks while our incinerator operated until 2019. Our facility has shut down from years of advocacy calling out leaking stacks and nearly 1000 odor and clean air violations. Yet, if the EPA would have done its job, it would have saved so many lives. My small 8 by 6 block neighborhood association, located one mile downwind of the Detroit incinerator lost over 22 members to COVID because even though our facility shut down, the lax regulations of this facility for 33 years caused a lifetime of respiratory and cardiovascular problems that my community still lives with. COVID hit us hard because the EPA did not do its job regulating facilities like these, causing us to breathe in small particles of trash. Incinerators are often located in overburdened EJ communities and burn tons of plastic per year. It is important to remember that the fossil fuel industry is causing harm from the time the oil is taken out of the ground to the time these single use plastic products end up in landfills or burned in an incinerator. What's worse is that these billion dollar industries think that pyrolysis and gasification, so called chemical recycling facilities can stop our plastic problem by burning it. That just creates another problem with our health that the fossil fuel industry does nothing to address. These chem recycling industries that heat plastics to make fuel need to be regulated as incinerators. Burning plastics does not solve our plastic problem, it makes the health of our communities and the environment worse. If these facilities are not more strictly regulated, they will continue to increase cancer risks in young women like my friend Emily who just had a mastectomy at age 38, because she lived near this incinerator and breathed in the hormone altering burnt-plastic pollution that illegally leaked from our stacks for years. The EPA is currently legally obligated to review and revise standards for incinerators every 5 years under the Clean Air Act, but the EPA has repeatedly failed to update these standards, increasing cancers, asthma, and heart problems to my friends and family. These regulations are vital to protecting neighboring communities from dangerous incinerators. It's indefensible to let incinerators operate any longer without stronger and more meaningful oversight of their dangerous operations. Communities like mine have been waiting far too long for updated regulations and no community can afford to wait any longer. — 3 min max – As a leading voice for environmental justice, I urge you to make waste incinerators, chemical recycling technologies, and the frontline communities living near them a top priority by following the regulations that are listed within the Clean Air Act. I also urge your strong support of FY 2023 Interior, Environment & Related Agencies bill to direct the EPA to consider climate and environmental justice impacts of chemical recycling technologies in their ongoing rule-making process regarding the regulatory treatment of pyrolysis and gasification units under

Section 129 of the Clean Air Act. You have the power to elevate this issue with the Biden Administration and get the EPA to finally move ahead with these vital and long-overdue regulations and protections our communities demand and deserve.

To the Honorable leaders of WHEJAC: Chair Brenda Mallory, Co-chair Richard Moore, Co-chair Peggy Shepherd, Vice-chair Catherine Flowers, Thank you for last week's 2-day informational meeting on the EPA Screening Tool regarding the Justice40 Initiative and Disaster Response. I'm submitting these comments on behalf of Just Transition Northwest Indiana, a grassroots organization working to support EJ communities in Northwest Indiana. For the past two years, Just Transition Northwest Indiana has been organizing with the NAACP LaPorte County Branch, Northwest Indiana Ministers' Conference, Earthjustice, and the Hoosier Environmental Council on various local EJ issues. My first point: The Midwest advisory panel for WHEJAC is composed solely of 3 representatives from Minnesota. This is not a fair representative sample of Midwest environmental justice communities. Northwest Indiana is a major industrial pollution hotspot for the entire U.S. According to the Assessment of Environmental Justice Needs in Northern Lake County Communities, a 2018 report by the Hoosier Environmental Council, the City of Gary alone has 52 CERCLA/Superfund sites, 423 hazardous waste sites, and 460 underground storage tanks. Yet, this predominantly Black and Brown community continues to be inundated with industry permit requests for new developments that will threaten the health of residents and the environment of the entire Region. I urge you to read the linked report for complete statistics and analysis. Alongside the NAACP Gary Branch, community members have formed Gary Advocates for Responsible Development (GARD) to fight back against these environmental assaults in their neighborhoods. Whiting, Indiana, is home to the largest BP refinery in the U.S., and the group BP Whiting Watch attempts to watchdog the facility. Our primary focus at Just Transition NWI is the community of Michigan City, Indiana, where *2 million tons of toxic coal ash waste* are leaking into Lake Michigan and neighboring Trail Creek at NIPSCO's Michigan City Generating Station. The Michigan City community is predominantly Black, Brown, and low-income, with $\frac{1}{4}$ of the residents living below the federal poverty level. The coal ash at the NIPSCO site is slated to stay there indefinitely because it is considered a "legacy" or inactive landfill and not covered under the federal CCR Rules. This emergency along the lake will have an ongoing devastating impact on community health, the environment, and the economy if not rectified. NIPSCO has for decades dumped its coal ash waste into pits along and on the lake. In the Town of Pines, directly west of Michigan City, the community recently received a consent decree from the Department of Justice to clean up NIPSCO's contamination stemming from the Yard 520 landfill, now an Alternative Superfund site. NIPSCO knowingly dumped its toxic coal ash there and offered it as road and yard fill for the town, homes, and playgrounds. The town still has not been fully remediated, and *38 homes* have been deprived of a municipal water hookup after NIPSCO's ash poisoned their wells. *70 residents* are obligated to NIPSCO to provide them with bottled water. This is a classic example of misuse of power and the fox guarding the henhouse. This low-income town could desperately use a community point person from EPA for outreach and technical assistance. Even though a consent decree was issued, they still have difficulty navigating what's to come. The Town of Pines is an example of how "administrative burden" works to undermine environmental progress. No one there has the capacity nor training to deal with the situation they are victims of, and once again, the polluting industry is off the hook. We fear that NIPSCO will continue its free reign in Michigan City if its legacy waste is allowed to remain on Lake Michigan, negating any repurposing of that area for the population to use for community benefit. Furthermore, the city of Chicago is home to many BIPOC-led groups, more specifically Little Village Environmental Justice Organization (LVEJO) and Southeast Environmental Task Force (SETF), both of which are doing incredible EJ work on the ground there, in addition to Clean Power Lake County (CPLC) in Waukegan, Illinois. Please consider inviting representatives from all the organizations mentioned in this email to weigh in on any and all federal EJ programs! My second point: We have also spearheaded legislative efforts, but our progress has been inhibited in a highly

conservative supermajority-controlled, regulated utility state. The supermajority sits on billions in a “rainy day” fund, while the Indiana Department of Environmental Management (IDEM) and the DNR have had their funds stripped down to barely operational. Commissioner Bruno Pigott recently left his post as IDEM Commissioner to join EPA and is well aware of the tangled situation here. In the Indiana General Assembly, the House and Senate Environment Committees refused to hear almost all environmental bills in committee. The year before last, no environmental bills were heard. Instead, they were amended into best-case scenarios for industry. Still, this is the state we are supposed to trust with federal funds coming in. This is an untenable plan for Indiana. We appreciate your recognition of states like ours struggling with this stranglehold. We are gravely concerned that any EJ funding whether through the Infrastructure Plan or Justice40 Initiative that becomes available to the State of Indiana will be deliberately misappropriated. We urge you to have boots-on-the-ground representatives in EJ communities like Michigan City, Gary, Indiana, Chicago, and Waukegan, and select members of these organizations to be a part of WHEJAC Midwest representation. Thank you for your consideration. Sincerely, Susan Thomas

Southwest -4 Texas, Oklahoma, New Mexico, Arizona

Full Name (First and Last): Sarah Bishop Merrill
Name of Organization or Community: SAVERGV
City and State: Boca Chica, TX

Brief description about the concern: Our human and endangered species populations here are underserved. We are currently needing help resisting 2 more LNG export terminals and their related pipelines, all of which will have a huge Carbon Footprint, worsening extreme heat (114 degrees F. already the Valley in Rio Grande City this week!), fire danger, drought, heat stress for outdoor workers, and species extinction. In this comment, I stress the need to deliver funding for the Weatherization preparedness, and then Weatherization Assistance money in the Bi-Partisan Infrastructure legislation, to our indigent and lower income communities. Another concern we need you to refer to agencies is that in permitting LNG and pipelines, their cumulative atmospheric effects (Methane, VCEs, GHGs increasing even if wetlands destruction is mitigated), and the impact on Climate Change of continuing these fossil fuel projects. Since our underserved communities, in colonies, the shrimp industry and our tribal community, are especially vulnerable to flooding here, when septic systems flood and leak, causing cholera outbreaks among other trouble, we need to develop, with your help, Eco-System Services research and plans like those in Wilderness Houston, whose website is linked here.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:
Help us encourage the Energy Department to stop new LNG projects, not to produce the full 30 billion Cu Meters permitted by limiting or banning new LNG projects, which have a huge carbon footprint. Also, let EPA review these projects, not just FERC and USACE. Force the permitting agencies to consider the cumulative effects in terms of GHGs and climate change, -excessive warming and flooding, - not just whether more wetlands are preserved, as mitigation. Expand concept of MITIGATION to include mitigation and adaptation to extremes of Climate Change. Stop LNG and preserve the quality of air and life for our underserved populations, who will not be employed in these LNG plants. Also, facilitate funding to train construction contractors to construct sustainable construction with adequate insulation AND ventilation and filtration systems, in homes, schools, and workplaces, on a larger scale than Proyecto Azteca has produced so far. Housing for our underserved populations needs construction and improvement, retrofitting, and weatherization.

West -5

**Colorado, Wyoming, Montana, Idaho, Washington, Oregon, Utah, Nevada,
California, Alaska, Hawaii**

I was on the virtual public meeting for 3 and a half hours waiting to speak on public comment. There was only one person from California who spoke. The rest were from East coast and Oregon. This is very disturbing to a member of the community from the Central Valley. Next time recognize the Central Valley!!! John X Mataka

Full Name (First and Last): Laura Rosenberger Haider

Name of Organization or Community: Fresnans Against Fracking

City and State: Fresno, CA

Brief description about the concern: Some residents of Fresno, CA are showing signs of Arsenic poisoning including muscle cramps, dehydration, peripheral neuropathy, pain or swelling in feet and hands or wrist, tingling, peripheral vascular disease, headaches, confusion, drowsiness tumors, skin lesions, low kidney function, loss of night vision, anemia, diarrhea, nausea, cognitive problems, hearing loss, cardiovascular problems, epilepsy, strokes, hair loss On a blood test for arsenic, my results were at the high end of the range. In addition, I'm allergic to the TCP in Fresno tap water and it makes me thirsty. There is a poultry farm with high PM 2.5 emissions in SW Fresno and a biomass plant in SE Fresno. The old leaky Raisin City Oilfield is on our aquifer recharge zone.

What do you want the WHEJAC to advise the White House Council on Environmental Quality to do?:

Ban new oil wells and reduce fossil fuel production to decrease climate change that is reducing our supply of fresh water. Distribute free Organic vegetable juice (without toxic metal pollution) on the streets of Fresno County, especially in SW Fresno. Also distribute free PM 2.5 masks in every store there. Keep repairing our filtered water machines that are often broken or vandalized by those who don't care about human lives. Some parts of Fresno County don't have nearby filtered water machines.

Docket/No Location

Why is an Asphalt Company being allow to circumvent appropriate channels? They are building the plant across the road from a low income housing community that is primarily black and already experiencing major lung ailments due to environmental hazard's exposure (would burning/smoke emissions plant). The asphalt is being built on the southern border of a township but will have adverse effects to the residents in the city but does not have to comply with city regulations! It tried to build the plant a few years ago in an all-white township, but the residents protested and this is the result. A very sneaky way to circumvent community opposition. This seems to be an epic failure of the monitoring system!

APPENDIX C:

Additional Submitted Written Public Comments

Appendix

5G Tree Care Industry Journal 1-2021.docx.pdf	2
04142022.Property Management Cos. JSYK Distribution Letter.pdf	6
Electromagnetic Fields Linked to Asthma in Kids.pdf.....	8
EMF and Wildlife Part 2.pdf.....	11
ENDAUM ltr to DOE FINAL.pdf	145
Exploring-Racial-Equity-and-Social-Justice-Impacts-of-Cell-Towers-and-ZTA-19-07.pdf	148
FW Climate & Economic Justice Screening Tool May 25, 2022.pdf	151
JSC and NPNA comments to WHEJAC on federal disaster relief.pdf.....	153
Letter to Secretary Granholm re Uranium Mining Concern 3-25-22.pdf.....	160
NACD 2022-05-25 WHEJAC Comments.pdf.....	163
NRDC et al to EPA w att ltr 2 May 2022.pdf	168
NWF Comments CEQ tool RFI.pdf	176
RWPRCA ltr to DOE Final.pdf	179
S. 186 Wireless Radiation History Testimonies and Urgency.pdf	182
State New Hampshire 5G final report.pdf.....	194
SUR Letters and Resolutions FINAL 4-29-22.pdf.....	584
The drive to widen the digital divide - CalMatters.pdf.....	593
THE HAZARDS OF in ELECTROMAGNETIC FIELDS (EMFS).pdf	597
The Kids Are Not All Right Tech Health Alison Main .pdf	600
Thermal and non-thermal health effects of low intensity non-ionizing radiation- An international perspective.pdf.....	604
UMUT_Resolution2021-135_Opposition_Strategic_Uranium_Reserve.pdf	620
Washington-Spectator-5G 2022Full article .pdf.....	622
WHEJAC Letter 4-14-22.pdf	626
WHEJAC Meeting Comments HG NJY 20220511.pdf	634
WHEJAC Submission 4-14-22 FINAL.pdf	638
WHEJAC submission May 25 2022.pdf	646
WHEJAC.pdf	650
WHEJACK SJI and LMD Comment Submission.pdf	654
Wireless is an Environmental Justice Issue.pdf	670

Appendix

5G Tree Care Industry Journal 1-2021.docx.pdf	2
04142022.Property Management Cos. JSYK Distribution Letter.pdf	6
Electromagnetic Fields Linked to Asthma in Kids.pdf.....	8
EMF and Wildlife Part 2.pdf.....	11
ENDAUM ltr to DOE FINAL.pdf	145
Exploring-Racial-Equity-and-Social-Justice-Impacts-of-Cell-Towers-and-ZTA-19-07.pdf	148
FW Climate & Economic Justice Screening Tool May 25, 2022.pdf	151
JSC and NPNA comments to WHEJAC on federal disaster relief.pdf.....	153
Letter to Secretary Granholm re Uranium Mining Concern 3-25-22.pdf.....	160
NACD 2022-05-25 WHEJAC Comments.pdf.....	163
NRDC et al to EPA w att ltr 2 May 2022.pdf	168
NWF Comments CEQ tool RFI.pdf	176
RWPRCA ltr to DOE Final.pdf	179
S. 186 Wireless Radiation History Testimonies and Urgency.pdf	182
State New Hampshire 5G final report.pdf.....	194
SUR Letters and Resolutions FINAL 4-29-22.pdf.....	584
The drive to widen the digital divide - CalMatters.pdf.....	593
THE HAZARDS OF in ELECTROMAGNETIC FIELDS (EMFS).pdf	597
The Kids Are Not All Right Tech Health Alison Main .pdf	600
Thermal and non-thermal health effects of low intensity non-ionizing radiation- An international perspective.pdf	604
UMUT_Resolution2021-135_Opposition_Strategic_Uranium_Reserve.pdf	620
Washington-Spectator-5G 2022Full article .pdf.....	622
WHEJAC Letter 4-14-22.pdf	626
WHEJAC Meeting Comments HG NJY 20220511.pdf	634
WHEJAC Submission 4-14-22 FINAL.pdf	638
WHEJAC submission May 25 2022.pdf	646
WHEJAC.pdf	650
WHEJACK SJI and LMD Comment Submission.pdf	654
Wireless is an Environmental Justice Issue.pdf	670

BEWARE

the Dangers from AM Radio and 5G Transmission Sites

BY RICK HOWLAND

As if tree care isn't dangerous enough, there's an increasing safety threat that hasn't yet gotten much attention – radio waves. Radio waves are everywhere, and have been since the dawn of the universe. Man-made ones have been around for more than a century, starting with the wireless telegraph. But with ever-more sophisticated uses of the radio spectrum and increased use of aerial equipment – aerial lifts and cranes – in proximity to the source of radio waves, serious injury becomes a concern.

The latest threat is the proliferation of the so-called 5G, or Fifth Generation, cellular-phone networking that promises faster data speeds and greater reliability using multiple technologies, including mini-cell sites at the neighborhood level on utility poles. But working too closely or too long near one of these mini installations or near a high-power radio transmitter can be dangerous in several ways, specifically resulting in burns or, in some rare circumstances, electric shock.

The industry has experienced incidents related to radio-frequency (RF) radiation.

John Haehnel, director of safety and training for Tree Tech, Inc., a dual-accredited, 38-year TCIA member company headquartered in Foxboro, Massachusetts, can speak to the dangers from experience, and has the scars to prove it.

This past September, Haehnel and his utility line-clearance crew were working just outside of Boston with an all-terrain

crane within the proximity – about 100 yards – of several AM radio towers and a 5G cell-transmission installation. "I got zapped," he reports, "maybe from the AM tower or the 5G. We are running into that more and more."

Haehnel, who happened to be filling in for the vacationing crane operator that day, states that, as one of his crew was getting ready to go aloft, the worker reported something was wrong and that he felt as if he was being shocked. (This phenomenon is described in numerous Federal Communications Commission [FCC] documents.)

Haehnel had the crane boom out about 110 feet or more. "I had the crane's ball down to tie in the worker, walked over to it, got to within a foot-and-a-half and got zapped by the ball." He says the lightning-like flashover resulted in first- and second-degree burns and a scar to one hand. "The ball was so hot, you could not touch it."

Initially, Haehnel thought the situation might be something electrical with the crane, until the nearby radio towers explained it. "Ironically, I had just done a

"I got zapped, maybe from the AM tower or the 5G. We are running into that more and more."

John Haehnel

A small-cell-site round, omni-directional antenna atop a pole. Photo courtesy of Lucas Tree.





The equipment on this pole is part of the small-cell site. There is usually information on the pole about who owns it and contact information, as well as caution signs. Photo courtesy of Tree Tech.

small-scale, 5G safety presentation just two weeks prior," he says, adding, "but from where we were, we could not see the big 5G antenna," which is part of a 5G network, not just the small local sites.

Haehnel reports that they later discovered four or five AM antennas and the big 5G antenna installation nearby. "We had scoped out the site and put the crane ball next to the tree, but we could not see the towers from ground level," he says.

Because of this incident, Haehnel's crew shut down the job and left the site.

When he got "zapped," initially the effect did not seem too bad, Haehnel says. "It was like an electric burn flashed over my left hand like a first-degree burn." The next day, Haehnel says, "the middle finger had developed a second-degree burn and there was a hole in my finger," which accounts for the scar.

Background

The American Cancer Society (ACS) says of radio frequency, "Some people

can have significant RF exposure as part of their jobs. This includes people who maintain antenna towers that broadcast communication signals and people who use or maintain radar equipment."

TCIA has found this also includes aerial-lift and crane operators performing tree care, mostly utility-line clearance, but potentially residential crews as well.

The ACS continues, "If RF radiation is absorbed by the body in large enough amounts, it can produce heat. This can lead to burn and body-tissue damage. Although RF radiation is not thought to cause cancer by damaging the DNA in cells the way ionizing radiation does (for example, X-rays), there has been concern that in some circumstances, some forms of non-ionizing radiation might still have other effects on cells that might somehow result in cancer."

The FCC, in multiple published documents, refers to both the dangers from RF exposure mentioned above and the rare but potential danger of electrical shock from radio waves. Though

speculation on some level continues, it is clear and proven that under certain conditions, radio waves can burn you.

The good news is that the FCC and international health organizations such as the World Health Organization (WHO) report there is little to no evidence that the devices we use daily that employ electromagnetic fields (EMF) energy, such as microwave ovens and cell phones, pose a major threat. The bad news is, that is not the case for the higher RF-energy waves at or near broadcast sites.

According to the FCC, "Biological effects can result from exposure to RF energy. Biological effects that result from heating of tissue by RF energy are often referred to as 'thermal' effects. It has been known for many years that exposure to very high levels of RF radiation can be harmful due to the ability of RF energy to heat biological tissue rapidly. This is the principle by which microwave ovens cook food. Exposure to very high RF intensities can result in heating of biological tissue and an increase in body temperature. Tissue damage in humans could occur during exposure to high RF levels because of the body's inability to cope with or dissipate the excessive heat that could be generated. Two areas of the body, the eyes and the testes, are particularly vulnerable to RF heating because of the relative lack of available blood flow to dissipate the excess heat load." (For more on the subject, see <https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety>.)

AM radio tower also a danger

Another case was reported by Daniel Mayer, owner of Mayer Tree Service, Inc., a 28-year TCIA member company based in Essex, Mass., that occurred while working on the picturesque and historic campus of Endicott College in nearby Salem, Mass.

"It's the same thing," he begins. "We did not know we were working near the college's campus radio tower. I was feeling energy in the crane ball and we were getting arcing on the machine, so we folded the crane and called an inspector." Mayer says one's first instinct is to suspect electrical problems with the machine, but investigators soon found the situation was



The caution sign on the lower-right side of the pole shown here warns of the dangers of small-cell sites. Photo courtesy of Tree Tech.

precipitated by the campus radio tower during broadcasting. To draw an analogy, Mayer notes, "It's very much like the effect on the rigging of a sailboat arcing during an electrical storm."

Mayer recounted the incident to Jay Sturm, president of and a crane-safety specialist with Cranes101, a training company and nine-year TCIA Corporate Member company based in Bellingham, Mass., and subsequently forwarded a copy of a video recording of the incident to Sturm for analysis. That helped determine that the problem was, indeed, radio frequency related and not equipment. Sturm says this is a growing concern among crane operators in all fields.

A new threat

"Interesting timing," says Timothy Walsh, director of corporate safety at The Davey Tree Expert Company, when asked about this topic. "People are just becoming aware of this situation."

Walsh says Davey Tree, an accredited, 48-year TCIA member company headquartered in Kent, Ohio, recently worked with an expert on the subject, who explained the hazards and how to identify these so-called small-cell 5G installations. "Right now, as an industry, we just do not yet understand the risk. So we also do not know of any formal processes that exist" to deal

with the situation when it arises, Walsh says.

He adds that Davey Tree is in the process of developing operational protocols, but emphasizes, "This is all so new. It seems everyone got all excited about the new 5G system and forgot about addressing the potential hazards."

"We are formalizing a plan, and we do have safety alerts and tailgate meetings about the subject," Walsh says, cautioning. "There is conflicting information, but we want to understand the hazards and make our people aware of them."

"We have not yet had an incident," Walsh continues, noting the company does tree work for commercial and residential properties, with a separate group working around power and communications lines where, he states, "there is more potential for exposure."

If we do not know exactly what radio-frequency waves can do to a tree care crew working in proximity to such an installation, what can be done to remain safe?

Says Haehnel, "We talk to our teams about what happened and instruct our sales team as to what to look for," he says, referring to towers and small-cell-site installations. He says aerial neighborhood views (including sources such as Google)



John Haehnel's scarring still had not fully healed three months after he was zapped by the energized ball, resulting in first- and second-degree burns. Photo courtesy of Tree Tech.

can be very helpful in identifying towers, and the 5G small sites are easily spotted "on utility poles in front of homes along the street. They look like a metal can attached to a pole," Haehnel notes.

"Actually, when working near an AM-radio broadcast site, we can contact the FCC, which can get the broadcast power turned down while we are working," Haehnel says.

He maintains that all such sites have contact-information tags on them that identify the owner. Usually it requires 24 to 48 hours lead time to shut off the power to that site, he explains, adding that, "There should be no service interruption to 5G users, since the carrier can switch temporarily to another cell site."

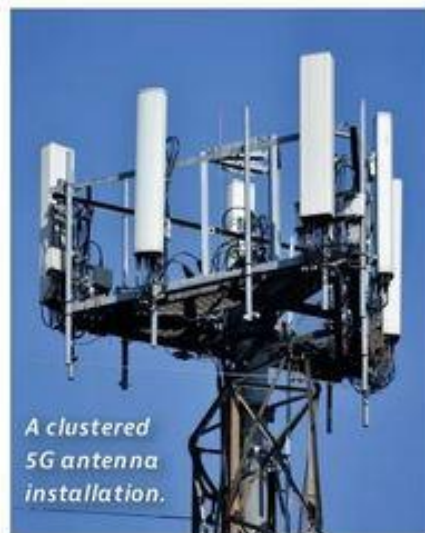
Gerry Breton, CTSP, safety and training director for Lucas Tree Expert Company, Inc., a dual-accredited, 41-year TCIA member company headquartered in Falmouth, Maine, says, "The industry is just getting familiar with RF challenges. The issue is popping up in New England, but is not prevalent yet during this stage of the switch to 5G."

He's attended several briefings on the subject, which review FCC and OSHA updates. Breton says there are some things to become aware of - some quite unanticipated - especially when working around these new 5G installations. He notes that in addition to being marked with the name of the owner/service provider, each site (usually a utility pole) will have numerous warning notices about working in and around the

antennas, indicating safe positioning and proximity for that antenna type and other safety information.

Breton reports the situation is so important that, "We reviewed with our supervisors what these installations are, what they look like and where they are located at the top of utility-distribution poles. Now when we're out planning our jobs, we pay close attention to how close vegetation is to the antennas.

"If our work plan indicates we will be working near this small-cell site, we know we must reach out to the cell provider," he continues. Breton suggests copying one of his techniques, which is to contact a few providers long before any jobs are planned to understand the processes needed to shut down a cell site if work is needed at that site.



A clustered 5G antenna installation.

Breton acknowledges that RF exposure is more a potential hazard for line workers and line-clearance contractors, but "even tree care crews working in and around small-cell areas will need a hazard-assessment protocol. When you have a tree crew working at the roadside and they may be trimming around a small-cell site, it is important to scope it out," he says. "If you're outside the danger zone, no action is required." If there is potential danger, Breton says, "workers are to notify their supervisor who, in turn, is to notify the carrier to shut down the site.

"It is important to note that there is no cost to shut down a site," he stresses.

In an aside that many may not consider, Breton warns of some unforeseen dangers. One risk is during a storm response when you are providing vegetation clearing. You need to know if those units, whether they are still standing or are on the ground, are disconnected either by the storm or by the utility. "The sites are powered by 120 volts," Breton reports, adding that even if regular power is out in a neighborhood, some sites have their own emergency backup and the cell antenna may still be capable of broadcasting, meaning it can be live with electric power.

So, one thing we know is that not all radio waves are benign, and it takes knowledge to recognize potential risks. Another thing is that there is a lot of information available online; not only are there resources such as seminars on the subject, but also there is a network of tree care safety professionals open to sharing information, and that includes with those who may be the competition.

To view a video demonstrating the radio-frequency-related arcing discussed here, go to tcimag.tcia.org and, under the Resources tab, click videos. Or, under the Current Issue tab, click View Digimag, then go to this page and click here.

Did you like this article or find it useful? Scan the QR code to provide your feedback or, in the digital version of this issue, click here.





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Office of
Enforcement and
Compliance Assurance

Re: Property Management Companies

Dear Madam or Sir,

This letter is intended to notify you of an action by the U.S. Environmental Protection Agency (EPA) that discusses the compliance responsibilities of certain property management companies (PMCs) under the Toxic Substances Control Act (TSCA) lead-based paint [Renovation, Repair and Painting Rule](#) (RRP Rule).

If you are affiliated with an organization that includes PMCs that may be affected, then we encourage you to share this information with your members or associates.

WHAT ACTION WAS TAKEN?

On March 21, 2022, EPA withdrew two Frequently Asked Questions (FAQs) that addressed PMC compliance responsibilities under the RRP Rule: FAQ #23002-13650 and # 23002-18348. **As of that date, the two FAQs are *no longer in effect*, and therefore PMCs cannot rely on them as EPA's views about PMC compliance responsibilities under the RRP Rule.** In other words, with the withdrawal of these two FAQs, EPA will be assessing compliance by PMCs with the RRP Rule as it would for any other entity. The withdrawal of the FAQs does *not* change the RRP Rule, including its definition of "renovation."

EPA first published [notice](#) of the Agency's intent to withdraw the two FAQs on November 4, 2021. Among other things, the notice explains that:

"Consistent with the RRP rule, any individual or entity (including PMCs) is subject to the RRP rule requirements when they perform or offer to perform renovation, repair or painting activities for compensation in housing and child-occupied facilities built before 1978, and therefore must be a certified firm."

In the November 4 notice, EPA requested public comment on the planned action. EPA received and considered [public comments](#) regarding the planned action. Additionally, in November and December 2021, EPA widely distributed information about the November 4 notice to trade associations, community and non-profit organizations and others that might be affected by or interested in the planned action.

On January 11, 2022, EPA [affirmed](#) that the Agency would withdraw the two FAQs, effective March 21, 2022. EPA made this information available through an official [announcement](#) and [press release](#).

WHO DOES THE ACTION AFFECT?

EPA's action affects PMCs that perform, offer to perform, or claim to perform renovations for pre-1978 residential housing and child-occupied facilities.

WHAT MUST AN AFFECTED PARTY DO TO COMPLY WITH THE RRP RULE?

PMCs subject to the RRP Rule must possess RRP certification from EPA (or from an authorized state or tribe), among other compliance requirements under the RRP Rule. Those requirements include ensuring that renovations comply with lead-safe work practices, and that a certified renovator is assigned to each covered renovation and properly discharges the duties specifically assigned to certified renovators by the rule. Also, all PMCs subject to the RRP Rule need to ensure that they, their employees and any outside renovation contractors they engage comply with RRP Rule requirements. Finally, a PMC that works in an authorized state/tribal area should confirm with the relevant authorities whether the state/tribal program requires additional action.

A PMC that is subject to the RRP Rule but has not yet obtained certification from EPA (or from an authorized state/tribe) should promptly [apply](#) to obtain certification. (Merely applying for certification does not prevent potential enforcement for violations.)

ARE THERE POTENTIAL PENALTIES FOR NON-COMPLIANCE WITH THE RRP RULE?

Yes. Failure to comply with the RRP Rule may result in enforcement and potentially significant civil penalties. See [15 U.S.C. § 2615](#).

Highlights of recent RRP [enforcement](#) actions are available online.

WHERE CAN YOU FIND MORE INFORMATION?

Information about [RRP Rule requirements](#) is available online.

If you have questions about this letter or the regulatory requirements, then please contact James Miles at miles.james@epa.gov.

Sincerely,

Saenz, Diana Digitally signed by Saenz, Diana
Date: 2022.04.14 15:13:03 -04'00'

Greg Sullivan
Director
Waste and Chemical Enforcement Division
Office of Civil Enforcement

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Date: 2022.04.14 15:41:48 -04'00'

Manuel Ronquillo
Acting Deputy Director
Federal Facilities Enforcement Office



Electromagnetic Fields Linked to Asthma in Kids

Study: Mom's Exposure During Pregnancy Raises Kids' Asthma Risk

By Brenda Goodman, MA

FROM THE WEBMD ARCHIVES 

Aug. 1, 2011 -- Researchers seeking to explain the rising number of asthma cases in children have fingered a new suspect: electromagnetic fields (EMFs), energy that can't be seen or felt that is generated by household appliances, electronic devices, cars, and power lines.

In a study, they found that babies born to women who are exposed to stronger EMFs during pregnancy had more than triple the risk of developing asthma compared to babies born to women exposed to weaker EMFs.

In other words, about 13% of children born to women in the group with the lowest EMF exposures developed asthma compared to about 33% of children born to women who had high EMF exposures.

"That's a striking figure," says David Savitz, PhD, a professor of community health and obstetrics and gynecology at Brown University in Providence, R.I. "That magnitude of association we don't see very often. If it was correct, and that's a big 'if,' that would be really startling."

Savitz, who has studied the health effects of electromagnetic fields but was not involved in the research, says that while the finding is interesting, there's no reason to give up using a hair dryer or microwave just yet.

He says that unlike contaminants like cigarette smoke or lead that are known to be dangerous, there's little evidence that low-frequency EMFs, the kind measured in the study, are harmful.

"This has been very, very thoroughly studied, and it really is questionable whether it causes any health effects at any reasonable level," Savitz tells WebMD. "It's certainly not something that falls into the category of a known hazard."

But Savitz and others acknowledge that all research has to start somewhere.

"There are a lot of important topics that started out looking pretty flaky and pretty unlikely. There was a time when it made no sense that smoking could be bad for you," he says.

Other experts agree.

“The study appears to be well executed and the finding is surprising,” says Jonathan M. Samet, MD, a pulmonologist and epidemiologist at the Keck School of Medicine at the University of Southern California in Los Angeles.

Samet recently led a World Health Organization panel that concluded that EMFs from cell phones and other wireless devices could possibly cause cancer.

The current study didn't account for EMFs from cell phones or wireless networks, which emit higher-energy frequencies than were measured in the study.

Samet says that based on what we know about the development of asthma, it's hard to understand how EMFs might play a role. Repeating the study, he says, will be an important next step.

Previous studies have shown that EMFs may adversely affect the immune system.

Linking EMFs to Asthma in Kids

Researchers asked pregnant women who were members of the Kaiser Permanente Northern California health plan to wear magnetic field sensors around their waists for 24 hours.

The sensors took readings every 10 seconds, recording magnetic field levels of everything the women came into contact with during the day.

The sensors measured low frequency magnetic fields, which are generated by things like refrigerators, vacuum cleaners, hair dryers, cars, power lines, stoves, microwaves, computers, nearly anything that can be plugged in or runs on a motor.

They did not measure magnetic fields generated by cell phones or wireless networks, which operate at higher frequencies.

The sensors generated a total of 8,640 readings for each mother and baby.

Researchers then ranked those readings from the highest to lowest and picked out the middle number as a way to judge exposure.

Researchers don't know why some women had higher exposures while others had lower exposures, but Savitz says roughly 10% to 20% of households in the U.S. would meet the criteria for high EMF exposures used in the study.

Researchers then followed the women and their children for up to 13 years.

Children were considered to have asthma if a doctor diagnosed them with the condition twice in the same year.

Compared to children of mothers in the low magnetic field group, who developed asthma at rates that were roughly comparable to the national average, those in the high group had a 350% increased risk of getting the condition, while those in the medium group had a 74% increased risk.

The association remained even after researchers adjusted their data for things that might independently influence the development of asthma in kids, like age, sex, early birth, low

birth weight, breastfeeding, and a family history of the condition.

Researchers say women who are worried about EMFs can do simple things to lower their exposure.

“The problem with EMF is that you can’t see, smell it, you can’t touch it,” says study researcher De-Kun Li, MD, PhD, a reproductive and perinatal epidemiologist at the Kaiser Permanente Division of Research in Oakland, Calif. “But you can avoid those sources that we know about.”

“The great thing about EMF is that distance really helps,” Li says. For example, “When you turn the microwave on, don’t stand right next to it. Try to, when you use a hair dryer, try to use it far away from your tummy as much as you can.”

In the case of can openers, opting for a hand crank device, rather than an electric one, can lower EMF exposure.

In the case of vacuum cleaners, the study may be a good excuse to hand off the job to your partner.

The study is published in the Archives of Pediatric and Adolescent Medicine.

WebMD Health News | Reviewed by Laura J. Martin, MD on August 01, 2011

Sources 
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News release, *Archives of Pediatric and Adolescent Medicine*.

De-Kun Li, MD, PhD, reproductive and perinatal epidemiologist, Kaiser Permanente Division of Research, Oakland, Calif.

David Savitz, PhD, professor of community health and obstetrics and gynecology, Brown University, Providence, R.I.

Jonathan M. Samet, MD, pulmonologist and epidemiologist, Keck School of Medicine, University of Southern California, Los Angeles.

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Review Article

B. Blake Levitt*, Henry C. Lai and Albert M. Manville II

Effects of non-ionizing electromagnetic fields on flora and fauna, Part 2 impacts: how species interact with natural and man-made EMF

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Abstract: Ambient levels of nonionizing electromagnetic fields (EMF) have risen sharply in the last five decades to become a ubiquitous, continuous, biologically active environmental pollutant, even in rural and remote areas. Many species of flora and fauna, because of unique physiologies and habitats, are sensitive to exogenous EMF in ways that surpass human reactivity. This can lead to complex endogenous reactions that are highly variable, largely unseen, and a possible contributing factor in species extinctions, sometimes localized. Non-human magnetoreception mechanisms are explored. Numerous studies across all frequencies and taxa indicate that current low-level anthropogenic EMF can have myriad adverse and synergistic effects, including on orientation and migration, food finding, reproduction, mating, nest and den building, territorial maintenance and defense, and on vitality, longevity and survivorship itself. Effects have been observed in mammals such as bats, cervids, cetaceans, and pinnipeds among others, and on birds, insects, amphibians, reptiles, microbes and many species of flora. Cyto- and geno-toxic effects have long been observed in laboratory research on animal models that can be extrapolated to wildlife. Unusual multi-system mechanisms can come into play with non-human species – including in aquatic environments – that rely on the Earth's natural geomagnetic fields for critical life-sustaining information. Part 2 of this 3-part series includes four online supplement tables of effects seen in animals from both ELF and RFR at

vanishingly low intensities. Taken as a whole, this indicates enough information to raise concerns about ambient exposures to nonionizing radiation at ecosystem levels. Wildlife loss is often unseen and undocumented until tipping points are reached. It is time to recognize ambient EMF as a novel form of pollution and develop rules at regulatory agencies that designate air as 'habitat' so EMF can be regulated like other pollutants. Long-term chronic low-level EMF exposure standards, which do not now exist, should be set accordingly for wildlife, and environmental laws should be strictly enforced – a subject explored in Part 3.

Keywords: cell phone towers/masts/base stations; Earth's geomagnetic fields; magnetoreception, radiofrequency radiation (RFR); nonionizing electromagnetic fields (EMF); plants; wildlife.

Introduction: electromagnetic fields – natural and man-made

In Part 1 of this three-part series, rising ambient EMF levels were explored. Part 2 focuses specifically on the unique magnetoreception physiologies found in wildlife as well as the mechanisms by which they interact with the Earth's natural geomagnetic fields and man-made EMF at intensities now commonly found in the environment. Part 2 Supplements contain tables of studies showing effects at extremely low intensity exposures comparable to today's ambient levels.

Energy is a part of nature affecting every living thing in positive, negative and neutral ways. The Earth itself is a dipole magnet with a north and a south pole. All living things have evolved within the protective cradle of the Earth's natural geomagnetic fields. In fact, magnetic oscillations emanate from the Earth's molten iron core around 10 times per second (10 Hz) where relaxed but alert human thought/brainwaves occur between 8 and 14 Hz.

In addition to the Earth's natural emanations, vast Schumann Resonances (SR) that constantly circle the globe

*Corresponding author: B. Blake Levitt, P.O. Box 2014, New Preston, CT, 06777, USA, E-mail: blakelevitt2@gmail.com and blakelevit@cs.com

Henry C. Lai, Department of Bioengineering, University of Washington, Seattle, WA, USA, E-mail: hlai@uw.edu

Albert M. Manville II, Advanced Academic Programs, Krieger School of Arts and Sciences, Environmental Sciences and Policy, Johns Hopkins University, Washington DC Campus, USA, E-mail: amanvil1@jhu.edu

were theorized in 1952 by physicist Windfried Otto Schumann and reliably measured in the 1960s [1, 2]. SR are a global electromagnetic phenomenon caused by a complex relationship between lightening at the Earth's surface and the ionosphere. Excited by the 2,000 thunderstorms that occur globally at any given time and approximately 50 flashes of lightening every second, the space between Earth and the ionosphere 60 miles (97 km) above it form a resonant cavity and closed waveguide [3]. Schumann Resonances occur in the ELF bands between 3 and 60 Hz with distinct fundamental peaks around 7.83 Hz. Since the 1960s, scientists have discovered that variations in the resonances correspond to seasonal changes in solar activity, the Earth's magnetic environment, in atmospheric water aerosols and various other earth-bound phenomena, including increased weather activity due to climate change. There are an estimated 1.2 billion lightening flashes globally each year, 25 million in the U.S. alone [4], not all of which are of sufficient length to contribute to the resonances.

Many behavioral aspects in biology are thought to be synchronized with both the Earth's natural fields and the Schumann Resonances. Many species rely on the Earth's natural fields for daily movement, seasonal migration, reproduction, food-finding, and territorial location, as well as diurnal and nocturnal activities. Human circadian rhythms, mainly regulated by light targeting signaling

pathways in the hypothalamic suprachiasmatic nucleus, are known to be finely tuned to the Earth's day/night cycles as well as natural seasonal variations, as are most species [5–8]. Artificial ELF-EMF is also known to adversely affect human circadian clocks, possibly through modulation in circadian clock gene expression itself [9].

Nonionizing electromagnetic fields (EMF; 0–300 GHz) include all the frequencies that fall between visible light below the ultraviolet range and the Earth's natural static fields. The nonionizing bands are used in virtually everything involved with communications and energy propagation so useful in modern life, including electric power production/distribution, all wireless technologies and accompanying infrastructure for cell phones, WiFi, baby/home monitoring systems, 'smart'grid/meters, all 'smart' technology/devices, 2-through-5G Internet of Things, AM/FM broadcast radio and television, shortwave and HAM radio, surveillance/security systems, satellites, radar, many military applications, and myriad medical diagnostic tools like MRI's, to name but a few (see Figure 1).

In its natural state, very little radiofrequency radiation (RFR) reaches the Earth's surface. Aside from the Earth's natural extremely low frequency (ELF) direct current (DC) magnetic fields, lightening and sunlight would primarily comprise our normal exposures to the electromagnetic spectrum. Most harmful radiation coming from outer space is blocked by the Earth's magnetosphere. But now, for the first

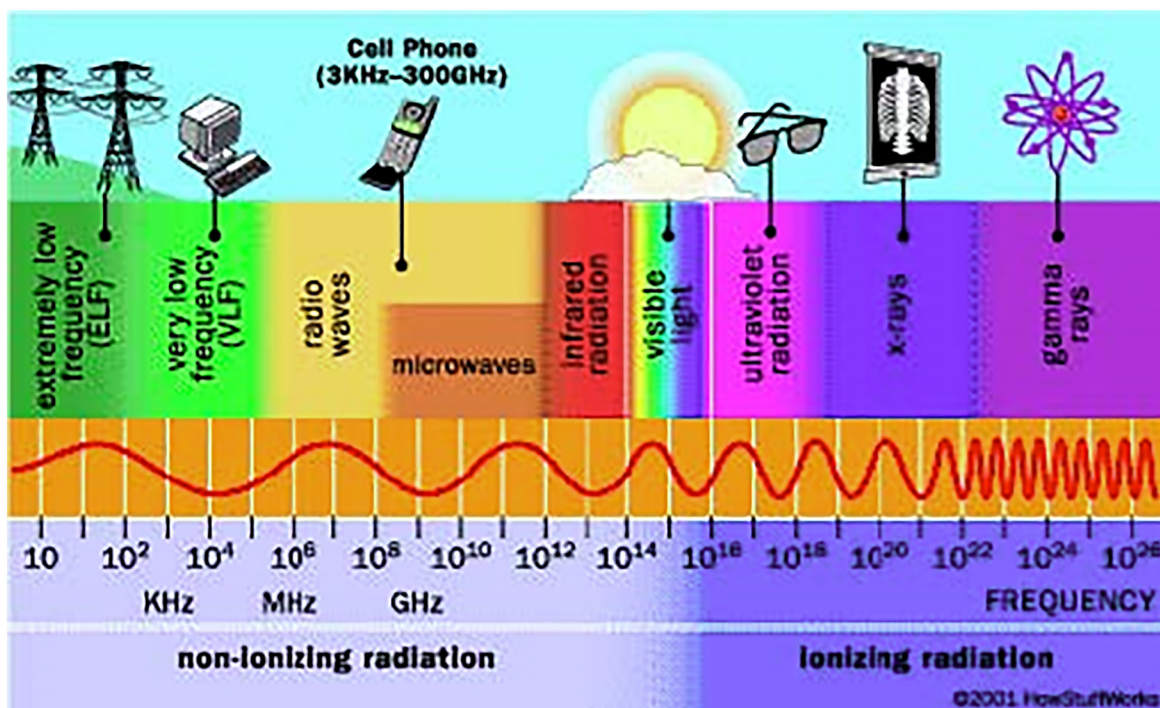


Figure 1: The electromagnetic spectrum.

The electromagnetic spectrum is divided into ionizing and nonionizing radiation. Ionizing radiation falls at and above the ultra violet range in the light frequencies. Examples of ionizing radiation include gamma rays, cosmic rays, X-rays and various military and civilian nuclear activities. It is the nonionizing bands that we have completely filled in with modern technology.

time in evolutionary history, we have infused the Earth's surface with a blanket of artificial energy exposures with no clear understanding of what the consequences may be.

And although “natural,” not all energy is alike. Man-made exposures contain propagation characteristics — such as alternating current, modulation, complex signaling characteristics (e.g., pulsed, digital, and phased array), unusual wave forms (e.g., square and sawtooth shapes), and at heightened power intensities at the Earth's surface that simply do not exist in nature. These are all man-made artifacts. In our embrace of technology, we have completely altered the Earth's electromagnetic signature in which all life has evolved, in essence bypassing the magnetosphere's protection. And because so much of wireless technology is satellite based, increasing exposures are no longer just ground-generated. All atmospheric levels are now affected by increasing ambient exposures (see Part 1 and Part 1 Supplement). This is especially true in the lower atmosphere, which is ‘habitat’ (beyond mere oxygen and clean air standards) for all species that mate, migrate, and feed in the air — including birds, mammals (such as bats), insects and some arachnids.

Species extinctions

There has been an unprecedented rate of biodiversity decline in recent decades according to the International Union for Conservation of Nature [10] which maintains a “Red List of Threatened Species” that is considered the world's most comprehensive source on the global conservation status of animal, fungi and plant species — all critical indicators of planetary health.

IUCN's 2018 list showed that 26,000 species are threatened with extinction, which reflected more than 27% of all species assessed. This was greatly increased from their 2004 report that found at least 15 species had already gone extinct between 1984 and 2004, and another 12 survived only in captivity. Current extinction rates are now at least 100 to 1,000 times higher than natural rates found in the fossil record.

The more recent May 2019 report by the Intergovernmental Science and Policy Platform on Biodiversity and Ecosystem Services, Paris, France [11] projected that at least 1 million plant and animal species worldwide are at imminent threat of extinction if our current human actions and activities are not immediately reversed. A review of 73 reports by Sanchez-Bayo and Wyckhuys [12] found those rates had greatly accelerated. The authors noted that biodiversity of insects in particular is threatened worldwide with dramatic declines that could lead to a 40% extinction of insect species over the next several decades. In terrestrial ecosystems they found *Lepidoptera*, *Hymenoptera*, and *Coleoptera* (dung

beetles) were most affected, while in aquatic ecosystems *Odonata*, *Plecoptera*, *Trichoptera* and *Ephemeroptera* have already lost a considerable proportion of species. Affected insect groups included niche specialist species, as well as common and generalist species, many of which are critically important for pollination, as well as seed, fruit, nut and honey production, and natural pest control, among others of immeasurable economic and ecological value.

Humans are the primary cause for most declines via habitat destruction/degradation; over-exploitation for food, pets, cattle and medicine; artificially introduced species; pollution/contamination; pesticides; and disease. Climate change is increasingly established as a serious threat, as well as agricultural practices like monoculture crops for cattle feed, biofuels, and timber. New pesticides and weed killers introduced within the last 20 years, using neonicotinoids, glyphosphate, and fipronil, are especially damaging since they are long-lasting and capable of sterilizing soil of beneficial microorganisms, including worms and grubs, which can then extend to areas far beyond applications sites.

One example of multi-factorial damage includes the iconic American Monarch butterfly (*Danaus plexippus*) which is found across America and Southern Canada and generally geographically divided into eastern and western migratory groups by the Rocky Mountains. That species has declined by a full 99.4% in the west since the 1980s — 85% of that being since 2017 [13, 14]. According to the Center for Biological Diversity [15], the eastern monarch population has shrunk by 90% in the past two decades. Massive habitat loss, wildfires, climate change, droughts, enhanced storm ferocity, and the 1990s introduction of Monsanto “Roundup Ready” crops capable of surviving herbicides that kill other weeds — including milkweed, which monarchs need for breeding and as their sole food supply along their migratory routes — are thought to be the primary culprits.

Here, we argue, environmental EMF should be added to this list since many insects and other living species have sensitive receptors for EMF, e.g., monarchs were found to have light sensitive magnetoreceptors in their antennae that serve as an inclination compass when daylight is absent [16]. RFR is also known to alter the time period needed for a butterfly to complete morphogenesis, plus gastrulation and larval growth can be accelerated [17]. And the devastating loss of pollinating insects like honey bees and other wild pollinators may also be related to environmental EMF (see “Insects” below.)

Anecdotally, many people recall when there were significantly more insects and far more abundant wildlife. Since about 1980, there has been a steady, almost imperceptible, biodiversity diminishment among many species globally [18–20]. In 2018, scientists estimated that the

largest king penguin colony shrank by 88% in just 35 years [21] due in major part to effects from climate change, while according to the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean, over 97% of bluefin tuna have disappeared from the world's oceans, primarily due to industrial overfishing but exacerbated by oil spills, contamination, and climate change. Tree and cave-dwelling bats until recently were common, including in the Eastern United States. Now with the massive impacts from White-nosed Syndrome (a fatal bat fungal disease), annual wind-turbine bat collision mortality estimated at nearly 1 million per year in the U.S. alone [22, 23], and pesticide use, few bats are seen. Bats species are also sensitive to EMF. Impacts from EMF as now seen in extensive reviews add only yet another troubling variable for all wildlife [24–36].

Since all food webs are uniquely tied together, there are negative cascading effects across all ecosystems. Birds that eat insects are hard hit: 8-in-10 partridges have disappeared from French farmlands while there has been a 50–80% reduction in nightingales and turtledoves respectively in the UK. Since 1980 the number of birds that typically inhabit Europe's farmlands has shrunk by 55%, while in the last 17 years, French farmland-bird counts dropped by a full third. Intensified agricultural practices are thought responsible, with loss of insects being the largest contributor [12, 37]. In the United States, of the 1,027 species of migratory birds currently protected under the Migratory Bird Treaty Act of 1918, an estimated 40% are in decline based on breeding bird surveys [38], Christmas Bird Counts [39], and other monitoring tools [22, 23]. This trend is comparable to what is happening globally. What role EMF plays in these declines is unclear but remains a disturbing possibility. Nor do we understand the limits of tolerance any given species has for environmental disturbance — some show high flexibility while others thrive only within the narrowest ranges.

One estimate of Earth's species finds that since 1970, wild animal populations have been reduced on average by 60%. Popularly called the “sixth mass extinction” [40], the term connotes the sixth time in the Earth's history that large numbers of species have rapidly disappeared over a relatively short period, this time due to human activity, not asteroid strikes or volcanic activity. Though not officially so-designated, many now refer to this most recent geologic/ecosystem period as the “Anthropocene” — the Age of Man [41–46].

Insect populations have been especially hard hit with extinctions eight times faster than that of mammals, birds and reptiles [12]. Insect total mass is falling by an estimated 2.5% per year, suggesting they could vanish by the next century. And what affects insect populations affects

everything in the food web in one way or another. Loss of insect diversity and abundance can cause devastating effects throughout food webs and endanger entire ecosystems [12]. In Europe, Hallmann et al. [47] found a more than 75% decline over 27 years in total flying insect biomass in 63 protected areas, many throughout Germany. There was an 82% decline in mid-summer flying insect mass. Many European insect species migrate from distances as far away as Africa. The researchers noted that changes in weather, land use, and habitat characteristics alone cannot explain the overall decline and that there may be more than one unrecognized factor involved in evaluating declines in overall species abundance. That unrecognized factor may be the steadily rising ambient EMF that directly parallels these declines (see Part 1, Supplement 1).

Similar alarming invertebrate declines were discovered in the Western Hemisphere in 2017 when American entomologist Bradford Lister, after 40 years, revisited the El Yunque National Forest in Puerto Rico to follow up on a study begun in 1976 [48]. In the ensuing decades, populations of arthropods, including numerous flying insects, centipedes and spiders, had fallen by 98% in El Yunque, a pristine tropical rainforest within the U.S. National Forest System. Insectivores — including birds, lizards, and toads — showed similar declines, with some species vanishing entirely. After controlling for factors like habitat degradation or loss and pesticide use, the researchers concluded that climate change was the primary factor since the average maximum temperature in that rainforest had increased by 4 °F during that period. They did not factor in the large U.S. military VLF installation in Aquada that communicates with submarines all over the world, or the multiple sweeping over-the-horizon phased array radar units aimed at Puerto Rico from coastal sites in the U.S. that irradiate deep into that forest, or the multiple NOAA Doppler weather radar sites scattered all over the small island to track hurricanes, or the many cell towers there too.

These global declines are truly alarming with implications for planetary health as well as human and wildlife integrity. Many who study this say that climate change alone is not the only factor and that something new is going on [47]. The question is: could steadily rising environmental EMF, as one of the most ubiquitous but unrecognized new environmental genotoxins introduced since the 1980s, be contributing to these unprecedented species losses, beginning with insects but now manifesting in other species too? The upper microwave bands couple maximally with some insects the size of fruit flies and are capable of creating devastating resonance and other effects. Historically, radiofrequency radiation (RFR) impacts to insects were among the first biological effects to be

studied [49] with the hope of discovering new forms of insect control [50]. All insect metamorphic developments have been studied, including egg, larva, pupa, and adult stages. One hypothesis holds that some adult species are more sensitive than at larval stages because adult appendages act as conducting pathways to the body (see “Insects” below).

It is these exact frequency bands between 30 kHz and 3 GHz used in telecommunications technology that have been on the rise during this period. And 5G is on the horizon which may specifically target insect populations (see Part 1).

Species sensitivity to EMFs

Other species have vastly more complex electromagnetic sensing tools than humans, as well as unique physiologies that evolved to sense weak fields. Many species are highly sensitive to the Earth’s natural electromagnetic fields, as well as geographic and seasonal variations. In fact, it appears that most living things — including many species of mammals, birds, fish, and bacteria — are tuned to the Earth’s electromagnetic background in ways once considered as “superpowers” but are now known to be physiological, even as mechanisms are still imperfectly understood. For example, many animals have been observed sensing earthquakes long before human instruments detect them, including snakes and scorpions that seek shelter; cattle that stampede; birds that sing at the wrong times of day; and female cats that frantically move kittens [7].

This ability is likely due, in part, to numerous species reacting to changes in the Earth’s magnetic field and electrostatic charges in the air detected through a naturally occurring mineral called magnetite found in many species [51, 52]. In fact, honey bees are able to detect static magnetic field fluctuations as weak as 26 nT against background earth-strength magnetic fields that are much higher [53] and to sense weak alternating fields at frequencies of 10 and 60 Hz [54]. Magnetite reacts a million times more strongly to external electromagnetic fields than any other known magnetic material. Authors Kobayshi and Kirchvink [52] and Kirchvink et al. [53, 54] hypothesized results were consistent with biophysical predictions of a magnetite-based magnetoreceptor. Other mechanisms, like radical pair mechanisms and cryptochromes, may also be responsible (see “Mechanisms” below).

Much has been written about magnetoreception — the term used to describe how species sense electromagnetic fields — which is well established but not well understood. Many species use information about the Earth’s natural

fields for migration, mating, food-finding, homing, nesting, and numerous other activities. Migratory bird species [55, 56], honey bees [57], fish [58], mammals [59], bats [60], numerous insect species [61], mollusks [62], and even bacteria [63] are known to sense Earth’s magnetic fields in various ways. Magnetoreception may enable some bird species to actually see the Earth’s fields [64].

Some insect and arachnid species (e.g., Trichobothria) can detect natural atmospheric electric fields [65] which trigger ballooning behavior — e.g., climbing to the highest place, letting out silk, and traveling on wind currents using hair-like Trichobothria that detects airborne vibrations, currents, and electrical charge. Some have been found as high as 2.5 mi (4 km) in the sky, dispersing over hundreds of kilometers. Morley and Robert [65] found that the presence of a weak natural vertical e-field elicited ballooning behavior and takeoff in the spiders; their mechano-sensory hairs function as putative sensory receivers which are activated by natural weak electric-fields in response to both e-field and air-flow stimuli. The researchers hypothesized that atmospheric electricity was key to the mass migration patterns of some arthropod fauna.

Even soil nematodes (*Caenorhabditis elegans*) orient to earth-strength magnetic fields in their burrowing behaviors and a recent study by Vidal-Gadea [66] found that weak static fields slightly above Earth’s natural fields determined stem cell regeneration in flatworms (*Planaria*) [67].

Large ruminant mammalian species also orient to the Earth’s fields. Grazing cattle and deer were first observed aligning to geomagnetic field lines by Begall et al. [68]. Using satellite imagery, field observations, and measuring “deerbeds” in snow, they noted that domestic cattle across the globe, as well as grazing and resting red (*Cervus alphas*) and roe (*Capreolus capreolus*) deer, consistently align their body axis in a general north–south direction and that roe deer also orient their heads northward when grazing or resting. Burda et al. [69] discovered, however, that man-made ELF-EMF disrupted the north-south alignment with the geomagnetic field in resting cattle and roe deer when they found body orientation was random on pastures under or near power lines, with the disturbed pattern diminishing with distance from conductors. Cattle exposed to various magnetic field patterns directly beneath or near power lines exhibited distinct patterns of alignment. They concluded there was evidence for magnetic sensation in large mammals, as well as overt behavioral reactions to weak ELF-MF in vertebrates, implying cellular and molecular effects. Slaby et al. [70] also found cattle align along a north-south axis but suggested that such alignment may depend on herd density as the affect disappeared in herds with higher numbers. Fedrowitz [71] expanded this to

include bovine sensitivity to other weak ELF-EMF from powerlines but with observed effects due to combined electric and magnetic fields rather than the electric field exposure alone (see “Bovines” below).

Cervený et al. [72] found red fox (*Vulpes vulpes*) use geomagnetic fields during hunting. Even domestic dogs were found by Hart et al. [73] to be sensitive to small variations in the Earth’s orientation in their excretion habits, preferring a general north-south axis for both defecation and urination depending on geomagnetic field changes. And Nießner et al. [74] found dogs and some other species may actually “see” geomagnetic fields through blue-light sensing photoreceptor proteins in their eyes called cryptochromes.

According to the US/UK World Magnetic Model [75], sensitivity to the geomagnetic field may further complicate issues for migratory species (e.g., some turtles, sea animals, birds, and insects) because the Earth’s magnetic north pole is shifting faster than at any time in human history. Compared to the period between 1900 and 1980, it has greatly accelerated to about 30 mi (50 km) distance per year — moving west from over Canada’s Ellesmere Island, its traditional allocation for most of recorded history — toward Russia [76]. Magnetic north fluctuates according to changes in the Earth’s molten core, unlike true north which aligns according to the Earth’s axis. This trend may indicate a coming pole reversal with north and south trading places, something that occurs approximately every 400,000 years with the last being about 780,000 years ago. Some animals may be capable of recalibrating navigational cues but that remains to be seen. Since some migratory bird species may see geomagnetic fields through special receptor cells in their eyes and via other mechanisms, they could be thrown off course. It is unclear how many other species also see geomagnetic fields but some crustaceans and several insect species, especially those with compound eye structures consisting of thousands of ommatidia — tiny independent photoreception units with a cornea, lens, and photoreceptor cells that orient in different directions and distinguish brightness and many more bands of color than humans — are good candidates. Compared to single-aperture eyes, compound eyes have a very large view angle that can detect fast movement and in some cases light polarization.

In aquatic environments, some lakes have more than 200 species of fish that use some form of electromagnetism to locate food and reproduce. Electric eels can deliver a 500-V zap to kill prey. Sharks have an array of electromagnetic sensors. These include: magnetic field receptors in their mouths, eyes that are 10 times more sensitive than humans, and their perception of tiny electric neuronal discharges from the moving muscles in prey (including

humans) guides their attacking/feeding behavior (see “Fish” below). Sharks are often attracted by low-level electromagnetic fields surrounding underwater electric cables and are sometimes electrocuted when they mistake the conduit for living prey and bite into it. Many fish have lateral lines on either side of their bodies that are composed of magnetite, which allows fish to swim in synchronous schools [52].

Many other animals evolved special receptor organs to detect environmental EMF. The duck-billed platypus (*Ornithorhynchus anatinus*), a semi-aquatic primitive egg-laying mammal, has thousands of electric sensors on its bill skin. As noted in Lai [77], using these electroreceptors and interacting with another type of mechanoreceptor, a platypus can detect an electric field of 20 $\mu\text{V}/\text{cm}$ [78] — equivalent to that produced by the muscles of a shrimp. The information is processed by the somatosensory cortex of the platypus to fix the location of prey. This type of electroreception is common in the three species of monotremes: platypus, and long (*Zaglossus bruijini*) and short-bill (*Tachyglossus aculeatus*) echidna. Electric fish (elasmobranchs) emit EMF that covers a distance of several centimeters [79, 80]. This allows location of potential prey by comparing its electrical properties with that in its immediate vicinity. Their electroreceptors have been shown to detect a field of 5 nV/cm. Such EMF-sensing systems are highly sensitive and efficient but also highly vulnerable to disruption by unnatural fields. Organisms that use the geomagnetic field for migration have the capability not only to detect the field but also the orientation of the field.

Anthropogenic light frequencies affect wildlife in ways we have only recently grasped. Ecological studies have found that artificial light-at-night is disrupting nocturnal animals in devastating ways, including disorientation and disruption in breeding and migration cycles in turtles, flying insects, birds, butterflies and a host of other wildlife including mammals [81–84]. As much as 30% of nocturnal vertebrates and over 60% of invertebrates may be affected by artificial light [85]. Illumination reflected off of clouds known as “sky glow” can produce unnaturally bright conditions at night from various wavelength spectra that impact different species, with the potential to alter the balance of species interactions [86, 87]. It has been found that changing the color of the light can help some species yet harm another [88]. For instance, low-pressure sodium lights that have more yellow in their spectrum reduce moth deaths around the bulbs, but salamanders cannot navigate from one pond to the next under yellow or red light. Some frogs have been observed to freeze for hours, even after lights have been turned off, and to suspend both feeding and reproduction [83].

One of nature's great mysteries involves "natal homing behavior" — the ability of some animal species to return to their original location of birth in order to reproduce, sometimes over great distances. Natal homing behavior is known in sea turtles [89]; eels [90]; and salmon [91], among other species. The underlying mechanism, though imperfectly understood, involves such species "remembering" the geomagnetic field configurations of their birthplace via a process known as "imprinting," and thus can locate and return to it even if they are thousands of miles/kilometers away at reproduction time. Apparently, newborns of these species are imprinted with the memory of the intensity and the inclination angle of the local geomagnetic field. This information is then later used to locate their place of birth where they return to breed.

The question is whether man-made EMF could distort this imprinting memory in later locating the site. For example, what if RFR-emitting facilities are located near turtle breeding sites? Could that interfere with imprinting? There is some evidence from Landler et al. [92] of adverse effects in turtles. The researchers found that RFR could disrupt a natural orientation, establish its own orientation, and reverse completely a natural orientation, indicating a need for research to further investigate as we simply do not know the full effects to other species from anthropogenic EMF.

Energy conduction in different species: unique physiologies and morphologies

The unique physiology and morphology of non-human species create additional complexities. For instance, quadrupedal species with four feet on the ground have different and potentially more efficient conductivity than bipedal species with two feet. One example is bovine heightened sensitivity to increased ground current near high tension lines [93, 94] and cell towers [95–97]. Also, bodies that are predominately parallel to the ground, which includes most four-legged mammals, rather than a perpendicular upright gait, conduct EMF in different ways than vertical species like humans, apes, and other primates. Species that hug the ground, like snakes, salamanders, and frogs, have unique exposures to ground currents, especially on rainy nights when water, as a conductive medium, can increase exposures [98]. This may make some species more sensitive to artificial ground current caused by electric utility companies using the Earth as their neutral return back to the substation for excess

alternating current on their lines instead of running additional neutral lines on utility poles [99].

Hair and whiskers and related appendages in various species are known to detect small variations in electromagnetic fields as well as water and weather alterations [100]. In fact, ants have been observed to use their antennae as "EMF antennas" when subjected by researchers to external electromagnetic fields, aligning themselves to "channel" RFR away from the colony [7]. Species such as birds, as well as some insects with compound eyes structures, can see vastly more colors than humans, while cats, dogs, and owls, for instance, hear many more sound frequencies at incredibly low levels.

Magnetoreception mechanisms: electroreceptor cells, magnetite, cryptochromes/radical pairs

According to Lai [77], "...in order for an environmental entity to affect the functions of an organism, the following criteria have to be met: the organism should be able to detect the entity; the level of the entity should be similar to those in the normal ambient environment which is generally much lower than the level of the entity used in experimental studies; and the organism must have response mechanisms tuned to certain parameters of the entity that allow immediate detection of the presence and changes of the entity. Thus, a variation of the entity would be detected as an aberrant input and trigger a response reaction. In order to understand how man-made EMF affects wildlife, the above criteria must be considered, including multiple sensory mechanisms that vary from species to species."

The questions are: How do diverse species detect weak natural geomagnetic signals, distinguish the subtle internal microcurrent and magnetic fields inherent to all biology from external fields, then get beyond both internal and external background noise to make use of that electromagnetic information?

There are three primary mechanisms used to understand magnetoreception:

- (1) Magnetic induction of weak electrical signals in specialized sensory receptors [101].
- (2) Magnetomechanical interactions with localized deposits of single-domain magnetite crystals [52, 102, 103].
- (3) Radical-pair photoreceptors, which may be the most plausible [104–111].

In the induction model (mechanism 1), according to Lin [102], the first category of electrodynamic interactions with weak magnetic fields is epitomized by elasmobranchs, including sharks, rays, and skates, with heads that contain long jelly-filled canals with high electrical conductivity known as the Ampullae of Lorenzini. As these fish swim through the Earth's geomagnetic lines of flux, small voltage gradients are induced in these canals with electric field detections as low as $0.5 \mu\text{V/m}$ [101]. The polarity of the induced field in relation to the geomagnetic field provides directional cues for the fish. However, in birds, insects, and land-based animals, such cells have not been found, indicating this may not be a universal mechanism but rather are environment/species-specific factors [111].

The magnetomechanical model (mechanism 2) involves the naturally occurring iron-based crystalline mineral called magnetite found in most species [52]. Its function is most simply demonstrated in magnetotactic bacteria [63] with high iron content where biogenic magnetite is manufactured in 20–30 single domain crystal chains [112]. Orientation is patterned according to the geomagnetic field. Blakemore et al. [113] found that magnetotactic bacteria in the northern hemisphere migrate toward the north pole of the geomagnetic field whereas the same strains migrate toward the South Pole in the southern hemisphere. At the equator, they are nearly equally divided in north- and- south seeking orientations [114]. And they all migrate downward in response to the geomagnetic field's vertical component, which, in aqueous environments may be essential for their survival in bottom sediments.

Among the many species where magnetite has been found include the cranium and neck muscles of pigeons [115, 116]; denticles of mollusks [117, 118]; and the abdominal area of bees [119]. Tenforde [103] delineated other species with localized magnetite, including dolphins, tuna, salmon, butterflies, turtles, mice, and humans.

The third mechanistic model (mechanism 3) getting research attention today involves a complex free-radical-pair reaction and conversion of the forms of electrons (singlet-triplet inter-conversion) in a group of protein compounds known as cryptochromes. Cryptochromes have been found in the retinas of nocturnal migratory songbirds by Heyers et al. [55] and Moller et al. [56], showing complex communication with the brain for orientation when relying on magnetoreception. Gegear et al. [61] found cryptochromes to be a critical magnetoreception component in fruit flies (*Drosophila melanogaster*). As noted in Lai [77], cryptochromes are also present in the retinas of some animals [120]. RFR [121] and oscillating magnetic fields [122] have been reported to disrupt the migratory compass orientation in migratory

birds. There are also reports that indicate the presence of cryptochromes in plants, which may be responsible for the effect of EMF on plant growth [123]. Cryptochromes are also known to be involved with circadian rhythms [56, 124]. For an excellent review on plausibility, theories, and complexities of cryptochrome/radical pairs, see Ritz et al. [111].

Many species likely use a combination of these mechanisms as well as more subtle influences as yet undetected. The vector of the geomagnetic field may provide the directional information, while intensity and/or inclination provide the positional information needed for orientation. In behavioral studies [125, 126], Wiltschko et al. found that birds used both magnetite and cryptochrome mechanisms when they responded to a short, strong magnetic pulse capable of changing magnetization of magnetite particles, while their orientation was light-dependent and easily disrupted by high-frequency magnetic fields in the MHz range indicating radical pair processes. These findings suggest that along with electrophysiological and histological studies, birds have a radical pair mechanism located in the right eye that provides compass-like directional information while magnetite in the upper beak senses magnetic intensity, thus providing positional information. However, Pakhomov et al. [122] pointed out that the songbird magnetic compass can be disrupted by an oscillating 1.403-MHz magnetic field of 2–3 nT, at a level that cannot be explained by the radical-pair mechanism.

Light plays a significant role [127], which is of environmental concern today as more technology moves toward using the infrared bands for communications and the increase of satellites create artificial/unfamiliar star-like lights in the night sky that are potentially capable of impacting night migration patterns. There is other evidence that species use a combination of photoreceptors and magnetite-based magnetoreception. As mentioned above, in birds the two mechanisms exist side by side, mediating different types of magnetic information as needed, such as flight on sunny vs. cloudy days or nocturnal flights, and they can be easily disrupted [106, 128–130]. Birds may co-process visual information with magnetic information and be able to distinguish between the two [131, 132]. This function likely occurs in the eye or higher avian brain areas via light-dependent information processing and radical pair cryptochromes [131, 133]. Birds' magnetic compass is an inclination compass and RFR fields in the Larmor frequencies near 1.33 MHz were found to disrupt birds' orientation in an extremely sensitive resonance relationship. Blue-light absorbing photopigment cryptochromes have been found in the retinas of birds. RFR appears to directly interfere with the primary

processes of magnetoreception and disable the avian compass as long as the exposure is present [126, 128].

Mammals have also demonstrated magnetoreception indicating radical-pair mechanisms. Malkemper et al. [134] found that the surface-dwelling wood mouse (*Apodemus sylvaticus*) built nests in the northern and southern sectors of a visually symmetrical, circular arena, using the ambient magnetic field, or in a field rotated by 90°, indicating the animals used magnetic cues. When the mice were also tested in the ambient magnetic field with a superimposed radio frequency magnetic field (100 nT, 0.9 to 5 MHz frequency sweep), they changed preference from north-south to east-west nest building. But unlike birds that have been found sensitive to a constant Larmor frequency exposure at 1.33 MHz, that range had no effect on mice orientation. Individual animal physiology clearly plays a role in how various species respond. Malewski et al. [135] also found that the Earth's magnetic field acts as a common directional indicator in five species of subterranean digging rodents. And for the first time, research also found that human brain waves exhibit a strong response to ecologically-relevant rotations of Earth-strength magnetic fields [136].

We need far better understanding of magnetoreception's neural, cellular, and molecular processes because the ultimate question is, given our constant rising background levels of EMF, is this ambient noise reaching a tipping point beyond which species simply cannot “hear?” Are we artificially overwhelming living species' ability to function with innate natural biological sensors that evolved over eons in a far more “electro-silent” world? The electroreception mechanisms described above — electroreceptors, magnetite, and cryptochrome/radical-pairs — enable living organisms to detect the presence and immediate changes in environmental fields of very low intensity. And thus they can be easily disturbed by the presence of unfamiliar low-intensity man-made fields.

Electrohypersensitivity in humans has also shown instantaneous response to EMF at low intensity [137]. According to Lai [77], one wonders whether the underlying mechanisms of electrohypersensitivity are similar to those described above. Electrohypersensitivity may be a remnant of the evolutionary responses of living organisms to electromagnetic fields — particularly magnetic fields — in the environment. Similarities include responsiveness to very low-field intensity; the response is persistent and built into the physiology of an organism; and the response is immediate and reacts quickly to the fields. Cryptochrome-free radical mechanisms may be involved. Some people are more sensitive than others. Perhaps non-sensitive people can tolerate and compensate for effects, and/or have lost responsiveness to natural magnetic fields and thus have

become evolutionarily aberrant. Electrosensitivity is an issue in need of more careful and systematic study and has yet to be broadly highlighted as a health or public welfare concern.

One recent theory by Johnsen et al. [138] postulates that magnetoreception in animal species may be “noisy” — meaning that the magnetic signal is small compared to thermal and other receptor noise, for instance. They speculate that magnetoreception may serve as a redundant “as-needed” source of information, otherwise animal species would use it as their primary source of information. Many species, they note, preferentially exploit non-magnetic cues first if they are available despite the fact that the Earth's geomagnetic field is pervasive and ever-present. They speculate that magnetic receptors may thus be unable to instantaneously attain highly precise magnetic information, and therefore more extensive time-averaging and/or other higher-order neural processing of magnetic information is required. This may render “...the magnetic sense inefficient relative to alternative cues that can be detected faster and with less effort.” Magnetoreception may have been maintained, however, they said by natural selection because the geomagnetic field may sometimes be the only available source of directional and/or positional information.

We already know that some species use various mechanisms to detect EMFs as noted throughout this paper. With new environmental factors from anthropogenic causes, such as artificial light-at-night, air/water pollution, climate change impacting visibility as environmental cues, and rising background RFR — all of which can obscure natural information — magnetoreception may, in fact, become *more* necessary as an evolutionary survival tool as time goes on, not less.

Other mechanisms of biological significance: DNA — direct and indirect effects

(See Part 2, Supplements 1 and 2, for tables of ELF and RFR genetics studies)

A significant biological effect in any toxicology research involves the basic genetics of an exposed organism. Genetic effects consist mainly of gene expression, chromatin conformational changes, and genotoxicity. All such effects can influence normal physiological functions. Relevant to this paper is the fact that genetic effects are found at EMF levels similar to those in ambient environments, far below

levels from communication devices and infrastructure (see Part 1, Supplement 1).

DNA, the fundamental building block of all life, is a molecular double helix that is coiled, twisted and folded within the nucleus of each living cell. It is essentially identical among species with variations only in number and specific genes along chromosomes on DNA's twisted chains that distinguish various species and their characteristics from one another. DNA damage repeatedly seen in one species can therefore be extrapolated to other species, although not all species react the same to external stimuli.

Many factors, both endogenous and exogenous, damage DNA which is then normally repaired by DNA enzymes. But an absence of adequate repair can result in the accumulation of damaged DNA, which will eventually lead to aging, cell death (apoptosis) and/or cancer. DNA breaks occur as both single and double strand events; double strand breaks are difficult to repair correctly and can lead to mutations. DNA damage from endogenous factors can include free radical formation from mitochondrial respiration and metabolism; exogenous factors include chemicals, ionizing and nonionizing radiation, and ultra violet light among others [139]

In several early studies, Lai and Singh [140, 141] found both double and single strand DNA breaks in the brain cells of rats exposed to RFR for 2 h at 2,450 MHz, and whole body SAR levels of 0.6 and 1.2 W/kg. The effects were interestingly blocked by antioxidants [142] suggesting free radical involvement, which could indicate an indirect cause for DNA damage (see below). The low-intensity genetic effects listed in Part 2 Supplements 1 and 2 are at 0.1 W/kg and less. Therefore, the Lai and Singh [140, 141] RFR studies are not included in those Supplements. Very similar effects have also been found by Lai and Singh [143, 144] with 60-Hz magnetic field exposure.

There has also been much study of ELF genetic effects. As discussed in Phillips et al. [139], numerous studies found that ELF-EMF leads to DNA damage [143–158]. Two studies [159, 160] showed that ELF also affects DNA repair mechanisms. Sarimov et al. [161] found chromatin conformational changes in human lymphocytes exposed to a 50-Hz magnetic field at 5–20 μ T. EMF-induced changes in cellular free radicals are also well studied [77, 162].

Others investigated DNA damage early on but without the availability of today's more sensitive assays. Sarkar et al. [163] exposed mice to 2,450-MHz microwaves at a power density of 1 mW/cm² for 2 h/day over 120, 150, and 200 days. They found DNA rearrangement in the testis and brain of exposed animals that suggested DNA strand breakage. Phillips et al. [164] were the first to use the comet assay to study two different forms of cell phone signals —

multi-frequency time division multiple access (TDMA) and integrated digital enhanced network (iDEN) — on DNA damage in Molt-4 human lymphoblastoid cells using relatively low intensities of 2.4–26 W/g for 2–21 h. The authors reported seeming conflicting increases and decreases in DNA damage, depending on the type of signal studied, as well as the intensity and duration of exposure. They speculated the fields could affect DNA repair mechanisms in cells, accounting for the conflicting results.

In a recent literature review of EMF genetic effects by Lai [165], analysis found more research papers reporting effects than no effects. For RFR, 224 studies (65%) showed genetic effects while 122 publications (35%) found no effects. For ELF and static-EMF studies, 160 studies (77%) found effects while in 43 studies (23%) no effects were seen.

Research now points to the duration, signaling characteristics, and type of exposure as the determining factors in potential damage [164, 166], not the traditional demarcation between ionizing and nonionizing radiation. Long-term, low-level nonionizing radiation exposures common today are thought to be as detrimental to living cells as are short-term, high-intensity exposures from ionizing radiation. Effects may just take longer to manifest [167]. Nonionizing EMF at environmental levels does cause genetic damage. These have also been shown in humans exposed to environmental levels of EMF in both ELF and RFR ranges [168–171]. Conceivably, similar genetic effects could happen in other species living in similar environments.

This body of genetics work goes against the pervasive myth that low-level, low-intensity nonionizing radiation cannot cause detrimental genetic effects. That premise is in fact the bedrock belief upon which vested interests and government agencies rely in support of current exposure standards. But in fact, biological systems are far more complex than physics models can ever predict [6, 8, 172]. A new biological model is needed because today's exposures no longer fit that framework [173] for humans and wildlife. Enough research now indicates a reassessment is needed, perhaps including the very physics model used to back those traditional approaches (see Part 1).

Direct mechanisms: DNA as fractal antennas, cell membranes, ion channels

DNA as fractal antennas

There are several likely mechanisms for DNA damage from nonionizing radiation far below heating thresholds, both

direct and indirect, intracellular, intercellular, and extracellular. Such mechanisms potentially apply to all wildlife. One direct mechanism theorizes that DNA itself acts as a fractal antenna for EMF/RFR [174], capable of receiving information from exogenous exposures.

According to Blank and Goodman [174], DNA has interesting electrical characteristics due to its unique structure of intertwined strands connected by rungs of molecules called nucleotides (also called bases), with each rung composed of two nucleotides (one from each strand) in bonded pairs. The nucleotides are held together by hydrogen bonds in close proximity that results in a strong attraction between the two strands. There are electrons on both molecular surfaces making the symmetrical nucleotides capable of conducting electron current along the entire DNA chain, a phenomenon called electron transfer. This makes DNA a most efficient electrical conductor, something not lost on nanotechnology researchers.

DNA may also act as an efficient fractal antenna due to its tightly packed shape within the cell nucleus. Blank and Goodman [174] characterized DNA properties in different frequency ranges, and considered electronic conduction within DNA's compact construction in the nucleus. They concluded that the wide frequency range of observed interactions seen with EMF is the functional characteristic of a fractal antenna, and that DNA itself possesses the two structural characteristics of fractal antennas — electronic conduction and self symmetry. They noted that these properties contribute to greater reactivity of DNA with EMF in the environment, and that direct DNA damage could account for cancer increases, as well as the many other biological effects seen with EMF exposures.

A fractal is a self-repetitive pattern of sometimes geometric shapes, marked by a larger originating design progressing to small identical designs with a potentially unlimited periphery. Each part of the shape looks like the whole shape. Fractal designs are quite common in nature, e.g., in snail/mollusk shells, some deciduous tree leaves and conifer needles, pine cones, many flowering plants, some reptile scales, bird feathers and animal fur patterns, snowflakes, and crystals forming on cold winter glass windows. Minerals — both inert and biological — can also be fractals.

The varying sizes within fractals are what make them inherently multi-frequency. By mimicking nature, repetitive fractal patterns are also designed into mechanical transceiver antennas that radiate in multiband frequencies with more or less efficiency [175]. Cell phones, WiFi, digital TV, and many other transceivers use fractal antennas to operate.

The complex twisted shape and coiled structure of DNA — small coils coiled into larger coils, or *coiled coils*,

which Blank and Goodman [174] note that no matter how far you zoom in or out, the shape looks the same — is the exact structure of a fractal that maximizes the length of an antenna within a compact space while boosting multi-frequency signals. As such, DNA may be acting as a hidden intracellular biological fractal capable of interacting with exogenous EMF across a range of frequencies. In fact, one of DNA's fundamental functions may be specifically to interact with exogenous natural energy and as such may be more sensitive to EMF than other larger protein molecules within any living system. Once thought safely tucked away and protected within the nucleus, DNA may be acting as a most efficient electrical conductor at the nexus of all life. This interesting theory, unfortunately, has not been followed up by others to test its biological validity although fractals have been mimicked widely in technology.

Cell membranes/ion channels

Another direct effect from EMF is at the cell membrane itself. While DNA is life's fundamental building block, cells are DNA's complex electron-coherent architectural expression. The cell's membrane is far more than just a boundary. It is rather the most important ordering tool in the biological space between intracellular and extracellular activities, "... a window through which a unitary biological element can sense its chemical and electrical environment" [176]. And it is replete with microcurrent.

The cell's outer surface contains molecules that receive innumerable electrochemical signals from extracellular activities. Specific binding portals on the cell membrane set in motion a sequence leading to phosphorylation of specific enzymes that activate proteins for cellular 'work.' That includes everything from information processing in the central nervous system, mechanical functions such as muscle movements, nutrient metabolism, and the defense work of the immune system, among many others including the production of enzymes, hormones, antibodies, and neurotransmitters [177]. Complex microcurrent signaling pathways exist from the cell's outside to the inside via protein intramembraneous particles in the phospholipid plasma membrane. These convey information on external stimuli to the cell's interior to allow cellular function.

The cell membrane also has electrical properties. Microcurrent constantly moves from the interior to the exterior and vice versa of the cell membrane. According to Adey and Sheppard [176], some of these properties influence proteins that form voltage gated membrane channels, which is one way that cells control ion flow and membrane electromagnetic potential essential to life. There are

specific windows that react according to frequency, amplitude, and duration differences, indicating a nonlinear and non-equilibrium character to exogenous exposures on cells [177–185].

Some pulsed fields are more biologically active than non-pulsed fields and different forms of pulsing also create different effects. As far back as 1983, Goodman et al. [186] found pulsed weak electromagnetic fields modified biological processes via DNA transcription when a repetitive single pulse and the repetitive pulse train were used. The single pulse increased the specific activity of messenger RNA after 15 and 45 min while the pulse train increased specific activity only after 45 min of exposure. Digital technology simulates pulsing and is the most common form of environmental exposure today.

Cellular calcium ion channels have long been of interest and may be particularly sensitive targets for EMFs due to possible increased calcium flux through the channels which can lead to secondary responses mediated through Ca^{2+} /calmodulin stimulation of nitric oxide synthesis, calcium signaling, elevated nitric oxide (NO), NO signaling, peroxynitrite, free radical formation, and oxidative stress — many with implications to DNA as hypothesized by Pall [187]. Calcium is essential to signal transduction between cells and is significant to everything from metabolism, bone/cell/blood regeneration, hormone production and neurotransmissions among many others. These cellular calcium responses to EMF indicate an artificial change in the signaling processes at the cell membrane — considered a switchboard for information between the exterior environment and intracellular activities that guide cell differentiation and control growth [188].

Pall [187] cited 23 studies of effects to voltage gated calcium channels (VGCC) and noted nonthermal mechanisms were the most likely since many studies showed effects were blocked by calcium channel blockers (widely prescribed for heart irregularities having nothing to do with thermal issues). Pall [189] noted that many other studies showed EMF changes in calcium fluxes and intracellular calcium signaling. He hypothesized that alterations in intracellular calcium activity may explain some of the myriad biological effects seen with EMF exposure, including oxidative stress, DNA breaks, some cancers, infertility, hormonal alterations, cardiac irregularities, and diverse neuropsychiatric effects. These end points need further study and verification.

There is much to be learned about calcium effects as studies are contradictory. Changes in free radicals (see below) also affect calcium metabolism. There are more studies showing EMF effects on free radicals than calcium changes. Calcium activates the nitric oxide free radical

pathway but there are only a few studies of this pathway following EMF exposure — less than 5% of EMF-oxidative change studies are on nitric oxide mechanisms. Also of interest is the fact that power density and frequency windows were seen in early research at rising harmonic increments along the electromagnetic spectrum beginning in the ELF bands [190–195]. Observed effects were quite dramatic in what researchers described as calcium efflux or ‘dumping’ from cells. The most dramatic effects were seen at 180 Hz in the ELF range. This appears to contradict Pall’s work [189] cited above as increased calcium efflux is the opposite of what Pall’s hypothesis would predict, e.g., calcium *influx*. With more research both calcium influx and efflux effects may be found to be caused by different variables and/or EMF exposures.

In addition, exogenous signaling characteristics are also important to how cells react to both ELF and RFR ranges. Building on the work that demonstrated carrier waves of 50 and 147 MHz, when sinusoidally amplitude modulated at 16 Hz ELF in *in vitro* chick brain tissue [190, 191] and in live awake cat brain models [196] that created frequency windows for calcium efflux, Blackman et al. [194] additionally found that signaling *characteristics* were also significant. Research showed that calcium efflux occurred only when tissue samples are exposed to specific intensity ranges of an ELF-modulated carrier wave; unmodulated carrier waves did not affect ion efflux. Blackman et al. [194] further wrote that cells may be capable of demodulating signals. The authors reported that 16-Hz sinusoidal fields, in the absence of a carrier wave, altered the efflux rate of calcium ions and showed a frequency-dependent, field-induced enhancement of calcium-ion efflux within the ranges 5–7.5 V/m and 35–50 V/m (peak-to-peak incident field in air) with no enhancement within the ranges 1–2, 10–30, and 60–70 V/m. This body of work indicates that living cells interact with, and are capable of taking direction from, exogenous fields in far more complex ways than ever imagined, at intensities barely above background levels. This work may be particularly important to new technology that turns previously wired ELF frequencies into wireless applications, such as “wireless electricity” to charge electric cars.

Blackman et al. [197] found for the first time a link between the ELF/EMF being studied and the density of the natural local geomagnetic field (LGF) in the production of a biological response. Calcium efflux changes could be manipulated by controlling the LGF along with ELF and RF-EMF exposures. In a local geomagnetic field at a density of 38 μT , 15- and 45-Hz electromagnetic signals had been shown to induce calcium ion efflux from the exposed tissues, whereas 1- and 30-Hz signals did not. Bawin and

Adey [190] found a reduction in efflux when using an electric field; Blackman et al. [194] found an increase when using an electromagnetic field, thus identifying/isolating for the first time the significance of the magnetic field component in exposure parameters. Building on the window ranges noted above, Blackman et al. [197] demonstrated that the enhanced calcium efflux field-induced 15-Hz signal could be rendered ineffective when the LGF is reduced to 19 μT with Helmholtz coils. In addition, the ineffective 30-Hz signal became effective when the LGF was altered to $k25.3 \mu\text{T}$ or to $+76 \mu\text{T}$. *The results demonstrated that the net intensity of the local geomagnetic field is an important cofactor in biological response and a potentially hidden variable in research.* The results, they noted, appear to describe a resonance-like relationship in which the frequency of the electromagnetic field can induce a change in calcium efflux proportional to LGF density (see Liboff [198, 199] below for more detail).

The bottom line is that changes of this magnitude at the cellular level — be it directly to DNA within the nucleus or via voltage gated channels at the cell's membrane — can lead to direct effects on DNA within and across species. The evidence cited above illustrates the degree, likelihood, and variety of impacts from EMF directly on cellular physiology that are capable of affecting DNA in all living systems in myriad ways.

Indirect mechanisms: free radicals, stress proteins, resonance, Earth's geomagnetic fields

Free radicals

An indirect, or secondary, mechanism for DNA damage would be through free radical formation within cells, which is the most consistently reported with both ELF and RFR exposures under many different conditions in biological systems. According to Phillips et al. [139], free radicals may also interact with metals like iron [142, 151, 152, 158] and play a role in genotoxic effects from something called the Fenton effect — a process “...catalyzed by iron in which hydrogen peroxide, a product of oxidative respiration in the mitochondria, is converted into hydroxyl free radicals, which are very potent and cytotoxic molecules” [139].

The significance of free radical processes may eventually answer some questions regarding how EMF interacts with biological systems. There are about 200–300 papers showing EMF effects on free radicals [77, 168, 200]. Free

radicals are important compounds involved in numerous biological functions that affect many species. Increases in free radicals explain effects from damage to macromolecules such as DNA, protein, and membrane lipids; increased heat shock proteins; neurodegenerative diseases; and many more.

Yakymenko et al. [168] published a review on oxidative stress from low-level RFR and found induced molecular effects in living cells, including significant activation of key pathways generating reactive oxygen species (ROS), activation of peroxidation, oxidative damage in DNA, and changes in the activity of antioxidant enzymes. In 100 peer-reviewed studies, 93 confirmed that RFR induced oxidative effects in biological systems and that their involvement in cell signaling pathways could explain a high pathogenic range of biological/health effects. They concluded that low-intensity RFR should be recognized as one of the primary mechanisms of biological activity of nonionizing radiation. In a follow-up study, Yakymenko et al. [200] investigated the oxidative and mutagenic effects of low intensity GSM 1,800 MHz RFR on developing quail embryos exposed *in ovo* ($0.32 \mu\text{W}/\text{cm}^2$, 48 s On, 12 s Off) during 5 days before and 14 days through the incubation period. They found statistically significant oxidative effects in embryonic cells that included a 2-fold increase in superoxide generation rate, an 85% increase in nitrogen oxide generation, and oxidative damage to DNA up to twice the increased levels of 8-oxo-dG in cells of 1-day old chicks. RFR exposure almost doubled embryo mortality and was statistically significant. They concluded that such exposures should be recognized as a risk factor for living cells, including embryonic integrity.

Lai [77] focused a review on static magnetic field ELF-EMF and found that changes in free radical activities are one of the most consistent effects. Such changes can affect numerous physiological functions including DNA damage, immune system and inflammatory response, cell proliferation and differentiation, wound healing, neural electrical activities, and behavior. Given that many species have proven sensitive to natural static geomagnetic fields and use such information in critical survival skills, some wildlife species may also be adversely affected via free radical alterations from anthropogenic exposures. But Lai [77] noted the inherent contradictions from EMF-induced changes in free radicals, particularly on cell proliferation and differentiation since those processes can affect cancer development as well as growth and development. Induced free-radical changes may therefore have therapeutic applications in killing cancer cells via the generation of the highly cytotoxic hydroxyl free radical by the Fenton Reaction (noted above), thereby creating a non-invasive low-side-effect cancer therapy.

Stress proteins

Another potentially indirect effect to DNA is via protein synthesis required by all cells to function. A living animal converts animal and plant proteins that it ingests into other proteins needed for life's activities — antibodies, for instance, are a self-manufactured protein. DNA is critical to protein synthesis and can create in humans about 25,000 different kinds of proteins with which the body can then create 2,000,000 types in order to fully function.

There are many different classes of proteins. These include stress proteins stimulated by potentially harmful environmental factors to help cells cope and repair damage due to factors like acute temperatures, changes in oxygen levels, chemicals/heavy metals exposure, viral/bacterial infections, ultraviolet light and other ionizing and nonionizing radiation exposures [124].

The presence of stress proteins indicates healthy repair action by an organism and is considered beneficial up to a point as a protective mechanism. According to Blank and Goodman [201], “The 20 different stress protein families are evolutionarily conserved and act as ‘chaperones’ in the cell when they ‘help’ repair and refold damaged proteins and transport them across cell membranes. Induction of the stress response involves activation of DNA.” Stress proteins are also considered a yardstick to determine what living cells experience as stress that requires remediation in the first place — something not always obvious, especially with subtle environmental exposures like low-level EMF barely above natural background levels.

Whether an effect is thermal or nonthermal, adverse or simply observed biologically, has been subject to fierce debate for decades; thus tissue-heating DNA pathways are also central to this paper. Heat as a cellular stressor was first observed in the 1960s by Italian researcher Ferruccio Ritossa in fruit flies (*D. melanogaster*) when experimental temperatures were accidentally raised by a few degrees and he observed enlarged chromosomes at particular sites. (*Drosophila*e are often used in research because they only have four pairs of chromosomes, are relatively easy to work with, have a fast breeding cycle, and lay numerous eggs.) As cited in Blank [124], as Ritossa's observation became better understood, with effects subsequently seen over decades in animals, plants and yeast cells, it came to be called the “heat shock response.” Extensive research established that the heat shock response lead to the formation of a unique protein class — heat shock proteins (HSP) that repair other proteins from potentially fatal temperature damage, as well as assist cells to be more thermo-tolerant. Research has gone on to prove that cells

produce other similar proteins to various stressors, now generally called stress proteins but most are still categorized as “HSP” from the original demarcation.

Goodman and Blank [202, 203] found that EMF is a cellular stressor even at low intensities in the absence of elevated temperatures. They found the protein distribution patterns synthesized in response to ELF-EMF resembled those of heat shock with the same sequence of changes even though the energy of the two stimuli differed by many orders of magnitude. Their results indicated that ELF-EMF stimulates a similar gene expression pathway as that of thermal shock and is itself a cellular stressor. Of particular significance is the fact that over-expression of stress genes is found in a number of human tumors and is characteristic of a variety of neoplasia [202]. Increased stress proteins are seen in numerous animal model studies pertinent to wildlife.

Blank and Goodman [201] further noted that both ELF and RFR activate the cellular stress response despite the large energy difference between them; that the same cellular pathways respond in both frequency ranges; and that models suggest that EMF can interact directly with electrons in DNA. They note that low energy EMF interacts with DNA to induce the stress response while the increased energy in RFR can lead to DNA strand breaks. *As such, this makes the stress response a frequency-dependent direct and indirect cause of DNA damage — a significant finding.* They concluded that exposure standards should not be based on exposure intensity alone but on biological responses long before thermal thresholds are met or crossed.

Resonance and geomagnetic fields

There are other important direct and indirect ways that EMFs interact with and effect biological systems, including various forms of resonance — cyclotron, electron paramagnetic, nuclear, and stochastic — as well as through inherently produced biological materials such as magnetite found in bird brains and many other species (see below).

Resonance is the phenomenon that occurs when a certain aspect of a force (like a frequency wave) matches a physical characteristic (like a cell or whole living organism) and the power inherent in the force is transferred to the physical object causing it to resonate or vibrate. Within the object, the resonance is self-perpetuating. The classic example is of an opera singer hitting high C in the presence of a crystal goblet for a sustained period until it shatters.

Following the work of Blackman et al. [197] who found the Earth's local geomagnetic fields (LGF) could influence calcium ions moving through membrane channels (see

above), Liboff [198, 199] proposed that cyclotron resonance was a plausible mechanism for coupling interactions between the LGM and living cells. Liboff found cyclotron resonance consistent with other indications that showed many membrane channels have helical configurations; that the model could apply to other circulating charged components within the cell; and that cyclotron resonance could lead to direct resonant electromagnetic energy transfer to selected cell compartments.

All resonance is based on a *relationship*. Cyclotron resonance is based on the relationship between a constant magnetic field and an oscillating (time-varying) electric or magnetic field that can affect the motion of charged particles such as ions, some molecules, electrons, atomic nuclei, or DNA in living tissue. Living systems are filled with charged particles necessary for life, including calcium, sodium, lithium, and potassium ions that all pass through the cell membrane and are capable of affecting DNA. Cyclotron resonance occurs when an ion is exposed to a steady magnetic field (such as the Earth's) which causes the ion to move in a circular orbit at a right angle to the field. The speed of the orbit is determined by the charge and mass of the ion and the strength of the magnetic field. If an electric field is added that oscillates at exactly the same frequency and that is also at a right angle to the magnetic field, energy will be transferred from the electric field to the ion causing it to move faster. The same effect can be created by applying an additional magnetic field parallel to the constant magnetic field. This is important because it provides a plausible mechanism for how living cells interact with both natural and artificial fields, and explains how vanishingly low levels of EMFs can create major biological activity when concentrated on ion particles. It also points to living systems' ability to demodulate — or take direction from — certain aspects of electromagnetic information from both natural and artificial exposures [7]. Resonance should not be underestimated. It applies to all frequencies and is not based on power density alone.

Another subtle energy relationship in biology is called stochastic resonance that has been determined to be significant in how various species interact with their natural environments, in some instances for their survival. Stochastic resonance is a phenomenon where a signal below normal sensing can be boosted by adding wide-spectrum white noise signals. The frequencies in the white noise that match the original signal's frequencies will resonate with each other and amplify the original signal while not amplifying the rest of the white noise. This increase in what is called the signal-to-noise ratio makes the original signal more prominent. Some fish, for instance, can “hear” predators better in the noise of running water than in still water due to stochastic resonance (see “Fish” below.).

The signal-to-noise ratio has been a prominent aspect of EMF research with some scientists long holding that energy exposures below the body's natural signal-to-noise ratio could not possibly damage living tissue. But the most recent research that finds effects to DNA from low intensity EMF indicates that many variables affect biological processes, often in nonlinear patterns far below the signal-to-noise ratio. Some of the most cutting edge research — with an eye toward treating human *in utero* birth defects and adult limb regeneration — is being done by manipulating the electric charge across cell membranes (called membrane potential) via intentional manipulation of genes that form ion channels. Pai et al. [204] found that by putting ion channels into cells to raise the voltage up or down, they could control the size and location of the brain in embryonic African clawed frogs (*Xenopus laevis*), thus demonstrating the importance of microcurrents on membrane potential in growth and development. The research group also studied endogenous bioelectricity on clawed frog brain patterning during embryogenesis, noting that early frog embryos exhibit a characteristic hyperpolarization of cells lining the neural tube. Disruption of this spatial gradient of the transmembrane potential (V_{mem}) diminished or eliminated the expression of early brain markers in frogs, causing anatomical mispatterning, including absent or malformed regions of the brain. This effect was mediated by voltage-gated calcium signaling and gap-junctional communication. The authors hypothesized that voltage modulation is a tractable strategy for intervention in certain classes of birth defects in humans but they did not make the leap to potential environmental damage to other species from such ambient exposures.

In general, whether direct, indirect, or synergistic, to understand ambient effects to wildlife, one also needs to know if effects are cumulative, what compensatory mechanisms a species may have, and when or if homeostasis will deteriorate to the point of no return [205]. In looking at environmental contaminants, we have historically focused on chemicals for both direct and indirect effects such as endocrine disruption. But primary biological manifestation is more physical than chemical since the only thing that distinguishes one chemical from another on the Periodic Table is the amount of electrons being traded up and down on the scale. Chemicals are actually secondary manifestations of initial atomic principles, not the other way around. Plus, the synergistic effects of the Earth's natural fields can no longer be dismissed as an interesting artifact that is not biologically active or relevant. All living systems are first and foremost expressions of biological energy in various states of relationship.

For a Table of more low-level effects studies on DNA, see Part 2, Supplements 1 and 2.

What the studies show

The literature is voluminous on EMF effects to nonhuman species, going back at least to the 1930s using modern methods of inquiry. We have, after all, been using animal, plant, and microbial models in experiments for decades. We may in fact know *less* about effects to humans than to other species.

In this paper, we focused on exposures common in today's environment. In Part 1, Rising Background Levels, we defined low level RFR as power density of 0.001 mW/cm² (1 μW/cm²), or a SAR of 0.001 W/kg. Part 2 Supplements 3 and 4 contain extensive tables with pertinent studies that apply to fauna and flora, respectively. The sections that follow in Part 2 on individual species include selected studies of particular interest to how EMF couples with, and potentially affects, wildlife. In most studies, as illustrated in Part 2, Supplement 3, the intensity of the incident EMF was provided in μW/cm² or V/m. To be consistent throughout the paper, we converted intensity in the studies to μW/cm². However, such conversion (i.e. V/m to μW/cm²) tends to overestimate the exposure level and does not represent the full picture. Therefore where studies provided the amount of energy absorbed, e.g., the specific absorption rate (SAR), they were also included in Supplement 3 (in W/kg). Very low levels of energy absorption have shown effects in all living organisms studied.

Levitt and Lai [167] reported numerous biological effects from RFR at very low intensities and SARs comparable to far-field exposures within 197–492 ft (60–150 m) from cell towers. Included were *in vivo* and *in vitro* low-intensity RFR studies. Effects included genetic, growth and reproductive changes; increased permeability of the blood brain barrier; changes in stress proteins; behavioral responses; and molecular, cellular, genetic, and metabolic alterations. All are applicable to migratory birds, mammals, reptiles, and other wildlife and to plant communities, and to far-field exposures in general. (An update of that table appears in Part 2 Supplement 3.) It is apparent that environmental levels of RFR can elicit biological/health effects in living organisms. Although there are not enough data on low-intensity effects of static ELF-EMF to formulate a separate table, some effects of low-intensity static ELF-EMF are also described throughout this paper. ELF genotoxic effects can be found in Part 2, Supplement 2 and ELF in flora are also listed separately in Part 2, Supplement 4.

Effects, however, do not easily translate from the laboratory to the field. Cucurachi et al. [31] reported on 113

studies with a limited number of ecological studies. The majority were conducted in laboratory settings using bird embryos or eggs, small rodents, and plants. In 65% of the studies, effects from EMF (50% of the animal studies and about 75% of the plant studies) were found at both high and low intensities, indicating broad potential effects. But lack of standardization among the studies and limited sampling size made generalizing results from organism to ecosystem difficult. The researchers concluded that due to the number of variables, no clear dose–response relationship could be determined. Nevertheless, effects from some studies were well documented and can serve as predictors for effects to wild migratory birds and other wildlife.

As noted elsewhere throughout this paper, living organisms can sense and react to very low-intensity electromagnetic fields necessary for their survival as seen, for instance, in studies by Nicholls and Racey [206, 207] on bats and many others. Bats are already in serious trouble in North America from white-nosed syndrome and commercial wind turbine blade collisions. Due to the increased use of tracking radars for bird and bat studies, impacts will likely only increase [22, 23]. Presence of low levels of RFR from tracking radars could adversely affect bat foraging activity, which in turn could affect the composition of insect populations in the vicinity. Many insects, including honey bees (*Apis mellifera* var) and butterflies also depend on the Earth's electromagnetic fields for orientation and foraging. Presence of exogenous RFR can disturb these functions. This is particularly relevant for pollinator insects, such as bees and butterflies. Pollinators are essential in producing commercial crops for human consumption, including almonds, apples, pears, cherries, numerous berry crops, citrus fruits, melons, tomatoes, sunflowers, soybeans, and much more. The strongest disruptive effect to insect pollinators occurs at 1.2 MHz known as the Larmor frequency [208] which is related to radical pair resonance and superoxide radical formation. This is an important indication that effects from RFR are frequency-dependent.

Lai [77], citing Shepherd et al. [209], noted that EMF can disrupt the directional sense in insects. The fact that many animals are able to differentiate the north and south poles of a magnetic field known as the polarity compass [68, 73, 134, 210, 211] indicates they are susceptible to having that important sense impaired. These polarity compass traits confer survival competitiveness to organisms but are of particular concern since directional cues can be easily disturbed by man-made EMF [69, 134, 212].

Bird migration also depends on proper sensing and orientation to natural electromagnetic fields. A study by Engels et al. [213] showed that magnetic noise at 2 kHz–9 MHz (within the range of AM radio transmission) could

disrupt magnetic compass orientation in migratory European Robins (*Erithacus rubecula*). The disruption can occur at a vanishingly low level of 0.01 V/m, or 0.0000265 $\mu\text{W}/\text{cm}^2$. Similar effects of RFR interference on magnetoreception have also been reported in a night-migratory songbird [214] and the European Robin [126]. Migration is already a taxing and dangerous activity for birds; adding another potential negative impact to bird survival is troubling.

Lai [77] also noted that another consideration is the “natal homing behavior” exhibited in some animals that return to their natal birth places to reproduce. These include sea turtles [89] eels [90]; and salmon [91]. Newborns of these animals are imprinted with the memory of the intensity and the inclination angle of the local geomagnetic field, later used to locate their place of birth when they return to breed. There are indications that man-made EMF can distort this imprinting memory to locate the site (see “Fish” and “Turtles” below). This has important consequences to the survival of particular species since it interrupts their reproductive processes.

It is clear that biological effects can occur at levels of man-made RFR in our present environment, thereby conceivably altering delicate ecosystems from a largely unrecognized danger.

Mammals

The majority of EMF laboratory research, some going back to the 1800s, has been conducted on a variety of mammal species using mice, rats, rabbits, monkeys, pigs, dogs, and others. (The second and third most used models are on insects and yeast respectively.) Thus, with varying degrees of confidence, we know a significant amount about how energy couples with, and affects, laboratory mammalian species across a range of frequencies. However, this evidence does not automatically transfer at the same confidence level regarding how this vast body of research applies to wildlife, including mammalian species.

There is unfortunately a dearth of field research on EMF effects to wildlife. Referenced below, however, are many potential indicator studies. The effects seen include reproductive, behavioral, mating, growth, hormonal, cellular, and others.

Rodents

Rodents are the most frequently used mammalian species in laboratory research across a range of frequencies and intensities. While studies are inconsistent, there are

enough troubling indications regarding potential EMF implications for wildlife.

In the RFR range, there have been several reviews of fertility and other issues in rodent models with citations too numerous to mention here — see La Vignera et al. [215] and Merhi [216] — but some stand out as potentially pertinent to wildlife.

Magras and Xenos [217] investigated effects of RFR on prenatal development in mice, using RFR measurements and *in vivo* experiments at several locations near an “antenna park,” with measured RFR power densities between 0.168 and 1.053 $\mu\text{W}/\text{cm}^2$. Divided into two groups were 12 pairs of mice, placed in locations of different power densities, and mated five times. One hundred eighteen newborns were collected, measured, weighed, and examined macro- and microscopically. With each generation, researchers found a progressive decrease in the number of newborns per dam ending in irreversible infertility. However, the crown-rump length, body weight, and number of lumbar, sacral, and coccygeal vertebrae, was improved in prenatal development of some newborns. RFR was below exposure standards and comparable to far-field exposures that mice could experience in the wild.

Aldad et al. [218], in a laboratory setting, investigated cell phone RFR (800–1,900 MHz, SAR of 1.6 W/kg) exposures in *in-utero* mouse models and effects on neurodevelopment and behavior. They found significant adult behavioral effects in prenatally exposed mice vs. controls. Mice exposed *in-utero* were hyperactive, had decreased memory and anxiety, and altered neuronal developmental programming. Exposed mice had dose-response impaired glutamatergic synaptic transmission onto layer V pyramidal neurons of the prefrontal cortex. This was the first evidence of neuropathology in mice from *in-utero* RFR at cell phone frequencies, now the most prevalent in the environment. Effects persisted into adulthood and were transmissible to next generations. Such changes can affect survival in wild populations.

Meral et al. [219] looked at effects in guinea pigs (*Cavia parcels*) from 900 MHz cell phone frequency exposures on brain tissue and blood malondialdehyde (MDA), glutathione (GSH), retinol (vitamin A), vitamin D(3) and tocopherol (vitamin E) levels, as well as catalase (CAT) enzyme activity. Fourteen male guinea pigs were randomly divided into control and RFR-exposed groups containing seven animals each. Animals were exposed to 890- to 915 MHz RFR (217 Hz pulse rate, 2 W maximum peak power, SAR 0.95 W/kg) from a cellular phone for 12 h/day (11 h 45 min stand-by and 15 min spiking mode) for 30 days. Controls were housed in a separate room without cell phone radiation. Blood samples were collected through cardiac puncture; biochemical analysis of brain tissue was

done after decapitation at the end of the 30-day period. Results found MDA levels increased ($p < 0.05$), and GSH levels and CAT enzyme activity decreased, while vitamins A, E and D(3) levels did not change significantly in the brain tissue of exposed animals. In blood samples of the exposed group, MDA, vitamins A, D(3) and E levels, and CAT enzyme activity increased ($p < 0.05$), while GSH levels decreased ($p < 0.05$). They concluded that cell phone radiation could cause oxidative stress in brain tissue of guinea pigs but more studies were needed to determine if effects are harmful and/or affect neural functions.

Lai et al. [220] found that Sprague-Dawley rats exposed to RFR during water maze testing showed spatial working memory deficits compared to controls. But similar studies [221–223] did not find performance effects in spatial tasks or alterations in brain development after similar exposures. However, subsequent studies in the last two decades have shown memory and learning effects in animals and humans after RFR exposure [224].

Several studies also investigated RFR behavioral effects in rodent models on learning, memory, mood disturbances, and anxiety behaviors with contradictory results. Daniels et al. [225] found decreased locomotor activity, increased grooming and increased basal corticosterone levels in rats exposed to RFR for 3 h per day at 840 MHz, but no significant differences were seen between controls and test animals in spatial memory testing or morphological brain assessment. The researchers concluded that RFR exposure may lead to abnormal brain functioning.

Lee et al. [226, 227] looked specifically at effects on pregnant mice and rat testicular function from combined RFR mobile network signal characteristics used in wide-band code division multiple access (W-CDMA) or CDMA used in 3G mobile communications. Experiments showed no observable adverse effects on development, reproduction, or mutation in tested subjects. And no significant effects were seen by Poullietier de Gannes et al. [228] in *in-utero* and post-natal development of rats with wireless fidelity (WiFi) at 2,450 MHz. Also, Imai et al. [229] found no testicular toxicity from 1.95 GHz W-CDMA.

One extremely high frequency (EHF) study comparable to 5G on a mouse model by Kolomytseva et al. [230] looked at leukocyte numbers and the functional activity of peripheral blood neutrophils. In healthy mice, under whole-body exposures to low-intensity extremely-high-frequency electromagnetic radiation (EHF, 42.0 GHz, 0.15 mW/cm², 20 min daily) found that the phagocytic activity of peripheral blood neutrophils was suppressed by about 50% ($p < 0.01$ as compared with the sham-exposed control) in 2–3 h after the single exposure. Effects persisted for 1 day and thereafter returned to normal within 3 days. But a significant modification of the

leukocyte blood profile was observed in mice exposed to EHF for 5 days after exposure cessation. Leukocytes increased by 44% ($p < 0.05$ as compared with sham-exposed animals). They concluded that EHF effects can be mediated via metabolic systems and further said results indicated whole-body low-intensity EHF exposure of healthy mice had a profound effect on the indices of nonspecific immunity. These low levels will be common near 5G infrastructure.

In well-designed non-rodent mammal field studies, Nicholls and Racey [206, 207], found that foraging bats showed aversive behavioral responses near large air traffic control and weather radars. Four civil air traffic control (ATC) radar stations, three military ATC radars and three weather radars were selected, each surrounded by heterogeneous habitat. Three sampling points were carefully selected for matched habitats, type, structure, altitude and surrounding land class at increasing distances from each station. Radar field strengths were taken at three distances from the source: close proximity (<656 ft/200 m) with a high EMF strength > 2 V/m (1.06 μ W/cm²), an intermediate line-of sight point (656–1,312 ft/200–400 m) with EMF strength < 2 V/m, and a control location out of radar sight ($> 1,312$ ft/400 m) registering 0 V/m. Bat activity was recorded three times for a total of 90 samples, 30 within each field strength category. Measured from sunset to sunrise, they found that bat activity was significantly reduced in habitats exposed to an EMF greater than 2 V/m compared to 0 EMF sites, but such reduced activity was not significantly different at lower EMF levels within 400 m of the radar. They concluded that the reduced bat activity was likely due to thermal induction and an increased risk of hyperthermia. This was a large field study near commercial radar installations with mostly high intensity exposures but low-level effects cannot be excluded given known magneto-sensitivity in bats.

In another field study using a small portable marine radar unit significantly less powerful than their earlier measured field study, Nicholls and Racey [207] found the smaller signal could also deter bats' foraging behaviors. First, in summer 2007, bat activity was compared at 20 foraging sites in northeast Scotland during experimental trials with radar switched on, and in controls with no radar signal. After sunset, bat activity was recorded for a period of 30 min with the order of the trials alternating between nights. Then in summer 2008, aerial insects were sampled at 16 of the sites using two small light-suction traps, one with a radar signal, the other a control. Bat activity and foraging were found significantly reduced when the radar signal was unidirectional, creating a maximized exposure of 17.67–26.24 V/m (83–183 μ W/cm²). The radar had no significant effect on the abundance of insects captured by the traps despite reduced bat activity.

Balmori [231] also noted significantly reduced bat activity in a free-tailed bat colony (*Tadarida teniotis*) where the number of bats decreased when several cell towers were placed 262 ft (80 m) from the colony.

In the ELF range, Janać et al. [232] investigated ELF/MF effects — comparable to powerline and stray voltage ground current — on motor behavior patterns in Mongolian gerbils (*Meriones unguiculatus*) and found age-dependent changes in locomotion, stereotypy, and immobility in 3- and 10-month-old males. Animals were continuously exposed to ELF-MF (50 Hz; 0.1, 0.25 and 0.5 mT) for seven days with behavior monitored for 60 min in the open field after the 1st, 2nd, 4th, and 7th day (to capture immediate effects), as well as three days after exposure (to capture delayed effects). They found that exposure to 3-month-old gerbils increased motor behavior (locomotion and stereotypy), and therefore decreased immobility. In the 3-month old gerbils, ELF/MF also showed a delayed effect (except at 0.25 mT) on stereotypy and immobility. In 10-month-old gerbils, ELF/MF of 0.1, 0.25 and 0.5 mT induced decreased locomotion, a slight increase in stereotypy, and pronounced stimulation of motor behavior. Increased motor behavior was observed three days after exposure, indicating long lasting effects. Researchers concluded that in 3- and 10-month-old gerbils, specific temporal patterns of motor behavior changes were induced by ELF/MF due to age-dependent morpho-functional differences in brain areas that control motor behavior.

The above is a very small sample of rodent studies. See Part 2 Supplements 1 and 2 for more genetic effects to rodents, and Supplement 3 for additional studies.

Bovines

Due to domestication and easy accessibility, there are numerous studies of dairy cows (*Bos taurus*) which appear particularly sensitive to both natural and man-made EMFs. Fedrowitz [71] published a thorough review with citations too numerous to mention here. Noted in the review is the fact that bovines, although easily accessible, are difficult to study with precision due to their size, which creates handling and dosimetric complexities. Also noted are that bovines today are at their milk- and beef-production physiological limits, and that the addition of even a weak stressor may be capable of altering a fragile bovine physiological balance. It is clear in the Fedrowitz review that cows respond to environmental exposures from a broad range of frequencies and properties, even as some studies lack good exposure assessment. RFR exposure created avoidance behavior, reduced ruminating and lying times,

and alterations in oxidative stress enzymes among other problems, while ELF-EMF found contradictory evidence affecting milk production, fat content, hormone imbalances and important changes in other physiological parameters. Cows have also been found sensitive to stray voltage and transient harmonics with problematic milk production, health, reproduction and behavioral effects.

The question is how much of this body of work could translate to other ruminants and large mammals on-field or in the wild such as deer/cervids — behaviorally, reproductively, and physiologically. Stray voltage and ELF-EMF near powerlines, and rural area RFR from both ground-based and satellite transmitters, for instance, may affect wild migratory herds and large ungulates in remote areas that go undetected.

Bovines and RFR

Loscher and Kas [233] observed abnormal behavior in a dairy herd kept in close proximity to a TV and radio transmitter. They found reduction in milk yield, health problems, and behavioral abnormalities. After evaluating other factors, they concluded the high levels of RFR were possibly responsible. They removed one cow with abnormal behavior to another stable 20 km away from the antenna, resulting in normalization of behavior within five days. Symptoms reappeared when the cow was returned to the stable near the antennas. In a later survey, Loscher [234] also found effects of RFR on the production, health and behavior of farm animals, including avoidance behavior, alterations in oxidative stress parameters, and ruminating duration.

Balode [59] obtained blood samples from female brown cows from a farm close to, and in front of, the Skrunda Radar — located in Latvia at an early warning radar system operating in the 156–162 MHz frequency range — and samples from cows in a control area. They found micronuclei in peripheral erythrocytes were significantly higher in the exposed cows, indicating DNA damage.

Stärk et al. [235] investigated short-wave (3–30 MHz) RFR on salivary melatonin levels in dairy cattle, with one herd at a farm located at 1,640 ft/500 m (considered higher exposure) and a second control herd located 13,123 ft/4,000 m from the transmitter (considered unexposed). The average nightly magnetic field strength readings were 21-fold greater on the exposed farm (1.59 mA/m) than on the control farm (0.076 mA/m). At both farms, after initially monitoring five cows' salivary melatonin concentrations at 2-h intervals during night dark phase for 10 consecutive days, and with the short-wave transmitter switched off during three of the 10 days (off phase), samples were analyzed using a radioimmunoassay. They

reported that mean values of the two initial nights did not show a statistically significant difference between exposed and unexposed cows and concluded that chronic melatonin reduction was unlikely. But on the first night of re-exposure after the transmitter had been off for three days, the difference in salivary melatonin concentration between the two farms (3.89 pg/ml, CI: 2.04, 7.41) was statistically significant, indicating a two-to-seven-fold increase of melatonin concentration. They concluded that a delayed acute effect of EMF on melatonin concentration could not be excluded and called for further trials to confirm results.

Hässig et al. [95] conducted a cohort study to evaluate the prevalence of nuclear cataracts in veal calves near mobile phone base stations with follow-up of each dam and its calf from conception through fetal development and up to slaughter. Particular emphasis was focused on the first trimester of gestation (organogenesis). Selected protective antioxidants (superoxide dismutase, catalase, glutathione peroxidase [GPx]) were assessed in the aqueous humor of the eye to evaluate redox status. They found that of 253 calves, 79 (32%) had various degrees of nuclear cataracts, but only 9 (3.6%) of calves had severe nuclear cataracts. They concluded that a relationship between the location of veal calves with nuclear cataracts in the first trimester of gestation and the strength of antennas was demonstrated. The number of antennas within 328–653 ft (100–199 m) was associated with oxidative stress and there was an association between oxidative stress and the distance to the nearest base station. Oxidative stress was increased in eyes with cataract (OR per kilometer: 0.80, confidence interval 95 % 0.62, 0.93). But the researchers further concluded that it had not been shown that the antennas actually affected stress. Hosmer-Lemeshow statistics showed an accuracy of 100% in negative cases with low radiation, and only 11.11% accuracy in positive cases with high radiation. This reflected, in their opinion, that there are a lot of other likely causes for nuclear cataracts beside base stations and called for additional studies on EMF during embryonic development.

Hässig et al. [96] further examined a dairy farm in Switzerland where a large number of calves were born with nuclear cataracts after a mobile phone base station was erected near the barn. Calves showed a 3.5 times higher risk for heavy cataracts if born there compared to the Swiss average. All usual causes for cataracts could be excluded but they nevertheless concluded that the incidence remained unknown.

Bovines and swine: ELF-EMF, stray electric current

Bovines appear unusually sensitive to ELF-EMF from stray current caused by both normal industrial and faulty

grounding methods near high tension transmission lines close to dairy farms. Stray current can cover large areas and occurs when current flows between the grounded circuit conductor (neutral) of a farm and the Earth through dairy housing equipment like metal grates. It typically involves small, steady power frequency currents [99], not high transient shocks, although that also can sometimes occur under wet weather conditions. According to Hultgren [236], dairy cattle can perceive alternating currents exceeding 1 mA between the mouth and all four hooves with behavioral effects in cows usually occurring above 3 mA. Stray current can act as a major physical stressor in cows and other animals [237]. This may also be happening in wild migratory species moving through such areas.

At the request of dairymen, veterinarians, and county extension agents in Michigan, U.S., Kirk et al. [238] investigated stray current on 59 Michigan dairy farms. On 32 farms, stray current sources were detected. Where voltage exceeded 1 V alternating current, increased numbers of dairy cows showed abnormal behavior in the milking facility and increased prevalence of clinical mastitis. Recovery from the stray current-induced abnormalities was related to the type of abnormality and the magnitude of the exposure voltage.

Burchard et al. [239] in a small but well-controlled alternating exposure study of non-pregnant lactating Holstein cows found a longer estrous cycle in cows exposed to a vertical electric field of 10 kV/m and a uniform horizontal magnetic field of 30 μ T at 60 Hz, compared to when they were not exposed. Rodriguez et al. [240] also found that exposure to EMF may increase the duration of the bovine estrous cycle. Burchard et al. [241] evaluated effects on milk production in Holsteins exposed to a vertical electric field of 10 kV/m and a uniform horizontal MF of 30 μ T at 60 Hz and found an average decrease of 4.97, 13.78, and 16.39% in milk yield, fat corrected milk yield, and milk fat, respectively in exposed groups, and an increase of 4.75% in dry matter food intake. And Buchard et al. [242] in two experiments investigated blood thyroxine (T4) levels in lactating pregnant and non-lactating non-pregnant Holstein cows exposed to 10 kV/m, 30 μ T EMF and found a significant change depending on the time of blood sampling in exposed groups. They concluded that exposure of dairy cattle to ELF-EMF could moderately affect the blood levels of thyroxine.

Hillman et al. [93, 94] reported that harmonic distortion and power quality itself could be another variable in bovine sensitivity to stray current. They found behavior, health, and milk production were adversely affected by transients at the 3rd, 5th, 7th, and triplen harmonic currents on utility power lines after a cell tower was found charging the ground neutral with 10+ V, causing the

distortion. After installing a shielded neutral isolation transformer between the utility and the dairy, the distortion was reduced to near zero. Animal behavior improved immediately and milk production, which had been suppressed for three years, gradually returned to normal within 18 months.

Swine (*Sus scrofa domestica*) — like rats and mice — have demonstrated aversive behavior to ELF-EMF electric fields. Hjeresen et al. [243] found miniature pigs, exposed to 60-Hz electric fields (30 kV/m for 20 h/day, 7 days/week up to 6 months) preferred an absence of the field during a 23.5-h period by spending more time out of the electric field than in it during sleep periods. And Sikov et al. [244], as part of a broad study of Hanford Miniature swine on reproductive and developmental toxicology (including teratology) over three breeding cycles found a strong association between chronic exposure to a vertical uniform electric field (60-Hz, 30-kV/m, for 20 h/day, 7 days/week) and adverse developmental effects vs. control. They concluded that an association exists between chronic exposure to strong electric fields and adverse developmental effects in swine (75% malformations in exposed vs. 29% sham) in first generation with consistent results in two subsequent generations.

Avian

Birds are important indicators of ecosystem well-being and overall condition. Even subtle effects can be apparent due to their frequent presence in RFR areas. Their hollow feathers have dielectric and piezoelectric properties, meaning they are conductive and capable of acting as a waveguide directing external RFR energy directly and deeply into avian body cavities [245–249]. Their thin skulls have both magnetite and radical pair receptors (see “Mechanisms” above) and they are highly mobile — often traveling across great migratory distances of tens to as much as a hundred thousand kilometers round-trip per year, resulting in potential multi-frequency cumulative effects from chronic near, middle, and far-field exposures. Avian populations are declining worldwide, especially among migratory species. This means that birds may be uniquely sensitive to adverse effects from environmental RFR since their natural habitat is air and they often fly at lateral levels with infrastructure emissions, bringing them that much closer to generating sources.

Tower and building construction, as direct obstacles, are known hazards to birds. One tower at 150 feet (46 m) above ground level is thought to account for as many as 3,000 songbird deaths per month in migratory pathways

during peak migration [250] and communication tower collisions have been documented to kill more than 10,000 migratory birds in one night at a TV tower in Wisconsin [251, 252]. It has been known for years that the songbird populations of North America and Europe are plummeting. Only recently were towers considered a significant factor. But is the problem solely due to obstacles in direct migratory pathways or is something else involved?

RFR from towers may be acting as an attractant to birds due to their singular physiology. Avian eyes and beaks are uniquely magnetoreceptive with both magnetite and cryptochrome radical pair receptors. One definitive study by Beason and Semm [253] demonstrated that the common cell phone frequency (900-MHz carrier frequency, modulated at 217 Hz) at nonthermal intensities, produced firing in several types of nervous system neurons in Zebra Finches (*Taeniopygia guttata*). Brain neurons of irradiated anesthetized birds showed changes in neural activity in 76% of responding cells, which increased their firing rates by an average 3.5-fold vs. controls. Other responding cells exhibited a decrease in rates of spontaneous activity. The Beason and Semm study [253] could explain why birds may be attracted to cell towers, a theoretical premise they previously observed with Bobolinks (*Dolichonyx oryzivorus*; [254]).

RFR may also act as an avian stressor/irritant. Early work by Wasserman et al. [255] in field studies on 12 flocks of migratory birds subjected to various combinations of microwave power density and duration under winter conditions at Monomet, MA, using birds from two additional flocks as controls, showed increased levels of aggression in some of the irradiated birds.

Other research indicated a range of effects capable of broad adverse environmental outcomes. Laboratory studies by Di Carlo et al. [256] found decreases in heat shock protein production in chick embryos. The researchers used 915-MHz RFR on domestic chicken embryos and found that exposure typical of some cell phone emissions reduced heat shock proteins (HSP-70) and caused heart attacks and death in some embryos. Controls were unaffected. In replicated experiments, similar results were found by Grigor’ev [257] and Xenos and Magras [258]. Batellier et al. [259] found significantly elevated embryo mortality in exposed vs. sham groups of eggs incubated with a nearby cell phone repeatedly calling a 10-digit number at 3-min intervals over the entire incubation period. Heat shock proteins help maintain the conformation of cellular proteins during periods of stress. A decrease in their production diminishes cellular protection, possibly leading to cancer, other diseases, heart failure, and reduction in protection against hypoxia and ultraviolet light.

Not all results are adverse. Tysbulin et al. [260, 261] investigated both short and prolonged GSM 900 MHz cell phone signal exposure on embryo development in Quail (*Coturnix coturnix japonica*), irradiating fresh fertilized eggs during the first 38 h and 14 days of incubation using a cell phone in connecting mode continuously activated through a computer system. Maximum intensity of incident radiation on the egg's surface was 0.2 mW/cm^2 . Results found a significant ($p < 0.001$) increase in differentiated somites in 38-h exposed embryos and a significant ($p < 0.05$) increase in total survival of embryos in eggs after 14 days exposure. They also found the level of thiobarbituric acid (TBA) reactive substances was significantly ($p 0.05\text{--}0.001$) higher in the brains and livers of hatchlings from exposed embryos and hypothesized that a facilitating effect exists due to enhanced metabolism in exposed embryos via peroxidation mechanisms. They concluded low-level nonthermal effects from GSM 900 MHz to quail embryogenesis is possible and that effects can be explained via a hormesis effect induced by reactive oxygen species (ROS).

Signaling characteristics such as pulsing vs. continuous wave are also important. Berman et al. [262], in a multi-lab study of pulsed ELF magnetic fields found a highly significant incidence of abnormalities in exposed chick eggs vs. controls. And Ubeda et al. [263] found irreversible damage to chick embryos from weak pulsed ELF-EMF magnetic fields that are common in the environment today. Initial studies on freshly fertilized chicken eggs were exposed during the first 48 h of post-laying incubation to pulsed magnetic fields (PMFs) with 100 Hz repetition rate, $1.0 \mu\text{T}$ peak-to-peak amplitude, and 500 μs pulse duration. Two different pulse waveforms were used, with rise and fall times of 85 μs or 2.1 μs . A two-day exposure found significant increased developmental abnormalities. In follow-up research, after exposure, eggs were incubated for an additional nine days without PMFs. Embryos removed from eggs showed an excess of developmental anomalies in the PMF-exposed groups compared with the sham-exposed samples. There was a high rate of embryonic death in the 2.1 μs rise/fall time. Results indicate PMFs can cause irreversible developmental changes, confirming that a pulse waveform can determine embryonic response to ELF magnetic fields common today.

Between 1999 and 2005, Fernie et al. for the first time investigated various potential reproductive effects on a captive raptor species — the American Kestrel (*Falco sparverius*) — from ELF-EMF equivalent to that of wild nesting pairs on power transmission lines. In a series of studies, captive pairs were typically bred under control or EMF exposure over 1–3 breeding cycles. In 1999, Fernie et al. [264] investigated photo phasic plasma melatonin in

reproducing adult and fledgling kestrels, finding that EMFs affected plasma melatonin in adult male kestrels, suppressing it midway through, but elevating it at the end of the breeding season. In long-term, but not short-term EMF exposure of adults, plasma melatonin was suppressed in their fledglings too which could affect migratory success. Molt happened earlier in adult EMF-exposed males than in controls. EMF exposure had no effect on plasma melatonin in adult females. In avian species, melatonin is involved in body temperature regulation, seasonal metabolism, locomotor activity, feeding patterns, migration, and plumage color changes important for mate selection. Melatonin also plays a key role in the growth and development of young birds. The researchers concluded it is likely that the results are relevant to wild raptors nesting within EMF exposures.

In 2000 Fernie et al. [265] focused on reproductive success in captive American Kestrels exposed to ELF-EMF, again equivalent to that experienced by wild reproducing kestrels. Kestrels were bred one season per year for two years under EMF or controlled conditions. In some years but not others, EMF-exposed birds showed a weak association with reduced egg laying, higher fertility, larger eggs with more yolk, albumen, and water, but thinner egg shells than control eggs. Hatching success was lower in EMF pairs than control pairs but fledging success was higher than control pairs in one year. They concluded that EMF exposure such as what kestrels would experience in the wild was biologically active in a number of ways leading to reduced hatching success.

Also in 2000, Fernie et al. [266] further investigated behavioral changes in American Kestrels to ELF-EMF, again in captive birds comparable to nesting pairs that commonly use electrical transmission structures for nesting, perching, hunting, and roosting. The amount of EMF exposure time of wild reproducing American Kestrels was first determined at between 25 and 75% of the observed time. On a 24-h basis, estimated EMF exposure in wild species ranged from 71% during courtship, to 90% during incubation. Then effects of EMFs on the behavior of captive reproducing kestrels were examined at comparable exposures of 88% of a 24-h period. Additionally, captive kestrels were exposed to EMF levels experienced by wild kestrels nesting under 735-kV power lines. There appeared to be a stimulatory/stress effect. Captive EMF females were more active, more alert, and perched on the pen roof more frequently than control females during courtship. EMF females preened and rested less often during brood rearing. EMF-exposed male kestrels were more active than control males during courtship and more alert during incubation. The researchers concluded that the increased activity of kestrels during courtship may be linked to changes in

corticosterone, but not to melatonin as found in earlier work [264], but said the behavioral changes observed were unlikely to result in previously reported effects in EMF-exposed birds as noted above. They added that behavioral changes of captive EMF-exposed kestrels may also be observed in wild kestrels, with uncertain results.

In 2001 Fernie and Bird [267] looked at ELF-EMF oxidative stress levels in captive American Kestrels using the same test parameters described above to see if ELF-EMF exposure elicited an immune system response. In captive male kestrels bred under control or EMF conditions equivalent to those experienced by wild kestrels, short-term EMF exposure (one breeding season) suppressed plasma total proteins, hematocrits, and carotenoids in the first half of the breeding season. It also suppressed erythrocyte cells and lymphocyte proportions, but elevated granulosa proportions at the end of the breeding season. Long-term EMF exposure (two breeding seasons) also suppressed hematocrits in the first half of the reproductive period. But results found that only short-term EMF-exposed birds experienced an immune response, particularly during the early half of the breeding season. The elevation of granulocytes and the suppression of carotenoids, total proteins, and melatonin [264] in the same kestrel species indicated that the short-term EMF-exposed male kestrels had higher levels of oxidative stress due to an immune response and/or EMF exposure. The researchers noted that long-term EMF exposure may be linked to higher levels of oxidative stress solely through EMF exposure. Oxidative stress contributes to cancer, neurodegenerative diseases, and immune disorders. And in 2005, Fernie and Reynolds [268] noted most studies of birds and EMF indicate changes on behavior, reproductive success, growth and development, physiology and endocrinology, and oxidative stress — with effects not always consistent or in the same direction under EMF conditions. The entire body of work by this research group has implications for all wild species that encounter a wide range of EMFs on a regular basis.

In field studies on wild birds in Spain, Balmori [269] found strong negative correlations between low levels of microwave radiation and bird breeding, nesting, roosting and survival in the vicinity of communication towers. He documented nest and site abandonment, plumage deterioration, locomotion problems, and death in Wood Storks (*Mycteria americana*), House Sparrows (*Passer domesticus*), Rock Doves (*Columba livia*), Magpies (*Pica pica*), Collared Doves (*Streptopelia decaocto*), and other species. While these species had historically been documented to roost and nest in these areas, Balmori [269] did not observe these symptoms prior to construction and operation of the

cell phone towers. Results were most strongly negatively correlated with proximity to antennas and Stork nesting and survival. Twelve nests (40% of his study sample) were located within 656 ft (200 m) of the antennas and never successfully raised any chicks, while only one nest (3.3%), located further than 984 ft (300 m) never had chicks. Strange behaviors were observed at Stork nesting sites within 328 ft (100 m) of one or several cell tower antennas. Birds impacted directly by the main transmission lobe (i.e., electric field intensity > 2 V/m) included young that died from unknown causes. Within 100 m, paired adults frequently fought over nest construction sticks and failed to advance nest construction (sticks fell to the ground). Balmori further reported that some nests were never completed and that Storks remained passively in front of cell site antennas. The electric field intensity was higher on nests within 200 m (2.36 ± 0.82 V/m; $1.48 \mu\text{W}/\text{cm}^2$) than on nests further than 300 m (0.53 ± 0.82 V/m, $0.074 \mu\text{W}/\text{cm}^2$). RF-EMF levels, including for nests <100 m from the antennas, were not intense enough to be classified as thermal exposures. Power densities need to be at least $10 \text{ mW}/\text{cm}^2$ to produce tissue heating of even $0.5 \text{ }^\circ\text{C}$ [270]. Balmori's results indicated that RFR could potentially affect one or more reproductive stages, including nest construction, number of eggs produced, embryonic development, hatching and mortality of chicks and young in first-growth stages.

Balmori and Hallberg [271] and Everaert and Bauwens [272] found similar strong negative correlations among male House Sparrows (*Passer domesticus*) throughout multiple sites in Spain and Belgium associated with ambient RFR between 1 MHz and 3 GHz at various proximities to GSM cell base stations. House Sparrow declines in Europe have been gradual but cumulative for this species once historically well adapted to urban environments. The sharpest bird density declines were in male House Sparrows in relatively high electric fields near base stations, indicating that long-term exposure at higher RFR levels negatively affected both abundance and/or behavior of wild House Sparrows. In another review, Balmori [25] reported health effects to birds that were continuously irradiated. They suffered long-term effects that included reduced territorial defense posturing, deterioration of bird health, problems with reproduction, and reduction of useful territories due to habitat deterioration.

Birds have been observed avoiding areas with high and low-intensity EMF, in daylight as well as nocturnally. An early study by Southern in 1975 [273] observed that gull chicks reacted to the U.S. military's Project Sanguin ELF transmitter. Tested on clear days in the normal geomagnetic field, birds showed significant clustering with

predicted bearing corresponding with migration direction, but when the large antenna was energized they dispersed randomly. He concluded that magnetic fields associated with such conductors were sufficient to disorient birds. Larkin and Sutherland [274] observed that radar tracking of individual nocturnal migrating birds flying over a large alternating-current antenna system caused birds to turn or change altitude more frequently when the antenna system was operating than when it was not. The results suggested that birds sense low-intensity alternating-current EMF during nocturnal migratory flight.

In a well-designed, multi-year avian study of magneto-disruption, Engels et al. [213] investigated environmental broadband electromagnetic ‘noise’ emitted everywhere humans use electronics, including devices and infrastructure. They found migratory birds were unable to use their magnetic compass in the presence of a typical urban environment today. European Robins (*E. rubecula*), exposed to the background electromagnetic ‘noise’ present in unscreened wooden huts at the University of Oldenburg campus, could not orient using their magnetic compass. But when placed in electrically grounded aluminum-screened huts, creating Faraday cages that attenuated electromagnetic ‘noise’ by approximately two orders of magnitude, their magnetic orientation returned. The researchers were able to determine the frequency range from 50 kHz to 5 MHz was the most disruptive. When grounding was removed, or additional broadband electromagnetic ‘noise’ was deliberately generated inside the screened and grounded huts, birds again lost magnetic orientation abilities. They concluded that RFR’s magneto-disruption effects are not confined to a narrow frequency band. Birds tested far from sources of EMFs required no screening to orient with their magnetic compass. This work documented a reproducible effect of anthropogenic electromagnetic ambient ‘noise’ on the behavior of an intact vertebrate. The magnetic compass is integral to bird movement and migration. The findings clearly demonstrated a nonthermal effect on European Robins and serves as a predictor for effects to other migratory birds, especially those flying over urban areas. Such fields are much weaker than minimum levels expected to produce any effects and far below any exposure standards.

Intensity windows in different species have also been found where effects can be more extreme at lower intensities than at higher ones due to compensatory mechanisms such as cell apoptosis. Panagopoulos and Margaritis [34] found an unexpected intensity window at thermal levels around 10 mW/cm² RFR — not uncommon near cell towers — where effects were more severe than at intensities higher than 200 mW/cm². This window appeared at a

distance of 8–12 in (20–30 cm) from a cell phone antenna, corresponding to a distance of about 66–98 ft (20–30 m) from a base station antenna. This could be considered a classic nonlinear effect and would apply to far-field exposures. Since cell base station antennas are frequently located within residential areas where birds nest, often at distances 20–30 m from such antennas, migratory birds, non-migratory avifauna, and other wildlife may be exposed up to 24-h per day.

Concerns also apply to impacts from commercial radio signals on migratory birds. The human anatomy is resonant with the FM bands so exposure standards are most stringent in that range. High intensity (>6,000 W) commercial FM transmitters are typically located on the highest ground available to blanket a wider area. Low powered FM transmitters (<1,000 W) can be placed closer to the human population. High intensity locations, which can be multi-transmitter sites (colloquially called “antenna farms”) for other services, also provide convenient perches and nest sites for migratory birds. FM digital signals, which simulate pulsed waves, pose additional health concerns to migratory birds. This creates a dangerous frequency potential for protected migratory birds such as Bald Eagles with wingspans that extend to about 6 ft (1.83 m) — a resonant match with the length of the FM signal — creating a potential full-body resonant effect for both humans and Bald Eagles. Birds could experience both thermal and non-thermal effects.

All migratory birds are potentially at risk, including Bald Eagles, Golden Eagles, birds of conservation concern [275], federal and/or state-listed bird species, birds nationally or regionally in peril, as well as birds whose populations are stable. Sadly, addressing these concerns — beginning with independent research conducted by scientists with no vested interest in the outcomes — has not been a priority for government agencies or the communications industry.

Insects and arachnids

Insects are the most abundant and diverse of all animal groups, with more than one million described species representing more than half of all known living species, and potentially millions more yet to be discovered and identified. They may represent as much as 90% of all life forms on Earth. Though some are considered pests to farm crops and others as disease vectors, insects remain essential to life and planetary health. Found in nearly all environments, they are the only invertebrates that fly, but adults of most insect species walk, while some swim.

Because of these different environmental adaptations, different species will encounter different EMF exposures in varying degrees. For instance, ground-based walking insects may be more susceptible to effects from 60 Hz stray current while flying insects may be more susceptible to wireless exposures. However, all species tested have been affected across a range of the nonionizing electromagnetic bands.

Most insects have an exoskeleton, three-part body consisting of a head, thorax, and abdomen, three pairs of jointed legs, compound eye structures capable to seeing many more colors, widths, and images than humans, and one pair of antennae capable of sensing subtle meteorological changes and Earth's geomagnetic fields. They live in close harmony with the natural environment for survival and mating purposes. The most diverse insect groups co-evolved with flowering plants, many of which would not survive without them. Most insect species are highly sensitive to temperature variations and climate alterations as they do not dissipate heat efficiently.

Nearly all insects hatch from eggs that are laid in myriad ways and habitats. Growth involves a series of molts and stages (called instars) with immature stages greatly differing from mature insects in appearance, behavior, and preferred habitat. Some undergo a four-stage metamorphosis (with a pupal stage) and others a three-stage metamorphosis through a series of nymphal stages.

While most insects are solitary, some — like bees, termites and ants — evolved into social networks, living in “cooperative” organized colonies that can function as one unit as evidenced in swarming behaviors. Some even show maternal care over eggs and young. They communicate through various sounds, pheromones, light signals, and through their antennae such as during the bees’ “waggle dance” (see below).

As far back as the 1800s, even though testing methods were primitive by today's standards, researchers were curious about electromagnetism's effect on insect development, particularly teratogenicity [276]. Research on EMF across frequencies and insect populations has been ongoing since at least the 1930s with an eye toward using energy as an insecticide and anti-contaminant in grain, typically at high intensity thermal exposures that would not exist in the natural environment. McKinley and Charles [277] found that wasps die within seconds of high frequency exposure. But not all early work was strictly high intensity, or all effects observed due to thermal factors.

There were interesting theories introduced by early researchers regarding how energy couples with various insect species. Frings [278] found larval stages are more

tolerant to heat than adult insects with appendages that can act as conducting pathways to the body, and that the more specialized the insect species, the more susceptible they appear to microwave exposure. Carpenter and Livingstone [279] studied effects of 10 GHz continuous-wave microwaves at 80 mW/cm² for 20 or 30 min, or at 20 mW/cm² for 120 min on pupae of mealworm beetles (*Tenebrio molitor*) — clearly within thermal ranges. In control groups, 90% metamorphosed into normal adult beetles whereas only 24% of exposed groups developed normally, 25% died, and 51% developed abnormally. Effects were assumed to be thermally induced abnormalities until they simulated the same temperature exposure using radiant heat and found 80% of pupae developed normally. They concluded that microwaves were capable of inducing abnormal effects other than through thermal damage.

Fruit flies

Insects at all metamorphic stages of development have been studied using RFR including egg, larva, pupa and adult stages. Much work has been done on genetic and other effects with fruit flies (*D. melanogaster*) because of their well-described genetic system, ease of exposure, large brood size, minimal laboratory space needed, and fast reproductive rates. Over several decades Goodman and Blank, using ELF-EMF on *Drosophila* models, found effects to heat shock proteins and several other effects ([201]; and see “Mechanisms” above). It is considered a model comparable to other insects in the wild approximating that size. *D. melanogaster* may be the most lab-studied insect on Earth, although honey and related bee species, due to their devastating losses over the last decade and significance to agriculture, are quickly catching up.

Michaelson and Lin [50] noted that RFR-exposed insects first react by attempting to escape, followed by disturbance of motor coordination, stiffening, immobility and eventually death, depending on duration of exposure and insect type. For example, *D. melanogaster* survived longer than 30 min while certain tropical insects live only a few seconds at the same field intensity. Also noted were concentration changes in many metabolic products and effects to embryogenesis — the period needed for a butterfly to complete metamorphosis — with accelerated gastrulation and larval growth [17]. Michaelson and Lin [50] cited several negative studies with *D. melanogaster* exposed with continuous-wave RFR between 25 and 2,450 MHz on larval growth [280, 281] and mutagenicity [282]. This was after Heller and Mickey [283] found a tenfold rise in sex-linked recessive mutations with pulsed RFR

between 30 and 60 MHz. It was among the earliest studies that found pulsing alone to be a biologically active exposure.

As reported in Michaelson and Lin [50], Tell [284] looked at *D. melanogaster*'s physiological absorption properties and found that a group of 6-day old male wild-type flies, exposed to 2,450 MHz for 55 min at an intense field caused a dramatic 65% reduction in body weight. This was thought to be from dehydration. They then sought to calculate the fruit fly's absorption properties in relation to plane electromagnetic waves and found that a fly has only a 1/1,000th effective area of its geometric cross section and thus is an inefficient test species for absorbed microwave radiation. However, they concluded that fruit flies were responsive to absorbed energy at thermal levels as a black body resonator at a power density of 1.044×10^4 mW/cm², corresponding to a thermal flux density of 0.562×10^{-3} cal. These are levels found in close proximity to broadcast facilities and cell phone towers today.

More recent investigations of RFR by Weisbrot et al. [285] using GSM multiband mobile phones (900/1,900 MHz; SAR approximately 1.4 W/kg) on *D. melanogaster* during the 10-day developmental period from egg laying through pupation found that non-thermal radiation increased numbers of offspring, elevated heat shock protein-70 levels, increased serum response element (SRE) DNA-binding and induced the phosphorylation of the nuclear transcription factor, ELK-1. Within minutes, there was a rapid increase of hsp70, which was apparently not a thermal effect. Taken together with the identified components of signal transduction pathways, the researchers concluded the study provided sensitive and reliable biomarkers for realistic RFR safety guidelines.

Panagopoulos et al. [286] found severe effects in early and mid-stage oogenesis in *D. melanogaster* when flies were exposed *in vivo* to either GSM 900-MHz or DCS 1,800-MHz radiation from a common digital cell phone, at non-thermal levels, for a few minutes per day during the first 6 days of adult life. Results suggested that the decrease in oviposition previously reported [287–289] was due to degeneration of large numbers of egg chambers after DNA fragmentation of their constituent cells which was induced by both types of mobile phone radiation. Induced cell death was recorded for the first time in all types of cells constituting an egg chamber (follicle cells, nurse cells and the oocyte) and in all stages of early and mid-oogenesis, from germarium to stage 10, during which programmed cell death does not physiologically occur. Germarium and stages 7–8 were found to also be the most sensitive developmental stages in response to electromagnetic stress induced by the GSM and DCS fields. Germarium was also

found to be more sensitive than stages 7–8. These papers, taken collectively, indicate serious potential effects to all insect species of similar size to fruit flies from cell phone technology, including from infrastructure and transmitting devices.

Fruit flies have also been found sensitive to ELF-EMF. Gonet et al. [290] found 50 Hz ELF-EMF exposure affected all developmental stages of oviposition and development of *D. melanogaster* females, and weakened oviposition in subsequent generations.

Savić et al. [291] found static magnetic fields influenced both development and viability in two species of *Drosophila* (*D. melanogaster* and *D. hydei*). Both species completed development (egg-to-adult), in and out of the static magnetic field induced by a double horseshoe magnet. Treated vials with eggs were placed in the gap between magnetic poles (47 mm) and exposed to the average magnetic induction of 60 mT, while control groups were kept far from the magnetic field source. They found that exposure to the static magnetic field reduced development time in both species, but only results for *D. hydei* were statistically significant. In addition, the average viability of both species was significantly weaker compared to controls. They concluded a 60 mT static magnetic field could be a potential stressor, influencing on different levels both embryonic and post-embryonic fruit fly development.

Beetles

Other insect species also react to both ELF-EMF and RF-EMF. Newland et al. [292] found behavioral avoidance in cockroaches (*Periplaneta americana*) to static electric fields pervasive in the environment from both natural and man-made sources. Such fields could exist near powerlines or where utilities ground neutral lines into the Earth. They found insect behavioral changes in response to electric fields as tested with a Y-choice chamber with an electric field generated in one arm of the chamber. Locomotor behavior and avoidance were affected by the magnitude of the electric fields with up to 85% of individuals avoiding the charged arm when the static e-field at the entrance to the arm was above 8–10 kV/m. Seeking to determine mechanisms of perception and interaction, they then surgically ablated the antennae and cockroaches were unable to avoid electric fields. They concluded that antennae are crucial in cockroach detection of electric fields that thereby helps them avoid such fields. They also noted that cockroach ability to detect e-fields is due to long antennae which are easily charged and displaced by such fields, not because of a specialized detection system. This leads to the

possibility that other insects may also respond to electric fields via antennae alone.

Vácha et al. [208] found that cockroaches (*P. americana*) were sensitive to weak RFR fields and that the Larmor frequency at 1.2 MHz in particular had a “deafening effect” on magnetoreception. The parameter they studied was the increase in locomotor activity of cockroaches induced by periodic changes in geomagnetic North positions by 60°. The onset of the disruptive effect of a 1.2 MHz field was found between 12 and 18 nT whereas the threshold of a field twice the frequency (2.4 MHz) fell between 18 and 44 nT. A 7 MHz field showed no significant effect even at maximal of 44 nT. The results suggested resonance effects and that insects may be equipped with the same magnetoreception system as birds.

Prolić et al. [293] investigated changes in behavior via the nervous system of cerambycid beetles (*Morimus funereus*) in an open field before and after exposure to a 50 Hz ELF-MF at 2 mT. Experimental groups were divided into several activity categories. Results showed activity increased in the groups with medium and low motor activity, but decreased in highly active individuals. High individual variability was found in the experimental groups, as well as differences in motor activities between the sexes both before and after exposure to ELF-MF. They assumed activity changes in both sexes were due to exposure to ELF-MF. Only a detailed analysis of the locomotor activity at 1-min intervals showed some statistically significant differences in behavior between the sexes.

Ants

Ants are another taxa found sensitive to EMF. Ants comprise between 15 and 25% of the terrestrial animal biomass and thrive in most ecosystems on almost every landmass on Earth. By comparison, the total estimated biomass (weight) of all ants worldwide equates to the total estimated biomass of all humans. Their complex social organization in colonies, with problem-solving abilities, division of labor, and both individual and whole colony communication via complex behavioral and pheromone signaling may account for their success in so many environments. Some ant species (e.g., *Formica rufa*-group) are known to build colonies on active earthquake faults and have been found to change behavior hours in advance of earthquakes [294], thus demonstrating predictive possibilities. Ants can modify habitats, influence broad nutrient cycling, spread seeds, tap resources, and defend themselves. Ants co-evolved with other species which led to many different kinds of mutual beneficial and antagonistic relationships.

Ants (e.g., *Solenopsis invictus*) are long known to be sensitive to magnetic fields both natural and manmade [295]. Ants (e.g., *Atta colombica*), like birds, have been found to be sensitive to the Earth’s natural fields and to use both a solar compass on sunny days as well as a magnetic compass when there is cloud cover [296]. Jander and Jander [297] similarly found that the weaver ant (*Oecophylla* spp) had a more efficient light compass orientation with a much less efficient magnetic compass orientation, suggesting that they switch from the former to the latter when visual celestial compass cues become unavailable. There is evidence from Esquivel et al. [298] that such magnetoreception is due to the presence of varying sized magnetite particles and paramagnetic resonance in fire ants (*Solenopsis* spp). But Riveros and Srygley [299] found a more complex relationship toward a magnetic compass rather than the presence of magnetite alone when leafcutter ants (*Atta columbica*) were subjected to a brief but strong magnetic pulse which caused complete disorientation regarding nest-finding. They found external exposures could interfere with ants’ natural magnetic compass in home path integration, which indicated evidence of a compass based on multi-domain and/or superparamagnetic particles rather than on single-domain particles like magnetite.

Acosta-Avalos et al. [300] found that fire ants are sensitive to 60 Hz alternating magnetic fields as well as constant magnetic fields, changing their magnetic orientation and magnetosensitivity depending on the relation between both types of magnetic fields. Alternating current had the ability to disrupt ant orientation, raising the question of effects to wild species from underground wiring and the common practice of powerline utility companies using the Earth as a neutral return pathway to substations, creating stray current along the way [99].

Camelítepe et al. [301] tested black-meadow ants’ (*Formica pratensis*) response under both natural geomagnetic and artificial earth-strength static EMFs (24.5 μ T). They found that under the natural geomagnetic field, when all other orientational cues were eliminated, there was significant heterogeneity of ant distribution with the majority seeking geomagnetic north in darkness while under light conditions ants did not discriminate geomagnetic north. Under artificial EMF exposure, however, ant orientation was predominantly on the artificial magnetic N/S axis with significant preference for artificial north in both light and dark conditions. This indicated EMF abilities to alter ant orientation.

Ants are also shown to react to RFR [302, 303]. Cammaerts et al. [304] found that exposures to GSM 900 MHz at 0.0795 μ W/cm² significantly inhibited memory and

association between food sites and visual and olfactory cues in ants (*Myrmica sabuleti*) and eventually wiped out memory altogether. Subsequent exposure, after a brief recovery period, accelerated memory/olfactory loss within a few hours vs. a few days, indicating a cumulative effect even at very low intensity. The overall state of the exposed ant colonies eventually appeared similar to that exhibited by honey bee (*Apis mellifera*) colony collapse disorder. Although the impact of GSM 900 MHz radiation was greater on the visual memory than on the olfactory memory, the researchers concluded that such exposures — common to cell phones/towers — were capable of a disastrous impact on a wide range of insects using olfactory and/or visual memory, including bees. Many ant species (e.g., *Lasius neglectus*, *Nylanderia fulva*, *Camponotus* spp, *Hymenoptera formicidae*, *Solenopsis invicta*, among others) are attracted to electricity, electronic devices, and powerlines, thereby causing short circuits and fires. One hypothesis [305] is that the accumulation of ants in electrical equipment may be due to a few foraging “worker ants” seeking warmth and finding their way into small spaces, completing electrical contacts which then causes a release of alarm exocrine gland pheromones that attract other ants, which then go through the same cycle. In their study, they found that workers subjected to a 120 V alternating-current released venom alkaloids, alarm pheromones and recruitment pheromones that elicited both attraction and orientation in ants as well as some other unknown behavior-modifying substances. But given how ants are affected by EMFs in general it is likely that an attractant factor is also involved, not just warmth and small spaces.

There is evidence that ants use their antennae as “antennas” in two-way electrochemical communications. Over 100 hundred years ago, Swiss researcher Auguste Forel [306] removed the antennae of different species of ants and put them together in one place. What would have normally evoked aggressive behaviors among the different species did not occur and they got along as if belonging to the same colony. To Forel this indicated an ability of ant antennae to help different ant species identify each other.

Two mechanisms in ants have long been known for chemical receptivity as well as electromagnetic sensitivity. Recently Wang et al. [307] found evidence that chemical signals located specific to antennae vs. other body areas drew more attention from non-nest mates. When cuticular hydrocarbons (CHCs) were removed by a solvent from antennae, non-nest mates responded less aggressively than to other areas of the body, indicating that antennae reveal nest-mate identity, conveying and receiving social signals. Regarding magnetoreception, magnetic measurements [308–310] found the presence of biogenic magnetite

was concentrated in antennae and other body parts of the ant *Pachycondyla marginata*. De Oliveira et al. [311] also found evidence of magnetite and other magnetic materials imbedded in various locations of antennae tissue in *P. marginata* indicating that antennae function as magnetoreceptors. The amount of magnetic material appeared sufficient to produce a magnetic-field-modulated mechanosensory output and therefore demonstrated a magnetoreception/transduction sense in migratory ants.

Ticks

Ticks are members of the order Arachnida, shared with scorpions and spiders. Recent papers in a tick species (*Dermacentor reticulatus*) mirrors an attraction to some frequencies but not others. Vargová et al. [312, 313] found that exposure to RFR may be a potential factor altering both presence and distribution of ticks in the environment. Studies were conducted to determine potential affinity of ticks for RFR using radiation-shielded tubes (RST) under controlled conditions in an electromagnetic compatibility laboratory in an anechoic chamber. Ticks were irradiated using a Double-Ridged Waveguide Horn Antenna to RF-EMF at 900 and 5,000 MHz; 0 MHz served as control. Results found that 900 MHz RFR induced a higher concentration of ticks on the irradiated arm of RST whereas at 5,000 MHz ticks escaped to the shielded arm. In addition, 900 MHz RFR had been shown to cause unusual specific sudden tick movements during exposure manifested as body or leg jerking [312]. These studies are the first experimental evidence of RFR preference and behavioral changes in *D. reticulatus* with implications for RFR introduced into the natural environment by devices and infrastructure. In a further study, Frątczak et al. [314] reported that *Ixodes ricinus* ticks were attracted to 900 MHz RFR at $0.1 \mu\text{W}/\text{cm}^2$, particularly those infected with *Rickettsia* (spotted fever).

RFR may be a new factor in tick distribution, along with known factors like humidity, temperature and host presence, causing concentrated non-homogenous or mosaic tick distribution in natural habitats. Tick preference for 900 MHz frequencies common to most cell phones has possibly important ecological and epidemiological consequences. Increasing exposures from use of personal devices and infrastructure in natural habitats where ticks occur may increase both tick infestation and disease transmission. Further studies need to investigate this work, given the ubiquity of ticks today, their northward spread due to climate change in the Northern Hemisphere, and the increasing and sometimes life-threatening illnesses they transmit to humans, pets, and wildlife alike.

Monarch butterflies

The American Monarch butterfly (*D. plexippus*) has fascinated researchers for over 100 years as it is the only insect known to migrate in multi-generational stages [315–319], with the ability to find their exact birthplace on specific milkweed plants (*Asclepias* spp.) at great distances across land and oceans.

Monarchs (*D. plexippus*), found across Southern Canada, the United States, and South America, are generally divided by the Rocky Mountains into eastern and western migratory groups. Their population has precipitously declined by 99.4% since the 1980s (85% of that since 2017) and by 90% in the past two decades in both western and eastern populations [13, 15]. These steep declines are from numerous anthropogenic causes and may have already crossed extinction thresholds, thereby leaving us bereft not only of their beauty and inspiration, but also the perfect model for long-distance animal migration study in general.

Monarch butterflies are among North America's most beloved invertebrates. They have for centuries navigated thousands of miles/kilometers in an iconic fall migration from southern Canada and the mid- and northeastern U.S. to a small area of about 800 square miles (2,072 square kilometers) in Central Mexico where they once wintered over in the millions in small remote oyamel fir forests. By the time they reach their final destination, some will have traveled distances exceeded only by some migratory seabird species. The monarch is the only insect known to migrate annually over 3,000 miles (4,828 km) at ~250 miles (402 km) per day in the fall from the Canadian border to Mexico, and in the springtime back again. Similar to some bird species, it is the only butterfly known to have a two-way migration pattern. Monarchs are only followed by army cutworm moths (*Euxoa auxiliaris*) which may migrate several thousand kilometers to high elevation sites in the Rocky Mountains to escape lowland heat and drought.

But monarchs are more interesting than for this one amazing migrational feat alone. How they do this is a long-standing mystery since their entire lifecycle, including their two-stage spring return migration, is multi-generational indicating genetic factors in directional mapping since the final return fall migration south cannot be considered “learned.” Several multifaceted mechanisms must come into play, as well as little understood complexities in how those mechanisms cooperate and trade off with each other under different environmental circumstances. Monarchs also go from solitary insects during early developmental stages confined to specific locations, then exhibit social insect behaviors after the third generation has reached northern latitudes and turned

south during the final fall migration. And all of this happens in a brain the size of a grain of sand.

Reppert et al. [320] published an excellent review in 2010 on the complexities of monarch migration, noting “... recent studies of the fall migration have illuminated the mechanisms behind the navigation south, using a time-compensated sun compass. Skylight cues, such as the sun itself and polarized light, are processed through both eyes and likely integrated in the brain's central complex, the presumed site of the sun compass. Time compensation is provided by circadian clocks that have a distinctive molecular mechanism and that reside in the antennae. Monarchs may also use a magnetic compass, because they possess two cryptochromes that have the molecular capability for light-dependent magnetoreception. Multiple genomic approaches are being utilized to ultimately identify navigation genes. Monarch butterflies are thus emerging as an excellent model organism to study the molecular and neural basis of long-distance migration.” Reppert and de Roode [321] updated that information in 2018.

Although it has been known for some time that monarchs use a circadian rhythm time-compensated directional sun compass [316, 322–338], many questions remain about its dynamics and concerns regarding effects from radiation.

Monarch antennae are known to contain magnetite [339, 340] and cryptochromes [335, 336, 341, 342] — both understood to play a role in magnetoreception (see “Mechanisms” above). One early study by Jones and MacFadden [343] found magnetic materials located primarily in the head and thorax areas of dissected monarchs. More recently, Guerra et al. [16] found convincing evidence that monarchs use a magnetic compass to aid their longest fall migration back to Mexico. Those researchers used flight simulator studies to show that migrants possess an inclination magnetic compass to assist fall migration toward the equator. They found this inclination compass is light-dependent, utilizing ultraviolet-A/blue light between 380 and 420 nm and noted that the significance of light (<420 nm) for an inclination compass function had not been considered in previous monarch studies. They also noted that antennae are important for an inclination compass since they contain light-sensitive magnetosensors. Like some migratory birds, the presence of an inclination compass would serve as an orientation mechanism when directional daylight cues are impeded by cloudy or inclement weather or during nighttime flight. It may also augment time-compensated sun compass orientation for appropriate directionality throughout migration. The inclination compass was found to function at earth-strength magnetic fields, an important metric.

The question remains: Can the magnetic compass in monarchs be disrupted by anthropogenic EMF like it does with geomagnetic orientation in migratory birds [213]. There is some indication this is possible. Perez et al. [330] found monarchs completely disorient after exposure to a strong magnetic field (0.4-T MF for 10 s, or approximately 15,000 times the Earth's magnetic field) immediately before release vs. controls. This is a high exposure but within range of man-made exposures today very close to powerlines.

Bees, wasps, and others

Pollinators, bees in particular, are keystone species without which adverse effects would occur throughout food webs and the Earth's entire biome were pollinators to disappear. Because of their central role and accessibility for research, bee studies have created a wealth of information, including regarding anthropogenic EMFs.

Bees — especially honey and bumble bees — are another iconic insect species beloved for their role in pollination; honey, propolis, royal jelly and beeswax production; their critical importance to our food supply; and their crucial role in global ecological health and stability. Found on every continent except Antarctica wherever there are flowering plants requiring insect pollination, there are over 16,000 known species of bees in seven different biological families, consisting of four main branches. Some species live socially in colonies while others are solitary. The western honey bee (*Apis mellifera*) is the best known and most studied due in part to its central role in agriculture. Bees feed on nectar for energy and pollen for protein/nutrients, and have co-evolved with many plant species in astoundingly complex ways. They are also highly sensitive to both natural and anthropogenic EMFs. Beeswax itself has electrical properties [50].

Human apiculture has been practiced since the time of ancient Egyptian and Greek cultures and bees have been closely studied since the 1800s. Almost all bee species, including commercially raised and wild species, are under decades-long multiple assaults. These include from pesticides, herbicides, climate change, various bacterial/viral diseases, infestations from parasitic mite species — particularly *Apis cerana*, *Varroa destructor* and *Varroa jacobsoni* beginning in the mid-1980s — and predation from introduced species that attack bees directly (e.g., the invasive giant bee-eating hornet *Vespa mandarinia*), as well as alter plant ecology over time to adversely affect bee food supply. Some have suggested that vanishing bees may also have to do with premature aging due to environmentally caused shortened telomeres [344].

Whole colony collapse disorder (CCD) is the most dramatic manifestation of domesticated bee demise in which worker bees abruptly disappear from a hive without a trace, resulting in an empty hive with perhaps a remaining queen and a few worker bees despite ample resources left behind. Few, if any, dead bees are ever found near the hive. CCD was first described in the U.S. in 2006 in Florida in commercial western honey bee colonies. Van Engelsdorp et al. [345] quantified bee losses across all beekeeping operations and estimated that between 0.75 and 1.00 million honey bee colonies died in the United States over the winter of 2007–2008. Up until that survey, estimates of honey bee population decline had not included losses occurring during the wintering period, thus underestimating actual colony mortality.

The same phenomenon had been described by beekeepers in France in 1994 [346] — later attributed to the timing of sunflower blooming and the use of imidacloprid (IMD), a chlorinated nicotine-based insecticide or “neonicotinoid” being applied to sunflowers for the first time there [347]. Similar to DDT but considered safer for mammals including humans, neonicotinoids are a slow-release class of neurotoxins that block insect nervous systems via acetylcholine receptors, interfering with neuronal signaling across synapses. Sublethal doses can interfere with bee navigation.

Since then similar phenomena have been seen throughout Europe [348] and some Asian countries. Causal hypotheses included all of the above factors with varying foci on pesticide classes like neonicotinoids and genetically modified crops, but no single agent adequately explains CCD. Bromenshenk et al. [349] however, identified pathogen pairing/co-infection with two previously unreported RNA viruses — *V. destructor-1*, and Kakugo viruses, and a new iridescent virus (IIV) (*Iridoviridae*) along with *Nosema ceranae* — in North American honey bees that were associated with all sampled CCD colonies. The pathogen pairing was not seen in non-CCD colonies. Later cage trials with IIV type-6 and *N. ceranae* confirmed that co-infection with those two pathogens was more lethal to bees than either pathogen alone. Still many questions remain.

There are two national surveying groups in the U.S. — the U.S. Department of Agriculture (USDA) which began surveying managed bee populations in 2015 but funding was cut in late 2019; and the Bee Informed Partnership (BIP), a non-profit that coordinates with research facilities and universities. Prior to USDA's funding cuts, managed colonies decreased from CCD by 40% [350] with an additional 26% over the same quarter in 2019 [351]. BIP's survey period for April 1, 2018 through April 1, 2019 found U.S. beekeepers lost an estimated 40.7% of their managed honey bee colonies. The previous year had similar annual

losses of 40.1%. The average annual rate of loss reported by beekeepers since 2010–11 was 37.8% [352].

Also in the U.S., for the first time in 2016, seven species of Hawaiian yellow-faced bees (*Hylaeus anthracinus*, *Hylaeus longiceps*, *Hylaeus assimulans*, *Hylaeus facilis*, *Hylaeus hiliaris*, *Hylaeus kuakea*, and *Hylaeus mana*) were added to the federal endangered species list, as well as the rusty patched bumble bee (*Bombus affinis*) which, prior to the late 1990s, had been widely dispersed across 31 U.S. states [353]. Mathiasson and Rehan [354] examined 119 species in museum specimens in New Hampshire going back 125 years and concluded that 14 species found across New England were on the decline by as much as 90%, including the lesser studied leafcutter and mining bees that nest in the ground, unlike honeybees that nest in commercial hives or in trees, shrubs, and rock crevices in the wild.

Worldwide, many bee and other pollinator populations have also declined over the last two decades. Managed honey bee (*Apis mellifera*) colonies decreased by 25% over 20 years in Europe and 59% over 58 years in North America, with many wild bumble bee populations in Europe and North America having gone locally extinct [355–358]. But while dramatic range contractions have been seen, not all bees in all places are declining; some populations are growing depending on opportunistic and species-adaptability factors. For many species data are still insufficient, of poor quality, or nonexistent [359]. In addition, bee declines can affect flora survival. Miller-Struttman et al. [360] recorded flower declines of 60% with 40 years of climate warming in alpine meadows — areas largely protected from land-use changes. Insects are highly sensitive to temperature changes.

A comprehensive UK survey of pollinator species [361] found that of 353 wild bee and hoverfly species across Britain from 1980 to 2013, 25% had disappeared from the places they had inhabited in 1980. Further estimates found a net loss of over 2.7 million in 0.6 mi (1 km) grid cells across all species. Declining pollinator evenness suggested losses were concentrated in rare species. Losses linked to specific habitats were also identified, with a 55% decline among wild upland species while dominant crop pollinators increased by 12%, possibly due to agricultural business interventions. The general declines found a fundamental deterioration in both wider biodiversity and non-crop pollination services.

There is no question that the huge diversity of pollinator species across the planet is suffering and that losses could be catastrophic with an estimated 90% of wild plants and 30% of world crops in jeopardy [362].

There is a likelihood that rising EMF background levels play a role. Bees have been known for decades to have an

astute sense of the Earth's DC magnetic fields [363, 364] and rely on that perception for survival. For centuries beekeepers had noticed curious movements in bee hives but Austrian ethologist Karl von Frisch finally interpreted that activity in the 1940s, winning the Nobel Prize in 1973 for what came to be known as the honey bee “waggle dance.” Through complex circles and waggle patterns, bees communicate the location of food sources to other members of the hive, using the orientation of the sun and the Earth's magnetic fields as a gravity vector, “dancing” out a map for hive members to follow like nature's own imbedded GPS. Bees also detect the sun's direction through polarized light and on overcast days use the Earth's magnetic fields, likely through the presence of magnetite in their abdominal area, and employ complex associative learning and memory [365].

Building on the earlier work of Gould et al. [119], Kobayashi and Kirschvink [52] noted that biogenic magnetite in honey bees is located primarily in the anterior dorsal abdomen. When small magnetized bits of wire were glued over those areas, it interfered with bees' ability to learn to discriminate magnetic anomalies in conditioning experiments, while nonmagnetized wire used in controls did not interfere [366]. Kirschvink and Kobayashi [367] found that when pulse-remagnetization techniques were used on bees trained to exit from a T-maze, that north-exiting bees could be converted to a south-exiting direction similar to what was observed in magnetobacteria and artificial reorientation by Blakemore [113]. Honeybees could also be trained to respond to very small changes in the geomagnetic field intensity [368]. Valkova and Vacha [369] discussed the possibility that honey bees use a combination of both radical pair/cryptochromes and magnetite to detect the geomagnetic field and use it for direction like many birds.

Given these sensitivities, bees may be reacting negatively through multi-sensory mechanisms to numerous sources of anthropogenic multi-frequency interference. Bumble bees (*Bombus terrestris*), a solitary species, and honey bees (*Apis mellifera*), a social hive species, are known to detect weak electric fields in different behavioral contexts, using different sensory mechanisms. Bumble bee e-field detection is likely through mechanosensory hairs [370–372] while honey bees reportedly use their antennae [373] that are electro-mechanically coupled to the surrounding e-field, taking place in the antennal Johnston's organ. Greggers et al. [373] found that honey bee antennae oscillate under electric field stimulation that can then stimulate activity in the antennal nerve. The latter occurs due to bees being electrically charged, and thus subject to electrostatic forces. Erickson [374] found different surface

potentials in bees when leaving or entering hives, and Colin et al. [375] found seasonal variability between positive and negative charges in resting bees. It has also been shown that honey bees with removed or fixed antennae are less able to associate food reward with electric field stimuli and that bees emanate modulated electric fields when moving their wings (at about 230 Hz) and body (at about 16.5 Hz) during the waggle dance [373].

Electro-ecological interplay between flowers and pollinators has also been known since the 1960s and is critical to pollen transfer from flowers to bees [376–378]. It is known that as bees fly through the air, they accumulate a positive charge. Flowers, on the other hand, which are electrically grounded through their root systems, tend to have a negative charge in their petals created by surrounding air that carries around 100 V for every meter above ground. The accumulating positive charge around the flower induces a negative charge in its petals which then interacts with the positive charge in bees. In fact, bees do not even need to land on flowers for pollen transfer to occur; pollen can “jump” from the flower to the bee as the bee approaches due to charge differentials between the two. Thus, it appears that bees and flowers have been “communicating” via electric fields all along [379]. Bees can also learn color discrimination tasks faster when color cues are paired with artificial electric field cues similar to those surrounding natural flowers, but did not learn as readily in an electrically neutral environment [370].

This evidence points to floral e-fields being used in a co-evolutionary symbiotic relationship with bees. Clarke et al. [370, 371] even found that bumblebees can distinguish between flowers that give off different electric fields as floral cues to attract pollinators. Like visual cues, floral electric fields exhibit complex variations in pattern and structure that bumblebees can distinguish, contributing to the myriad complex cues that create a pollinator’s memory of floral food sources. And because floral electric fields can – and do – change within seconds of being visited by pollinators, this sensory ability likely facilitates rapid and dynamic “information exchange” between flowers and their pollinators. Bumblebees can even amazingly use electric field information to discriminate between nectar-rewarding and unrewarding flowers [370].

Bees, locusts: ELF-EMF

Bees are also known to be sensitive to anthropogenic ELF-EMF. In 1973, Wellenstein [380] found that high tension powerlines adversely affected honey bees in wooden hives. This in part prompted the Bonneville Power

Administration, an American federal agency operating in the Pacific Northwest under the U.S. Department of Energy (U.S. DOE), to investigate in 1974 [381–384] the effects of transmission lines on people, plants, and animals, including honey bees. The industry group, Electric Power Research Institute, also followed up on bee research [385, 386]. Both of those studies confirmed that transmission line electric fields can affect honey bees inside wooden hives as wood is a poor insulator and current can be induced when hives are placed in electric fields whether metal is present or not. The strength of the current inside the hive was influenced by the electric field strength, hive height, and moisture conditions with effects noticeable when induced current exceeded 0.02–0.04 mA. Depending on hive height, this occurred in field strengths between 2 and 4 kV/m. Effects included increased motor activity with transient increase in hive temperature, excessive propolis production (a resinous material used by bees as a hive sealer), decreased colony weight gains, increased irritability and mortality, abnormal production of queen cells, queen loss, decreased seal brood, and poor over-winter colony survival [387]. Impacts were most likely caused by electric shocks inside the hives [386, 388]. Effects were mitigated with grounded metal screen/shielding of hives [385]; however, bees appeared unaffected by magnetic fields which permeate metal shielding. The authors concluded that the shielding results indicated that bees were unaffected by flying through an external electric field up to 11 kV/m but noted that the study design could not reveal if subtle effects were occurring.

A more recent study of electric fields by Migdał [389] focused on honey bee behavioral effects on walking, grooming, flight, stillness, contact between individuals, and wing movement. They found that the selected frequency, intensity, and duration of exposure effects bees’ behavioral patterns. Bees were exposed for 1, 3 and 6 h to E-fields at 5.0 kV/m, 11.5 kV/m, 23.0 kV/m, or 34.5 kV/m (with controls under E-field <2.0 kV/m). Within the exposed groups, results showed that exposure for 3 h caused decreased time that bees spent on select behaviors as well as the frequency of behaviors, whereas after both 1 and 6 h, the behavioral parameters increased within the groups. The researchers concluded that a barrier allowing behavioral patterns to normalize for some periods was indicated although none of the exposed groups returned to reference values in controls which adhered to normal behavioral patterns. Bees may have compensatory windows that appear to be both time and intensity dependent for E-fields. The significance of this study is that bees must accomplish certain activities – like flight frequency and the honey bee ‘waggle dance’ noted above – that are

critical for life expectancy and survival. Even slight sequential disturbances may have cascading effects.

In an early-1988 study, Korall et al. [390] also found effects to bees from magnetic fields (MF). Bursts comparable to some of today's pulsed exposures of artificial MF at 250 Hz — the frequency of buzzing during the waggle dance — were applied parallel to natural EMF field lines and induced unequivocal 'jumps' of misdirection by up to +10° in bees during the waggle dance. This alone could cause directional confusion in hives. Continuous fields of 250 Hz with bursts perpendicular to the static MF however caused no effects. They concluded that a resonance relationship other than classic resonance models was indicated (see "Mechanisms" above). This early work has implications for subsequent digital pulsing and all wireless broadband technology.

More recent work on honey bees and ELF-EMF by Shepherd et al. [209] in 2018 found that acute exposure to 50 Hz fields at levels from 20–100 μT (at ground level underneath powerline conductors), to 1,000–7,000 μT (within 1 m of the conductors), reduced olfactory learning, foraging flight success toward food sources and feeding, as well as altered flight dynamics. Their results indicated that 50 Hz ELF-EMFs from powerlines is an important environmental honey bee stressor with potential impacts on cognitive and motor abilities.

Some wasp species have also been found sensitive to ELF-EMF. Pereira-Bomfim et al. [391] investigated the magnetic sensitivity of the social paper wasp (*Polybia paulista*) by analyzing wasp behavior in normal geomagnetic fields and in the presence of external magnetic fields altered by either permanent magnets (DC fields) or by Helmholtz coils (AC fields). They evaluated the change in foraging rhythm and colony behavior, as well as the frequency of departing/homeward flights and the behavioral responses of worker wasps located on the outer nest surface. They found that the altered magnetic field from the DC permanent magnet produced an increase in the frequency of departing foraging flights, and also that wasps grouped together on the nest surface in front of the magnet with their heads and antennae pointing toward the perturbation source, possibly indicating a response to a potential threat as a defense strategy. Controls showed no such grouping behavior. The AC fields created by the Helmholtz coils also increased foraging flights, but individuals did not show grouping behavior. The AC fields, however, induced wasp workers to perform "learning flights." They concluded that for the first time, *P. paulista* demonstrated sensitivity to an artificial modification of the local geomagnetic field and that mechanisms may be due to both cryptochrome/radical pairs and magnetite.

Another flying insect model — desert locust (*Schistocerca gregaria*) — was found susceptible to entrainment by ELF-EMF. In a complex study, Shepherd et al. [392] analyzed acute exposure to sinusoidal AC 50 Hz EMF (field strength range: 10 to 10,000 μT) vs. controls on flights of individual locusts tethered between copper wire coils generating EMFs at various frequencies and recorded on high-speed video. Results found that acute exposure to 50 Hz EMFs significantly increased absolute change in wingbeats in a field-strength-dependent manner. Applying a range of ELF-EMF close to normal wingbeat occurrence, they found that locusts entrained to the exact frequency of the applied EMF. They concluded that ELF exposure can lead to small but significant changes in locust wingbeats, likely due to direct acute effects on insect physiology (vs. cryptochrome or magnetite-based magnetoreception) and/or behavioral avoidance responses to molecular/physiological stress. Wyszowska et al. [393] also found effects on locusts — exposure to ELF-EMF above 4 mT led to dramatic effects on behaviour, physiology and increased Hsp70 protein expression. Such higher exposures may be found near high tension lines.

Bees: RF-EMF

The effects of RF-EMF on bees is of increasing interest since that is the fastest rising EMF environmental exposure of the past 30 years [369]. Beginning in the early 2000s, studies of cell phones placed in the bottom of hives began to appear. Honey bees showed disturbed behavior when returning to hives after foraging and under various RFR exposures [394–396]. Early methodologies, however, were not well designed or controlled. For instance, Favre [397] found increased piping — a distress signal that honey bees give off to alert hive mates of threats and/or to announce the swarming process. Both active and inactive mobile phone handsets were placed in close proximity to honey bees with sounds recorded and analyzed. Audiograms and spectrograms showed that active phone handsets had a dramatic effect on bee behavior in induced worker piping. This study was criticized by Darney et al. [398] for using music in the active RFR exposure which may have introduced a variable capable of affecting bee piping in response to the added sound alone.

In a complex study, Darney et al. [398] tested high frequency (HF) and ultra high frequency (UHF) used in RFID technology in order to develop a method to automatically record honey bees going in and out of hives. They glued RFID tags onto individual bee dorsal surfaces that were detected at the hive entrance by readers emitting HF radio waves. They then looked for possible HF adverse

effects on honey bees' survival. Eight-day-old honey bees were exposed to HF 13.56 MHz or UHF 868 MHz RFR for 2 h split into ON and OFF periods of different durations. Dead bees were counted daily with cumulative mortality rates of exposed and non-exposed honey bees compared seven days after exposure. Two out of five experimental conditions found increased mortality, once after HF and once after UHF exposure, with OFF duration of 5 min or more, after which they recommended limiting honey bee exposure to RFR to less than 2 h per day. They also curiously concluded that the RFID parameters they used for monitoring hive activity presented no adverse effects but the multifrequency peak exposures and RFID attachments need further study in light of other works on RFID effects (see Part 1 for discussion of RFID.)

In another study using an active cell phone attached to hive frames, Odemer and Odemer [399] investigated RFR effects on honey bee queen development and mating success. Control hives had an inactive cell phone attached. After exposing honey bee queen larvae to GSM 900 MHz RFR during all stages of pre-adult development (including pupation), hatching of adult queens was assessed 14 days after exposure and mating success after an additional 11 days. They found that chronic RFR exposure significantly reduced honey bee queen hatching; that mortalities occurred during pupation but not at the larval stages; that mating success was not adversely affected by the irradiation; and that after exposure, surviving queens were able to establish intact colonies. They therefore determined that mobile phone radiation had significantly reduced the hatching ratio but not mating success if queens survived, and if treated queens successfully mated, colony development was not adversely affected. Even though they found strong evidence of mobile phone RFR damage to pupal development, they cautioned its interpretation, noting that the study's worst-case exposure scenario was the equivalent of a cell phone held to a user's head, not at a level found in typical urban or rural hive settings. They concluded that while no acute negative effects on bee health were seen in the mid-term, they also could not rule out effects on bee health at lower chronic doses such as found in ambient environments, and urgently called for long term research on sublethal exposures present in major city environments.

Sharma and Kumar [400] found similar abnormalities in honey bee behavior when they compared the performance of honey bees in RFR exposed and unexposed colonies. Two of four test colonies were designated and each equipped with two functional cell phones — a high exposure — placed on two different hive side walls in call mode at GSM 900 MHz. The average RFR power density

was measured at $8.549 \mu\text{W}/\text{cm}^2$ ($56.8 \text{ V}/\text{m}$, electric field). One control colony had a dummy phone; the other had no phone. Exposure was delivered in 15 min intervals, twice per day during the period of peak bee activity. The experiment was performed twice a week during February to April. It covered two brood cycles with all aspects of hive behavior observed, including brood area comprising eggs, larvae and sealed brood; queen proficiency in egg-laying rate; foraging, flight behavior, returning ability; colony strength including pollen storage; and other variables. Results included a significant decline in colony strength and egg laying and reduced foraging to the point where there was no pollen, honey, brood, or bees by the end of the experiment. One notable difference in this study was that the number of bees leaving the hive decreased following exposure. There was no immediate exodus of bees as a result of exposure — instead bees became quiet, still, and/or confused "...as if unable to decide what to do..." the researchers said. Such a response had not been reported before. The authors concluded that colony collapse disorder is related to cell phone radiation exposures.

Vilić et al. [401] investigated RFR and oxidative stress and genotoxicity in honey bees, specifically on the activity of catalase, superoxide dismutase, glutathione *S*-transferase, lipid peroxidation levels and DNA damage. Larvae were exposed to 900 MHz RFR at field levels of 10, 23, 41 and 120 V m^{-1} for 2 h. At a field level of 23 V m^{-1} the effect of 80% AM 1 kHz sinusoidal and 217 Hz modulation were also investigated. They found that catalase activity and the lipid peroxidation levels significantly decreased in larvae exposed to the unmodulated field at 10 V m^{-1} ($27 \mu\text{W}/\text{cm}^2$) compared to the control. Superoxide dismutase and glutathione *S*-transferase activity in honey bee larvae exposed to unmodulated fields were not statistically different compared to the control. DNA damage increased significantly in larvae exposed to modulated (80% AM at 1 kHz) field at 23 V m^{-1} ($140 \mu\text{W}/\text{cm}^2$) compared to control and all other exposure groups. Their results suggested that RFR effects in honey bee larvae manifested only after certain EMF exposure conditions. Interestingly, they found that increased field levels did not cause a linear dose-response in any of the measured parameters, while modulated RFR produced more negative effects than the corresponding unmodulated field. They concluded that while honey bees in natural environments would not be exposed to the high exposures in their experiments, the results indicated additional intensive research is needed in all stages of honey bee development since the cellular effects seen could affect critical aspects of bee health and survival.

Kumar et al. [402] also found biochemical changes in worker honey bees exposed to RFR. A wooden box was designed with glass on the front and back and wire gauze for ventilation on two sides for both exposed bees and controls. Cell phones (same make, model, and network connection) were kept in listen-talk mode for 40 min. At intervals of 10, 20 and 40 min, 10 exposed and 10 control bees were collected at the same times. Hemolymph was then extracted from the inter-segmental region of bee abdomens and analyzed. Results included increased concentration of total carbohydrates in exposed bees in the 10 min exposure period compared to unexposed bees. Increasing the exposure time to 20 min resulted in a further increase in the concentration, but exposure at 40 min had a reverse effect with declines in carbohydrate concentration although it was still higher than controls. Hemolymph glycogen and glucose content also showed the same exposure pattern – increase in content up to 20 min after which a slight decline that was still higher than controls. Changes in total lipids/cholesterol – the major energy reserves in insects – can affect numerous biological processes. Some lipids are crucial membrane structure components while others act as raw materials in hormones and pheromones. Changes in these parameters are significant to every biological activity, including reproduction. Also of interest in this study was that as exposure time increased, the bees appeared to have identified the source of disturbance. There was a large scale movement of workers toward the talk-mode (with higher RFR exposure during transmission function) but not the listening mode. Bees also showed slight aggression and agitation with wing beating. The researchers hypothesized that this increased activity could be responsible for increased energy use thereby accounting for the decrease in concentration of carbohydrates and lipids in the 40 min exposed sample. The researchers concluded that cell phone radiation influences honey bee behavior and physiology. Sharma [403] had also reported increased glycogen and glucose levels in exposed honey bee pupa.

It must be pointed out that the cell phone emission conditions used in some experiments are questionable, in particular where there was no detail regarding how the phones were activated to achieve emission.

Not all studies demonstrated adverse effects. Mall and Kumar [404] found no apparent RFR effects on brood rearing, honey production or foraging behavior in honey bees in hives with cell phones inside or near a cell tower; and Mixon et al. [405] also found no effects of GSM-signal RFR on increased honey bee aggression. They concluded that RFR did not impact foraging behavior or honey bee navigation and therefore was unlikely to impact colony health.

Although there are several anecdotal reports of insect losses near communication towers, there are only a handful of ambient RFR field studies conducted on invertebrates thus far. In the first large survey of wild pollinating species at varying distances from cell towers, Lázaro et al. [406] found both positive and negative effects from RFR in a broad range of insects on two islands (Lesvos and Limnos) in the northeastern Aegean Sea near Greece. Measured ambient RFR levels included all frequency ranges used in cell communications; broadcast RFR is absent on the islands. RFR values did not significantly differ between islands (Lesvos: 0.27 ± 0.05 V/m; Limnos: 0.21 ± 0.04 V/m; $v_3^2 = 0.08$, $p=0.779$) and did not decrease with the distance to the antenna, possibly, they hypothesized, because some sampling points near the antenna may have been outside or at the edge of the emission lobes. They measured RFR at four distances of 50, 100, 200 and 400 m (164, 328, 656, and 1,312 ft, respectively) from 10 antennas (5 on Lesvos Island and 5 on Limnos Island) and correlated RFR values with insect abundance (numbers of insects) and richness (general health and vitality) – the latter only for wild bees and hoverflies. The researchers conducted careful flowering plant/tree- and- insect inventories in several low-lying grassland areas, including for wild bees, hoverflies, bee flies, other remaining flies, beetles, butterflies, and of various types. Honey bees were not included in this study as they are a managed species subject to beekeeper decisions and therefore not a wild species. On Lesvos 11,547 insects were collected and on Limnos 5,544. Varied colored pan traps for both nocturnal and diurnal samples were used. Results found all pollinator groups except butterflies were affected by RFR (both positively and negatively) and for most pollinator groups effects were consistent on both islands. Abundance for beetles, wasps, and hoverflies significantly decreased with RFR but overall abundance of wild bees and bee flies significantly increased with exposure. Further analysis showed that only abundance of underground-nesting wild bees was positively related to RFR while wild bees nesting above ground were not affected. RFR effects between islands differed only on abundance of remaining flies. On species richness, RFR tended to only have a negative effect on hoverflies in Limnos. Regarding the absence of effects seen in butterflies, they hypothesized that the pan trap collection method is not efficient for collecting butterflies (butterflies accounted for only 1.3 % of total specimens), and that a different sampling method might produce a different result. They concluded that with RFR's negative effects on insect abundance in several groups leading to an altered composition of wild pollinators in natural habitats, it was possible this could affect wild plant diversity and crop

production. They further said the negative relationship between RFR on the abundance of wasps, beetles and hoverflies could indicate higher sensitivity of these insects to EMFs. Potentially more EMF-tolerant pollinators, such as underground-nesting wild bees and bee flies, may fill the vacant niches left by less tolerant species, thus resulting in their population increases. Another possible explanation is that EMFs may have particularly detrimental effects on more sensitive larval stages, and if so, larvae developing above ground (many beetles, wasps, hoverflies) may be more vulnerable than those developing underground since the former could be exposed to higher radiation levels.

In another field study, Taye et al. [407] placed five hives from December to May at varying distances of 1,000, 500, 300, 200 and 100 m (3,280, 1,640, 984, 656 and 328 ft, respectively) from a cell tower in India to measure flight activity, returning ability, and pollen foraging efficiency in honey bees (*Apis cerana* F). They found most effects closest to towers with the least returning bees at 100 m distance from the tower. Maximum foraging and return ability to the colonies was seen at 500 m, followed by 1,000 m and in descending order at 300 and 200 m, with the fewest returning bees at 100 m from the tower. The study also found that if bees returned, the pollen load per minute was not significantly affected.

Vijver et al. [408] however challenged the accuracy of distance from towers that is often used as a proxy for EMF gradients such as the study above. In a field study in The Netherlands, the researchers tested exposure to RFR from a cell base station (GSM 900 MHz) on the reproductive capacity of small virgin invertebrates during the most sensitive developmental periods spanning preadolescent to mating stages when reproductive effects would most likely be seen. Careful RFR field measurements were taken to determine null points in order to see if distance from emitters is a reliable RFR exposure model in field studies. They exposed four different invertebrate hexapod species. Springtails (*Folsomia candida*), predatory 'bugs' (*Orius laevigatus*), parasitic wasps (*Asobara japonica*), and fruit-flies (*D. melanogaster*) were placed in covered pedestal containers within the radius of approximately 150 m of a 900 MHz mobile phone base station for a 48-h period. Six control groups were placed within 6.6 ft (2 m) of the treatment groups and covered in Farady cages. After exposure, all groups were brought to the laboratory to facilitate reproduction with resulting fecundity and number of offspring then analyzed. Results showed that distance was not an adequate proxy to explain dose-response regressions. After complex data synthesis, no significant impact from the exposure conditions, measures of central tendency, or temporal variability of EMF on reproductive

endpoints were found although there was some variability between insect groups. As seen in other studies, distance is often used to create a gradient in energy exposures in studies but this study found the intensity of the transmitter and the direction of transmission to be more relevant, as did Bolte and Eikelboom [409, 410]. The direction and tilt of the transmitter determines whether the location of interest in field studies is in the main beam. In some instances, the closer proximity to the transmitter provided lower readings than further away, which they found between two locations. They also noted that the organisms selected in the study were small in size; springtails have a body length on average of 2 mm; wasps are about 3 mm, insect sizes from 1.4 to 2.4 mm, with the largest organisms tested being female fruit flies at about 2.5 mm length and males slightly smaller. Due to size, limited absorption and little energy uptake capacity, none of these insects are efficient whole-body receptors for 900 MHz waves with a wavelength of approximately 13 in (33 cm). But they further noted that this was a linear regression study and that biological effects are often non-linear. However, finding no distinct effects did not exclude physiological changes. They concluded that because of RFR exposure's increasing ubiquity, urgent attention to potential effects on biodiversity is needed.

The issue of insect size, nonlinearity, and antenna tilt/direction are factors of critical importance with 5G radiation which will create extremely complex near- and far-field ambient exposures to species in urban and rural environments alike, not only from a densification of small cell antennas close to the ground but also from increased satellite networks circling in low Earth orbits (see Part 1). The range of frequencies used for wireless telecommunication systems will increase from below 6 GHz (2G, 3G, 4G, and WiFi) to frequencies up to 120 GHz for 5G which, due to smaller wavelengths, is therefore a better resonant match for small insects. An alarming study by Thielens et al. [411], drawing on numerous robust studies of RFR's decades-long use as a thermal insecticide, modeled absorbed RFR in four different types of insects as a function of frequency alone from 2 to 120 GHz. A set of insect models was obtained using novel Micro-CT (computer tomography) imaging and used for the first time in finite-difference time-domain electromagnetic simulations. All insects showed frequency-dependent absorbed power and a general increase in absorbed RFR at and above 6 GHz, in comparison to the absorbed RFR power below 6 GHz. Their simulations showed that a shift of 10% of the incident power density to frequencies above 6 GHz would lead to an increase in absorbed power between 3–370% — a large differential of serious potential consequence to numerous insect species.

Using a similar approach, Thielens et al. [412] focused on the western honey bee (*Apis mellifera*) with RF-EMF, using a combination of *in-situ* exposure measurements near bee hives in Belgium and numerical simulations. Around five honey bee models were exposed to plane waves at frequencies from 0.6 to 120 GHz — frequencies carved out for 5G. Simulations quantified whole-body averaged RFR absorbed as a function of frequency and found that the average increased by factors of 16–121 (depending on the specimen) when frequency increased from 0.6 to 6 GHz for a fixed incident electric field strength. A relatively small decrease in absorption was observed for all studied honey bees between 12 and 120 GHz due to interior attenuation. RFR measurements were taken at 10 bee hive sites near five different locations. Results found average total incident RFR field strength of 0.06 V/m; those values were then used to assess absorption and a realistic rate was estimated between 0.1 and 0.7 nW. They concluded that with an assumed 10% incident power density shift to frequencies higher than 3 GHz, this would lead to an RFR absorption increase in honey bees between 390 and 570% — a frequency shift expected with the buildout of 5G.

The two previous studies alone should give pause regarding environmental effects to invertebrates in these higher 5G frequency ranges.

Kumar [413] noted that RFR should be included as causal agents of bee CCD and that test protocols need to be standardized and established. Standardization is critical since many studies conducted with cell phones in hives are of very uneven quality and only indicative of potential effects. Placing cell phones in hives and assuming that RFR is the only exposure is inaccurate and misleading. ELF-EMFs are always present in all telecommunications technology, using pulsed and modulated signals [414]. All of these characteristics have been found to be highly biologically active apart from frequency alone. Such studies are likely capturing ELF effects without identifying them. All aspects of transmission, including transmission engineering itself from towers, need to be considered to determine accurate exposures and delineate causative agents. Vibration and heat must also be considered — cell phones in transmission mode could raise hive temperature quickly and bees are highly temperature sensitive. Due to “waggle dance” specifics in creating foraging “roadmaps,” bees should not be artificially relocated from hives to determine return ability after EMF exposure. They may be confused by relocation alone, adversely affecting their return abilities. Such tests also involve only one stressor when there are multiple stressors on insect species today. Understanding such cofactors is critical in determining accurate data and

outcomes [415, 416]. Translating laboratory studies to field relevance has always been problematic but understanding EMF effects to insects has become urgent with ever increasing low-level ambient exposure from devices and infrastructure, especially in light of the new 5G networks being built. There are numerous variables that studies have yet to factor in. All of the above indicates a critical need to standardize experimental protocols and to take electroecology far more seriously, especially regarding aerial species in light of 5G.

Aquatic environments

There are fundamental electrical differences in conductivity (how well a material allows electric current to flow) and resistivity (how strongly a material opposes the flow of electric current) between air and water. Through water, EMF propagation is very different than through air because water has higher permittivity (ability to form dipoles) and electrical conductivity. Plane wave attenuation (dissipation) is higher in water than air, and increases rapidly with frequency. This is one reason that RFR has not traditionally been used in underwater communication while ELF has been. Conductivity of seawater is typically around 4 S/m, while fresh water varies but typically is in the mS/m range, thus making attenuation significantly lower in fresh water than in seawater. Fresh water, however, has similar permittivity as sea water. There is little direct effect on the magnetic field component in water mediums; propagation loss is mostly caused by conduction on the electric field component. Energy propagation continually cycles between electric and magnetic fields and higher conduction leads to strong attenuation/dissipation of EMF [98].

Because of these essential medium differences, electroreceptor mechanisms in aquatic species may be very different than those previously described in aerial species since air is a less conductive and resistive medium with less attenuation. That is why RFR travels more easily and directly through air. In aquatic species electroreception may be a result of transmission via water directly to the nervous system through unique receptor channels called Ampullae of Lorenzini [371]. In frogs, amphibians, fish, some worm species and others, receptor channels may be through the skin as well as via mechanisms more common in aerial species such as in the presence of magnetite (see “Mechanisms” above). There can be great variation in electroreceptive sensitivities in species inhabiting the two fundamentally different environments. Some amphibian species, however, have physical characteristics that span both mediums and therefore varied magnetoreception mechanisms.

Amphibians: frogs, salamanders, reptiles: regeneration abilities

Amphibians are the class of animals that include frogs, toads, salamanders, newts, some reptiles, and caecilians. The common term ‘frog’ is used to describe thousands of tailless amphibian species in the Order *Anura*. There are over 6,300 anuran species recorded thus far, with many more likely disappearing today due to climate change and other factors before we even knew they existed. Informal distinctions are made between frogs (thin-skinned species) and toads (thick, warty skins) but such distinctions are not used for taxonomic reasons. While the greatest concentration of diverse frog species is in tropical rainforests, they are widely found all over the world from the tropics to subarctic regions. Most adult frogs live in fresh water and/or on dry land while some species have adapted to living in trees or underground. Their skin varies in all manner of colors and patterns, from gray/green and brown/black to bright reds/yellows.

Frog skin is smooth and glandular — something of concern given nascent 5G technology (see Part 1) — and can secrete toxins to ward off predators. Frog skin is also semi-permeable which makes them highly susceptible to dehydration and pollutants. With radical weather shifts due to climate change and unpredictable swings between abnormal droughts followed by flooding in previously weather-stable regions, environmentally sensitive amphibians like frogs are considered bell-weather species. Frequently, time may be insufficient for some local/regional species to regenerate in between radical weather cycles, leading to population collapse.

Since the 1950s, there has been a significant decline in frog populations with more than one third of species today considered threatened with extinction while over 120 species are already believed to have gone extinct since the 1980s [10, 417, 418]. This amphibian decline is considered part of an ongoing global mass extinction, with population crashes as well as local extinctions creating grave implications for planetary biodiversity [419]. Amphibian extinction results are from climate change [420–422]; habitat loss/destruction [423, 424]; introduced species [425]; pollution [426], parasites [423, 427]; pesticides, herbicides and fungicides [428–430]; disease [431–435]; and increased ultraviolet-B radiation [436–439] among others. Anthropogenic sound pollution may also affect amphibian call rates and therefore impact reproduction [440] and artificial night lights affect male green frog (*Rana clamitans melanota*) breeding [441]. Nonionizing electromagnetic fields may also play a role [442].

McCallum [443] calculated that the current extinction rate of amphibians could be 211 times greater than their pre-anthropogenic natural “background extinction” rate with the estimate rising 25,000–45,000 times if endangered species are also included in the computation. Today, declining amphibian populations are seen in thousands of species across numerous ecosystems, including pristine forested areas [418] and declines are now recognized among the most severe impacts of the anthropocene era [417, 442].

In addition, the number of frogs with severe malformations often incompatible with survival has risen sharply. Deformities are a complex issue related to physiology, anatomy, reproduction, development, water quality, changing environmental conditions, and ecology in general. Any time deformities are observed in large segments of wildlife populations there are indications of serious environmental problems [442]. Amphibian malformations are presumed due to an aggressive infectious fungal disease called Chytridiomycosis, caused by the chytrid fungi *Batrachochytrium dendrobatidis* and *Batrachochytrium salamandrivorans* [432–435], and by parasites like *Ribeiroia ondatrae* [427]. Chytridiomycosis has been linked to dramatic amphibian declines and extinctions in North, Central, and South America, across sections of Australia and Africa and on Caribbean islands like Dominica and Montserrat. First identified in the 1970s in Colorado, U.S., it continues to spread globally at an alarming rate. Some populations witness sporadic deaths while others experience 100% mortality. There is no effective measure to control the disease in wild populations. Herbicides like glyphosate used in Roundup™ and atrazine, an endocrine disruptor, have also been found to cause severe malformations in both aquatic and land amphibian species from farmland pesticide/herbicide/fungicide runoff [428–430].

Frogs are known to be highly sensitive to natural and manmade EMF. Much research into the electrophysiology of frogs has been conducted because they are good lab models for human nervous system research, readily available, and easily handled. As far back as 1780, the Italian physicist Luigi Galvani discovered what we now understand to be the electrical basis of nerve impulses while studying static electricity (the only kind then known) when he accidentally made frog leg muscles contract while connected to the spinal cord by two different metal wires [444]. Galvani thought he had discovered “animal magnetism” but had actually discovered direct current and what later became known as a natural “current of injury” — the process by which an injured limb, for instance, produces a negative charge at the injury site that will later turn

to a positive charge at the same site in some species as discovered in the 1960s by Robert O. Becker [444–451]. The earliest curiosity about natural current continued throughout the 1800s on various aspects of EMF and later throughout the 1920s to 1940s in pioneering researchers Elmer J. Lund [452–454] and Harold Saxon Burr [455–457] who worked to establish the first unified electrodynamic field theory of life, using hydra, frog, and salamander models among several others because of their morphogenic properties [458]. While frogs do not regenerate limbs the way salamanders do, both are so similar in taxonomy that curiosity was high in the early pioneers cited above throughout the 1960s to 1990s about what fundamentally allowed limb regeneration in one species, by not the other. Much was learned in the process about amphibian electrophysiology and cellular microcurrent in wound healing, as well as the electrophysiological properties of cellular differentiation, and eventually dedifferentiation pertinent to all contemporary stem cell research. Today the implications of this early work have gained new interest and targeted research regarding endogenous microcurrent and limb regeneration potential in humans, as well as dedifferentiation/stem cell/morphogenesis in general for cancer treatment and other healing modalities. For a thorough review of studies on morphogenesis see Levin [459].

Ubiquitous low-level ambient EMFs today match some of the natural low-level microcurrent found critical to the fundamental processes of amphibian growth, reproduction, morphogenesis, and regeneration, lending new meaning to the early research that defined amphibian electrophysiology. We just need to make far better use of it to understand what role, if any, today's ambient exposures may be contributing to amphibian losses. (To compare tables between rising ambient EMF levels and low level effects in wildlife, see Part 1, Supplement 1; and Part 2, Supplement 3.)

Amphibian and reptile magnetoreception

How amphibians perceive natural and manmade EMF is similar to other species reviewed above and for amphibian mechanism reviews see Phillips et al. [460, 461]. Like many bird and insect species, evidence indicates that amphibians perceive the Earth's geomagnetic fields by at least two different biophysical magnetoreception mechanisms: naturally occurring ferromagnetic crystals (magnetite), and light-induced reactions via specialized photo-receptor cells (cryptochromes) that form spin-correlated radical pairs. Like birds, both mechanisms are present in some amphibians. Cryptochromes provide a directional

'compass' and the non-light-dependent magnetite provides the geographical 'map.'

In a thorough discussion of many magnetoreception studies in anura and urodela species, Diego-Rasilla et al. [462] found evidence that Iberian green frog tadpoles (*Pelophylax perezi*) had a light-dependent magnetic compass, and Diego-Rasilla et al. [463] also found that tadpoles of the European common frog (*Rana temporaria*) are capable of using the Earth's magnetic field for orienting along a learned y-axis. In these studies, they investigated if this orientation is accomplished using a light-dependent magnetic compass similar to that found in the earlier experiments with other species of frogs and newts [460, 462–470] or from some other factor. They concluded that the magnetic compass provided a reliable source of directional information under a wide range of natural lighting conditions. They also compared their findings to studies [470] that showed the pineal organ of newts to be the site of the light-dependent magnetic compass, as well as to recent neurophysiological evidence showing magnetic field sensitivity located in the frog frontal organ which is an outgrowth of the pineal gland. They hypothesized this work could indicate a common ancestor as long ago as 294 million years.

To determine if orientation using Earth's magnetic fields changed according to seasonal migration patterns, Shakhparonov and Ogurtsov [471] tested marsh frogs (*Pelophylax ridibundus*) in the laboratory to see if frogs could determine migratory direction between the breeding pond and their wintering site according to magnetic cues. Adult frogs (n=32) were tested individually in a T-maze 127 cm long inside a three-axis Helmholtz coil system (diameter 3 m). Maze arms were positioned parallel to the natural migratory route and measured in accordance with the magnetic field. Frogs were tested in the breeding migratory state and the wintering state, mediated by a temperature/light regime. Frog choice in a T-maze was evident when analyzed according to the magnetic field direction. They moved along the migratory route to the breeding pond and followed the reversion of the horizontal component of the magnetic field. The preference was seen in both sexes but only during the breeding migratory state. They concluded that adult frogs obtained directional information from the Earth's magnetic field.

Diego-Rasilla et al. [472] found similar evidence in two species of lacertid lizards (*Podarcismuralis* and *Podarcis lilfordi*) that exhibited spontaneous longitudinal body axis alignment relative to the Earth's magnetic field during sun basking periods. Both species exhibited a highly significant bimodal orientation along the north-northeast and south-southwest magnetic axis. Lizard orientations were

significantly correlated over a five-year period with geomagnetic field values at the time of each observation. This suggested the behavior provides lizards with a constant directional reference, possibly creating a spatial mental map to facilitate escape. This was the first study to provide spontaneous magnetic alignment behavior in free-living reptiles although studies of terrapins have also found such spontaneous magnetic alignment [92, 323, 473]. Nishimura et al. [474, 475] also found sensitivity to ELF-EMF (sinusoidal 6 and 8 Hz, peak magnetic field 2.6 μT , peak electric field 10 V/m) in a lizard species (*Pogona vitticeps*) as demonstrated by significant increased tail lifting — a reproductive behavior. Interestingly, this tail-lifting response to ELF-EMF disappeared when the parietal eye was covered, suggesting that the parietal eye contributes to light-dependent magnetoreception and that exposure to ELF-EMFs may increase magnetic-field sensitivity in the lizards. A further experiment [476] showed that light at a wavelength lower than 580 nm was needed to activate the light-dependent magnetoreception of the parietal eye.

Amphibians: RF-EMF

Most frogs spend significant time on land but lay eggs in water where they hatch into tadpoles with tails and internal gills. However, some species bypass the tadpole stage and/or deposit eggs on land. Frogs are thus subject to exposures from both land-based and aquatic environments. A frog's life cycle is complete when metamorphosis into an adult form occurs. Many adverse effects do not appear until after metamorphosis is completed but problems have been found throughout the entire life cycle after exposures to both ELF-EMF and RFR.

Most early research on frogs (other than the Becker et al. regeneration inquiries noted above) was conducted at high thermal levels rarely encountered in the environment but some are included here because they helped delineate amphibian electrophysiology with effects later supported in low-level research. Some early work did use frog models to investigate cardiac effects with lower intensity exposures. Levitina [477] found that intact frog whole-body exposure caused a decrease in heart rate, while irradiation of just the head caused an increase. Using VHF frequency RFR at a power density of 60 $\mu\text{W}/\text{cm}^2$, $A=12.5$ cm, Levitina attributed the cardiac changes to peripheral nervous system effects but according to Frey and Seifert [478], because of the wavelengths used in that study, little energetic body penetration would be expected. They said a skin receptor hypothesis was therefore reasonable.

Following on Levitina's work, Frey and Seifert [478] — using isolated frog hearts, UHF frequencies that penetrate tissue more efficiently and low intensity pulse modulation — found that pulsed microwaves at 1,425 GHz could alter frog heart rates depending on the timing of exposure between the phase of heart action and the moment of pulse action. Twenty-two isolated frog hearts were irradiated with pulses synchronized with the P-wave of the ECGs; pulses were of 10 s duration triggered at the peak of the P-wave. Two control groups were used without RFR exposures with no effects noted. They found heart rate acceleration occurred with pulsing at about 200 ms after the P-wave. But if the pulse occurred simultaneously with the P-wave, no increases were induced. Arrhythmias occurred in half the samples, some resulting in cardiac cessation. Clearly from this study, RFR affected frog heart rhythm and could cause death.

A more recent work by Miura and Okada [479] found severe vasodilation in frog foot webs from RFR. In a series of three experiments using 44 anesthetized frogs (*X. laevis*) at thermal and non-thermal intensities, researchers exposed foot webs to pulsed RFR in three parameters with the monitor coil set at 1 V peak-to-peak: 100 kHz 582-3 mG and 174.76 V cm^{-1} ; 10 MHz 7.3 mG and 2.19 V cm^{-1} ; 1 MHz 539 mG and 16.11 V cm^{-1} . They found not only dilated arterioles of the web which had already been re-constricted with noradrenaline, but also dilated arterioles under non-stimulated conditions. Vasodilation increased slowly and reached a plateau 60 min after radiation's onset. After radiation ceased, vasodilation remained for 10–20 min before slowly subsiding. Vasodilation was optimum when pulsation was applied 50% of the total time at a 10 kHz burst rate at 10 MHz. Effects were non-thermal. The pattern of vasodilation induced by warm Ringer solution was different from the vasodilatory effect of weak RFR, involving the level of intracellular Ca^{2+} . They hypothesized that since Ca^{2+} ATPase is activated by cyclic GMP which is produced by the enzymatic action of guanylate cyclase, RF-EMF may activate guanylate cyclase to facilitate cyclic GMP production. They concluded the study indicates for the first time that RFR dilates peripheral resistance vessels by neither pharmacological vasodilator agents nor physical thermal radiation, but that the precise mechanisms of activation of guanylate cyclase by RFR at the molecular level required further study. Vasodilation and constriction affects every part of the body and can affect all organ systems.

Prior to this, Schwartz et al. [480] found changes in calcium ions in frog hearts in response to a weak VHF field that was modulated at 16 Hz. This would be an exposure common in the environment. Calcium ions are critical to heart function.

Balmori [24–30, 442] and Balmori and Hallberg [271] have focused widely on EMF effects to wildlife, with two papers on amphibians. Balmori [442], in a review, noted that RFR in the microwave range is a possible cause for deformations and decline of some amphibian populations, and Balmori [481] in 2010 found increased mortality in tadpoles exposed to RFR in an urban environment. In the 2010 study, tadpoles of the common frog (*Rana temporaria*) were exposed to RFR from several mobile phone towers at a distance of 459 ft (140 m). Two month exposures lasted through egg phase to advanced tadpole growth prior to metamorphosis. RF and MW field intensity between 1.8 and 3.5 V/m (0.86–3.2 $\mu\text{W}/\text{cm}^2$) were measured with three different devices. Results determined that the exposed group ($n=70$) had low coordination of movements and asynchronous growth that resulted in both large and small tadpoles, as well as a disturbing 90% high mortality rate. In the control group ($n=70$) a Faraday cage was used under the same conditions. Controls found movement coordination to be normal and development synchronous with mortality rate at a low 4.2%. These results indicated that RFR from cell towers in a field situation could affect both development and mortality of tadpoles. Prior to this study, Grefner et al. [482] also found increased death in tadpoles (*Rana temporaria* L.) exposed to EMF, as well as higher mortality rates, and slower less synchronous development.

Mortazavi et al. [483] found changes in muscle contractions in frogs exposed to 900-MHz cell phone radiation for 30 min; gastrocnemius muscles were then isolated and exposed to a switched on/off mobile phone radiation for three 10-min intervals. The authors reported RFR-induced effects on pulse height and latency period of muscle contractions. SARs of the nerve-muscle preparation were calculated to be 0.66 (muscle) and 0.407 (nerve) W/kg.

Rafati et al. [484] investigated the effects of RFR on frogs from mobile phone jamming equipment emitting RFR in the same frequencies as mobile phones. (Although illegal in many countries, jammers are nevertheless used to interfere with signals and stop communication.) The study sought to follow up on reports of non-thermal effects of RFR on amphibians regarding alterations of muscle contraction patterns. They focused on three parameters: the pulse height of leg muscle contractions, the time interval between two subsequent contractions, and the latency period of frog's isolated gastrocnemius muscle after stimulation with single square pulses of 1 V (1 Hz). Animals in the jammer group were exposed to RFR at a distance of 1 m from the jammer's antenna for 2 h while the control frogs were sham exposed. All were then sacrificed and isolated gastrocnemius muscles were exposed to on/off

jammer radiation for three subsequent 10 min intervals (SAR for nerve and muscle of the different forms of jammer radiation was between 0.01 and 0.052 W/kg). Results showed that neither the pulse height of muscle contractions nor the time interval between two subsequent contractions were affected, but the latency period (time interval between stimulus and response) was statistically significantly altered in the RFR-exposed samples. They concluded the results supported earlier reports of non-thermal effects of EMF on amphibians including the effects on the pattern of muscle contractions. Control sham exposed samples showed no effects.

Amphibians, reptiles: ELF-EMF

Amphibians are highly sensitive to ELF-EMF. An early-1969 study by Levenson [485] using a magnetic field probe found increased high rates of teratogenesis in frogs (*Rana sylvatica*) and salamanders (*Ambystoma maculatum*). Two identical probes using different field strengths were employed — both operated in the kilogauss region with high field gradients. Amphibian eggs and embryos were exposed at various stages of development with gross abnormalities found in developing larvae vs. control. At the hatching stage severe abnormalities were noted in both anuran and urodele larvae from probe-treated eggs. Hatching abnormalities included microcephaly, altered development, and multiple oedematous growths. In probe-treated frogs there was a delay in the appearance of a high percentage of malformations until the climax stage of metamorphosis. Until that stage, the larvae were of the same appearance as control specimens, thus camouflaging the damage after just a brief treatment of early embryos. The frog abnormalities at metamorphosis differed from those in the hatching tadpoles and consisted mainly of severe subepidermal blistering and leg malformations including formation of multiple deformed limbs incompatible with life. Over 90% of the morphological alterations at metamorphosis climax were also found to be associated with deformed kidneys. The gastrula stages of development appeared to be the most sensitive in the delayed-effects category. While this was a high-field exposure experiment, it is an intensity that is found in some environments today especially near high tension lines and in abnormal ground current situations.

Neurath [486] also found strongly inhibited early embryonic growth of the common leopard frog (*Rana pipiens*) by a high static magnetic field with a high gradient (1T) — an exposure sometimes found in the environment — while Ueno and Iwasaka [487] found abnormal growth and

increased incidence of malformations in embryos exposed to magnetic fields up to 8T but exposures that high are typically near industrial sites and rarely found in nature.

Severini et al. [488] specifically addressed whether weak ELF magnetic fields could affect tadpole development and found delayed maturation in tadpoles. Two cohorts of *X. laevis laevis* (Daudin) tadpoles were exposed for 60 days during immaturity to a 50 Hz magnetic field of 63.9–76.4 μT rms (root mean square, average values) magnetic flux density in a solenoid. Controls were two comparable cohorts remotely located away from the solenoid. The experiment was replicated three times. Results showed reduced mean developmental rate of exposed cohorts vs. controls (0.43 vs. 0.48 stages/day, $p < 0.001$) beginning from early larval stages; exposure increased the mean metamorphosis period of tadpoles by 2.4 days vs. controls ($p < 0.001$); and during the maturation period, maturation rates of exposed vs. control tadpoles were altered. No increases in mortality, malformations, or teratogenic effects were seen in exposed groups. The researchers concluded that relatively weak 50 Hz magnetic fields can cause sub-lethal effects in tadpoles via slowed larval development and delays in metamorphosis. Such exposures are found in the environment today in some locations and even though the changes were small, coupled with climate change, such sub-lethal effects may impact some wildlife populations in some environments.

In similar followup work, Severini and Bosco [489] found sensitivity to small variations of magnetic flux density (50 Hz, 22-day continuous exposure, magnetic flux densities between 63.9 and 76.4 μT) in tadpoles exposed to a stronger field vs. controls exposed to a weaker field. A significant delay in development of 2.5 days was found in exposed vs. controls. They concluded the delay was caused by the slightly different magnetic flux densities with results suggesting a field threshold around 70 μT in controlling the tadpole developmental rate.

Schlegel in 1997 found European blind cave salamanders (*Proteus anguinus*) and Pyrenean newts (*Euproctus asper*) to be sensitive to low level electric fields in water [490]. And Schlegel and Bulog [491] in followup work found thresholds of overt avoidance behavior to electric fields as a function of frequency of continuous sine-waves in water. Nine salamanders from different Slovenian populations of the urodele (*P. anguinus*) that included three specimens of its ‘black’ variety (*P. anguinus parkelj*) showed thresholds between 0.3 mV/cm (ca 100 nA/cm²) and up to 2 mV/cm (670 nA/cm²), with the most reactive frequencies around 30 Hz. Sensitivity included a total frequency range below 1 Hz (excluding DC) up to 1–2 kHz with up to 40 dB higher thresholds. These are ranges that may

be found in the wild near high tension lines and utility grounding practices near water, by some underwater cabling, and by some RFR transmitters.

Landesman and Douglas in 1990 [492] found some newt species showed accelerated abnormal limb growth when pulsed electromagnetic fields were added to the normal limb regeneration process. While normal limb regeneration found normal regrowth patterns in 72% of specimens, 28% were abnormal. Abnormalities included loss of a digit, fused carpals, and long bone defects which occurred singly or in combination with one another. When exposure to a PEMF was added for the first 30 days post-amputation, followed by a 3–4 month postamputation period, a group of forelimbs with unique gross defects increased by an additional 12%. Defects (singly or in combination) included the loss of two or more digits with associated loss of carpals, absence of the entire hand pattern, and abnormalities associated with the radius and ulna. The researchers offered no explanation. Exposure intensities were similar to those used to facilitate non-juncture fracture healing in humans.

Komazaki and Takano in 2007 [493] found accelerated early development growth rates with 50 Hz, 5–30 mT alternating current exposures in the fertilized eggs of Japanese newts (*Cynops pyrrhogaster*). The period of gastrulation was shortened via EMF-promoted morphogenetic cell movements and increased $[\text{Ca}^{2+}]_i$. They said their results indicated that EMF specifically increased the $[\text{Ca}^{2+}]_i$ of gastrula cells, thereby accelerating growth. This study only observed through the larval stages and they did not see any malformations under EMF exposures, which they attributed to possible differences in the intensity and mode of EMF.

With amphibians and some reptiles demonstrating high sensitivity to natural background EMF for important breeding and orientation needs, amphibians living in aquatic, terrestrial, and aerial environments (i.e. tree frog species) may be affected from multi-frequency anthropogenic EMF in ways we do not fully understand. There are potential effects — especially from 5G MMW that couple maximally with skin — to all aspects of their development and life cycles, including secondary effects.

Fish, marine mammals, lobsters, and crabs

Aquatic animals are exquisitely sensitive to natural EMF and therefore potentially to anthropogenic disturbance. The Earth’s dipole geomagnetic field yields a consistent

though varying source of directional information in both land and aquatic species for use in homing behavior, orientation during navigation and migration. This information is used both as a ‘map’ for positional information as well as a ‘compass’ for direction [494–497]. Aquatic species are known to be sensitive to static geomagnetic fields, atmospheric changes and sunspot activities [498]. For recent comprehensive reviews on magnetic field sensitivity in fish and effects on behavior, see Tricas and Gill [36] and Krylov et al. [33]. Some biological ‘magnetic maps’ may be inherited [499]. And for a recent extensive discussion of the Earth’s natural fields and magnetoreception in marine animals with a focus on effects from electromagnetic surveys that use localized strong EMFs to map petroleum deposits under seabeds, see Nyqvist et al. [498] and below.

As mentioned above, because of the difference in conductivity of water and other factors, the way some aquatic species sense EMF may rely on unique modes of physiological perception, as well as those employed by terrestrial animals. There may also be sensory combinations not yet understood in some aquatic and semi-aquatic species. For instance, what role does the neural conductivity of whiskers (vibrissae) in seals, sea lions and walrus play other than for food finding? Aquatic species’ dense network of whiskers is larger with greater blood flow than terrestrial species and can contain 1,500 nerves per follicle vs. cats at 200 per follicle. Seal whiskers also vary geometrically from terrestrial species and the largest part of the seal brain is linked to whisker function. Seals use whiskers to map the size, shape and external structure of objects and can find prey even when blindfolded. Their whiskers are also sensitive to weak changes in water motion [100]. But are they also using them as a location or directional compass in relation to the geomagnetic field? That has yet to be studied.

Unique sensory differences in aquatic species have long been documented. Josberger et al. [500] noted that in 1,678 Stefano Lorenzini [501] was the first to describe a network of organs in the torpedo ray that became known as the Ampullae of Lorenzini (AoL). Its purpose was unknown for 300 years until Murray [502] measured AoL’s electrical properties in elasmobranch fish — sharks, rays and skates. Later work [101, 503–508] confirmed and greatly added to this knowledge. Researchers now know that AoL is likely the primary mechanism that allows elasmobranch fish to detect and map a potential prey’s physiology via the very weak changes in electric fields given off by prey’s muscle contractions.

Individual ampullae are skin pores that open to the aquatic environment with a jelly-filled canal leading to an alveolus containing a series of electrosensing cells. Within the alveolus, the electrosensitive cells of the ampullae

communicate with neurons and this integration of signals from multiple ampullae is what allows elasmobranch fish to detect electric field changes as small as 5 nV/cm [503, 506, 509, 510]. The AoL jelly has been reported as a semiconductor with temperature-dependence conductivity and thermoelectric behavior [500, 509, 510], as well as a simple ionic conductor with the same electrical properties as the surrounding seawater [503, 506]. Josberger et al. [500] attempted to clarify what AoL’s role is in electrosensing by measuring AoL’s proton conductivity. They found that room-temperature proton conductivity of AoL jelly is very high at 2 ± 1 mS/cm — only 40-fold lower than some current state-of-the-art manmade proton-conducting polymers. That makes AoL the highest conductive biological material reported thus far. They suggested that the polyglycans contained in the AoL jelly may contribute to its high proton conductivity.

Other aquatic magneto-sensory mechanisms more in harmony with terrestrial animals include the presence of ferromagnetic particles in magnetite — tiny naturally produced magnets that align with the Earth’s magnetic field, allowing for species’ direction and orientation. Magnetite appears to transmit necessary information through a connection with the central nervous system [340, 497, 511]. A magnetite-based system is plausible for cetaceans [512, 513] as magnetite has been found in the meninges dura mater surrounding the brains of whales and dolphins [514, 515]. There is also evidence that local variations/anomalies in the geomagnetic field in certain underwater topographies may play a role in live cetacean strandings [516, 517] which indicates a magnetic compass based on magnetite. And free-ranging cetaceans have shown evidence of magnetoreception-based navigation, e.g., Fin whale migration routes have been correlated with low geomagnetic intensity [513].

Recently, Granger et al. [518] found correlations in data between 31 years of gray whale (*Eschrichtius robustus*) strandings and sunspot activity, especially with RF ‘noise’ in the 2,800 MHz range. The 11-year sunspot cycle strongly correlates with the intense releases of high-energy particles known as solar storms which can temporarily modify the geomagnetic field, and in turn may modify orientation in magnetoreceptive species. Solar storms also cause an increase in natural broadband RF ‘noise’. They examined changes in both geomagnetic fields and RF ‘noise’ and found RF to be a determinant. Further, they hypothesized that increased strandings during high solar activity is more likely due to radical pair mechanisms which are more reactive with RFR than magnetite, which appears more reactive to ELF-EMF. Two previous studies also found correlations with cetacean strandings and solar activities [519, 520]. Both mechanisms may come into play under different circumstances or act in synergy.

Kremers et al. [512] investigated the spontaneous magnetoreception response in six captive free-swimming bottlenose dolphins (*Tursiops truncatus*) to introduced magnetized and demagnetized devices used as controls. They found a shorter latency in dolphins that approached the device containing a strong magnetized neodymium block compared to a control demagnetized block identical in form and density and therefore indistinguishable with echolocation. They concluded that dolphins can discriminate on the basis of magnetic properties — a prerequisite for magnetoreception-based navigation. Stafne and Manger [521] also observed that captive bottlenose dolphins in the northern hemisphere swim predominantly in a counter-clockwise direction while dolphins in the southern hemisphere swim predominantly in clockwise direction. No speculation was offered for this behavior.

How salmon navigate vast distances — from their hatching grounds in freshwater river bottoms to lakes during juvenile growth, then the open ocean during maturity, and with a final return to their neonatal birthing grounds to spawn and die (for most anadromous salmonids) — has fascinated researchers for decades. Research indicates they may use several magneto-senses to accomplish this, including inherited mechanisms [522], imprinting [499, 522], a magnetic compass [499, 522, 523], and biomagnetic materials. Salmon have been found to have crystal chains of magnetite [524]. One recent study found that strong magnetic pulses were capable of disrupting orientation in salmon models [525], indicating a magnetite-based mechanism. In salmon, the migration process is complicated by the fact that the ability to sense geomagnetic fields can be altered by changes in salinity between fresh and salt water, thus pointing to multi-sensory mechanisms [499].

Speculation that salmon use the geomagnetic field in some capacity for their iconic migration goes back decades [526]. Quinn [527] found evidence that sockeye salmon (*Oncorhynchus nerka*) fry use both a celestial and magnetic compass when migrating from river hatching to lakes. Putman et al. [499], who have written extensively on this subject, focused on how salmon navigate to specific oceanic feeding areas — a challenge since juvenile salmon reach feeding habitats thousands of kilometers from natal locations. The researchers experimentally found that juvenile Chinook salmon (*Oncorhynchus tshawytscha*) responded to magnetic fields similar to latitudes of their extreme ocean range by orienting in directions that would lead toward their marine feeding grounds. They further found that fish use the combination of magnetic intensity and inclination angle to assess their geographic location and concluded that the magnetic map of salmon appears to be inherited since the fish had no prior migratory experience. These results, paired with

findings in sea turtles (see below), indicate that magnetic maps are widespread in aquatic species and likely explain the extraordinary navigational abilities seen in long-distance underwater migrants [499].

It is less likely that light-sensing radical pair cryptochromes play much of a role in aquatic species though some hypothesize the possibility [528]. Krylov et al. [33], however, noted that there are no anatomical structures or neurophysiological mechanisms presently known for radical pair receptors in the brains of fish and that since light decreases with water depth and fish are capable of orienting in complete darkness using the geomagnetic field, their opinion was that it is too early to say fish have magnetoreception mechanisms based on free radicals, light-dependent or otherwise.

Fish, lobsters, crabs: ELF-EMF

For several reasons having to do with differences in conductivity in water vs. air (see above), RFR is of far less concern in aquatic environments at present than is ELF. With the ever-increasing number of underwater cables used for everything from transcontinental data/communications to power supplies for islands, marine platforms, underwater observatories, off-shore drilling, wind facilities, tidal and wave turbines among others, many new sources of both AC and DC electric current are being created in sea and freshwater environments alike. According to Ardelean and Minnebo writing in 2015 [529], almost 4,971 mi (8,000 km) of high voltage direct current (HVDC) cables were present on the seabed worldwide, 70% of which were in European waters, and this is only expected to grow dramatically as new sources of renewable energy are built to replace fossil fuels globally.

Curiosity about potential adverse effects from cable-generated ELF-EMF on all phases of fish life has also grown, especially in benthic and demersal species that spend significant time near cables in deeper bottom environments for egg laying, larvae growth, and development for most, if not all, of their adult lives.

Fey et al. [494, 495] and Öhman et al. [530] noted that there are two types of anthropogenic exposures created by cables: high voltage direct current (HVDC) that emits static magnetic fields, and three-phase alternating current (AC power transmission) that emit time-varying electromagnetic fields. The density of electric current near underwater cables on the sea floor can vary significantly depending on the type of cable and whether they are positioned on the sea bottom or buried [36, 530]. Noticeable magnetic field changes can occur within meters but generally not more

than several meters from the cable. However, Hutchinson et al. [531], in a robust field study and extensive review, found surprisingly stronger and more complex exposures than anticipated (see below).

Since fish are highly sensitive to static magnetic fields (MF), it is important to delineate static fields from anthropogenic alternating current EMF in aquatic studies. In freshwater species under laboratory conditions, Fey et al. [494] found similar results to those of salmon studies (noted above) in northern pike (*Esox lucius*) exposed to a static magnetic field from DC cables (10 mT) during the embryonic phase and in the first six days of post-hatching. No statistically significant MF effect was seen on hatching success, larvae mortality, larvae size at hatching, and growth rate during the first six days of life. However, significant MF effects were seen on hatching time (one day earlier in a magnetic field than in control), yolk-sac size was smaller, and yolk-sac absorption rate was faster. They interpreted the faster yolk-sac absorption in a magnetic field as an indication of increased metabolic rate but added that even if some negative consequences were expected as a result, that the actual risk for increased northern pike larvae mortality seemed negligible. Though higher than 10 mT magnetic field values are hazardous for fish larvae, they added such values do not occur in the natural environment even along underwater cables.

But in follow-up work of longer duration the same general research group reached a different conclusion. Fey et al. [495] studied effects on eggs and larvae of rainbow trout (*Oncorhynchus mykiss*) exposed to a static magnetic field (MF) of 10 mT and a 50 Hz EMF of 1 mT for 36 days (i.e., from eyed egg stage to approximately 26 days post hatching). They found that while neither the static MF nor the 50-Hz EMF had significant effects on embryonic/larval mortality, hatching time, larval growth, or the time of larvae swim-up from the bottom, both fields did however enhance the yolk-sac absorption rates. While they said this was not directly related to a MF effect, it was shown that larvae with absorbed yolk-sacs by the time of swim-up were less efficient in taking advantage of available food at first feeding and gained less weight. They concluded that these exposures could negatively affect the yolk-sac absorption rate thereby hampering fish in important feeding activities needed for fast weight gain and increased survival. In an additional study, Fey et al. [532] observed that rainbow trout reared in a laboratory for 37 days and exposed to a static MF (10 mT) or a 50-Hz EMF (1 mT) showed defects in otolith of the inner ear which is responsible for hearing and balance in fish. The authors concluded that underwater construction and/or cables that emit a MF of 10 mT or higher can affect living organisms within a few meters

distance, especially species like trout in settled life stages on the sediment bottom during early development.

Zebrafish (*Danio rerio*) are often used in EMF research in toxicology and developmental biology investigating effects on humans because the genomes are so similar. Li et al. [533] studied ELF-MF on the development of fertilized zebrafish embryos divided into seven groups. Embryos of experimental groups were continuously exposed to 50-Hz sinusoidal MF with intensities of 30, 100, 200, 400, or 800 μ T for 96 h. The sham group was identical but without ELF-MF exposure. Results showed that ELF-MF caused delayed hatching and decreased heart rate at early developmental stages but no significant differences were seen in embryo mortality or abnormality. Acridine orange staining assays showed notable signs of apoptosis in the ventral fin and spinal column and transcription of apoptosis-related genes (caspase-3, caspase-9) was significantly up-regulated in ELF-MF-exposed embryos. They concluded that ELF-EMF demonstrated detrimental effects on zebrafish embryonic development, including on hatching, decreased heart rate, and induced apoptosis, although such effects were not a mortal threat. The lower range exposures of this study are found in some aquatic environments.

Sedigh et al. [534] investigated effects on zebrafish exposed to static magnetic fields. Exposures of 1-week acute and 3-week subacute exposures to different static magnetic fields at 2.5, 5, and 7.5 mT were measured on stress indices (cortisol and glucose), sex steroid hormones (17 β -estradiol and 17- α hydroxy progesterone) and fecundity. They found a significant change in cortisol, glucose, 17 β -estradiol (E_2) and 17- α hydroxy progesterone (17-OHP) levels with increased intensity and duration of exposure and concluded that static magnetic fields at higher intensities showed harmful effects on the reproductive biology of zebrafish during both acute and subacute exposures.

Recent laboratory research by Hunt et al. [535] used the transparent glass catfish (*Kryptopterus vitreolus*) found in slow moving waters in Southeast Asia as a model to investigate magnetoreception. The study used Y-maze chambers, animal tracking software and artificial intelligence techniques to quantify effects of magnetic fields on the swimming direction of catfish. They placed a permanent Neodymium Rare Earth Magnet (11.5 \times 3.18 \times 2.2 cm) with a horizontal magnetic flux of 577 mT at the magnet's surface at 10 cm from the end of one of the Y-maze arms and found that catfish consistently swam away from magnetic fields over 20 μ T. The catfish also showed adaptability to changing magnetic field direction and location. The magnetic avoidance was not influenced by school behavior. Sham exposures produced no avoidance. Such exposures might be found near some underwater cables.

To further elucidate findings of species reactions near underwater cables and fill in knowledge gaps since the 2011 Tricas and Gill review [36], Hutchinson et al. [531] conducted both field and laboratory modeling studies of both AC and DC fields on the American lobster (*Homarus americanus*) and the little skate (*Leucoraja erinacea*). They noted that in previous studies, while behavioral responses had been seen, findings were unable to determine if significant biological effects (e.g., population changes) occurred. The American lobster was modeled because it is a magnetosensitive species [536] and concern existed that EMF from cables might restrict movements and/or migration. Lobsters may migrate up to 50 mi (80 km) one way from deep waters to shallow breeding grounds. The little skate was used as a model for the most electro-sensitive taxa of the elasmobranchs, which may be attracted by/to the EMF of cables, particularly for benthic species, thereby altering their foraging or movement behavior. Both models were therefore thought indicative of potential EMF impacts. In this robust field study, the researchers found that the American lobster exhibited a statistically significant but subtle change in behavioral activity when exposed to the EMF of the HVDC cable (operated at a constant power of 330 MW at 1,175 Amps). The little skate exhibited a strong behavioral response to EMF from a cable powered for 62.4% of the study with the most frequently transmitted electrical current at 16 Amps (at 0 MW, 37.5% of time), 345 Amps (100 MW, 28.6%) and 1,175 Amps (330 MW, 15.2%). They concluded that for both species, the behavioral changes have biological relevance regarding how they will move around and are distributed in a cable-EMF zone, but they noted that the EMF did not constitute a barrier to movements across the cable for either species.

Of interest in this study were the actual field readings near cables. Unexpected significant AC magnetic and electric fields did not match computer models and were observed to be associated with both of the DC power cables studied. The maximum observed AC values along the cable axis were 0.15 μT and 0.7 mV/m for the magnetic and electric fields respectively for one cable, and 0.04 μT and 0.4 mV/m respectively, for the other cable. Also, the cross section of the EMF peaks exhibited by the DC subsea power cables were broader than anticipated at both studied. The DC and AC magnetic fields reached background levels on either side of the cable on a scale of c.a. 5 and 10 m from the peak observed value respectively, whereas the AC electric fields reached background on a scale of 100 m (328 ft) from the peak value. Peak observed values occurred almost directly above the cable axis location; there was an offset of 3.3 ft (<1 m) where the cable was twisted. The researchers noted that this observation of AC fields, with broad areas of EMF distortion

being associated with DC cables, increased the complexity of interpreting the studies of EMF's biological effects from DC cables. The AC electric fields associated with the AC sea2shore cable (1–2.5 mV/m) were higher than the unanticipated AC electric fields produced by the DC cables (0.4–0.7 mV/m). The magnetic field produced by the AC sea2shore cable (range of 0.05–0.3 μT) was ~10 times lower than modeled values commissioned by the grid operator, indicating that the three-conductor twisted design achieves significant self-cancellation. This entire aspect of the study indicates the need for accurate field assessment, not just computer modeling, and well-designed systems since anomalies occur.

Nyqvist et al. [498] in a thorough review, focused on marine mammals and the use of underwater electromagnetic surveys that map petroleum deposits in seabeds via strong induced EMFs in varied directional applications. They found that EMFs created during such active surveying were within the detectable ranges of marine animals and the fields can potentially affect behavior in electro-perceptive species, but they noted that effects should be limited to within a few kilometers as the electric and magnetic fields created attenuate rapidly. They added that in migrating marine animals, exposures are of short duration and most are close to naturally occurring levels but cautioned that lack of studies is a concern, especially for the most sensitive elasmobranchs at highest risk for disturbance to electric fields. They also noted that with induced magnetic fields, animals using magnetic cues for migration or local orientation during certain time-windows for migration, orientation, or breeding, could be most affected by this surveying technology.

Taorimina et al. [537] studied both static and time-varying magnetic fields on the behavior of juvenile European lobsters (*Homarus gammarus*). Using two different behavioral assays, day-light conditions to stimulate sheltering behavior and exposures to an artificial magnetic field gradient (maximum intensity of 200 μT), they found that juvenile lobsters did not exhibit any behavioral changes compared to non-exposed lobsters in the ambient magnetic field. No differences were noted on the lobsters' ability to find shelter or modified their exploratory behavior after one week of exposure to anthropogenic magnetic fields (225 \pm 5 μT) which remained similar to behavior in controls. They concluded that neither static nor time-varying anthropogenic magnetic fields at those intensities significantly impacted the behavior of juvenile European lobsters in daylight conditions, but they noted that evidence exists showing magnetosensitivity changes during different life stages in lobster species, and that since their modeling was on juveniles, their study was therefore an incomplete picture requiring further study.

Scott et al. [538] focused on ELF-EMF effects on commercially important edible/brown crab species (*Cancer pagurus*) and what they found was startling. In laboratory tanks, they simulated EMF (with Helmholtz coils, 2.8 mT evenly distributed, assessments during 24 h periods) that would be emitted from sub-sea power cables now commonly used at offshore renewable energy facilities. They measured stress related parameters (L-lactate, D-glucose, haemocyanin and respiration rate) along with behavioral and response parameters (antennal flicking, activity level, attraction/avoidance, shelter preference and time spent resting/roaming). They found that although there was no EMF effect on haemocyanin concentrations, respiration rate, activity level or antennal flicking rate, there were significant changes in haemolymph L-lactate and D-glucose natural circadian rhythms, indicating alterations in hormones. Crabs also showed an unusually high attraction to EMF-exposed shelter areas (69%) compared to control shelter areas (9%) and significantly reduced their time roaming by 21%, with adverse implications for food foraging, mating, and overall health. They noted that EMF clearly altered behavior. Crabs spent less time roaming around the tank and more time in a shelter in direct contact with the EMF source, indicating natural roaming/food-or-mate-seeking behavior had been overridden by attraction to EMF. In fact, crabs consistently chose an EMF-exposed shelter over a non-exposed one and were always drawn to the EMF. The results appear to predict that in benthic areas surrounding EMF-emitting cables, there will be an increase in the abundance of *Cancer pagurus* present. They noted that such potential crab aggregation around benthic cables and the subsequent physiological changes in L-lactate and D-glucose levels caused by EMF exposure, is a concern regarding feeding rates, mating, and especially egg incubation directly in increased EMF environments. They concluded that long term investigations are needed regarding chronic EMF exposure, especially on egg development, hatching success and larval fitness, and added that EMF emitted in marine environments from renewable energy devices must be considered as part of the study of cumulative impacts during the planning stages.

Clearly ELF-EMF can affect myriad aquatic species at intensity levels found in proximity to underwater cables at environmental intensities.

Fish: RF-EMF

As mentioned, RFR is of minimal environmental concern for fish since aquatic environments, while highly

conductive mediums, also highly attenuate EMF at higher frequencies. This may change in the near future as new technologies now exist that may surpass these obstacles [98], thereby introducing for the first time novel new RFR exposures underwater. Longer wave wireless ELF with expanded ranges are used in anthropogenic sonar (sound navigation ranging), primarily for military applications. These travel easily through water and are known to adversely affect cetaceans and other species that rely on their natural sonar for communication, migration, reproduction and food finding. But sound waves are not considered “EMF” in the strict sense of the term; since the focus of this paper is EMF, sound waves are tangential here. But acoustic damage, especially to cetaceans from military and commercial applications, is well documented and ELF cables used for underwater military submarine communications can have significant EMF exposures near cables. Just because this paper does not address impacts from sound waves in detail does not mean they are without serious effects.

There are, however, three recent studies of RFR on zebrafish included here because it is plausible that such exposures could exist near shallow aquatic environments under some circumstances. Nirwane et al. [539] studied 900-MHz GSM RFR effects on zebrafish (*D. rerio*) neuro-behavioral changes and brain oxidative stress as a model for human exposures to cell phones. Exposures were applied daily for 1 h, 14 days, with SAR 1.34 W/Kg. They found 900-MHz GSM radiation significantly decreased socialization and increased anxiety as demonstrated by significant increased time spent in bottom areas, freezing behaviors, and duration and decreased distance travelled, as well as decreased average velocity and number of entries to the upper half of the tank. Exposed zebrafish spent less time in the novel arm of a Y-Maze indicating significant impaired learning compared to the control group. Exposure also decreased superoxide dismutase (SOD) and catalase (CAT) activities while increased levels of reduced glutathione (GSH) and lipid peroxidation (LPO) were encountered indicating compromised antioxidant defense. Post-exposure treatment with melatonin in the water, however, significantly reversed the induced neuro-behavioral and oxidative changes.

Piccinettia et al. [540] investigated *in vivo* effects on embryonic development in zebrafish at 100 MHz thermal and nonthermal intensities via a multidisciplinary protocol. Results found 100 MHz RFR affected embryonic development from 24 to 72 h post fertilization in all the analyzed pathways. Most notably at 48 h post fertilization, reduced growth, increased transcription of oxidative stress genes, onset of apoptotic/autophagic processes and a modification in cholesterol metabolism were seen. EMF

affected stress by triggering detoxification mechanisms. At 72 h post fertilization, fish partially recovered and reached hatching time comparable to controls. The researchers concluded that EMF-RFR unequivocally showed *in vivo* effects at non-thermal levels.

Dasgupta et al. [541] used embryonic zebrafish models at 3.5 GHz SAR \approx 8.27 W/kg and exposed developing zebrafish from 6 to 48 h post fertilization, then measured morphological and behavioral endpoints at 120 h post fertilization. Results found no significant impacts on mortality, morphology or photomotor response but noted a modest inhibition of startle response suggesting some levels of sensorimotor disruptions. They concluded that exposures at low GHz levels are likely benign but nevertheless entailed subtle sensorimotor effects. Such effects can affect fish survival in various ways, including inhibited response time to predators, among others. This study was done with an eye toward potential human bioeffects at frequencies used in 4 and 5G technology. It was also conducted at intensities higher than the focus of this paper.

If new technology overcomes the conductivity/attenuation limitations of aquatic environments and introduces more RFR to aquatic species, studies like those cited above may soon have more environmental relevance, even at higher intensities than explored here.

Turtles

Oceanic sea turtle migration joins that of other renowned long-distance migratory species like salmon and over-land monarch butterfly treks, spanning thousands of kilometers and traversing multiple complex environments throughout their life cycles. Sea turtles have long been known to use geomagnetic fields for orientation [542, 543]. Freshwater species (e.g., *Chelydra serpentina*) have also been shown to have a magnetic sense capable of artificial disruption [92] as do terrestrial box turtles (*Terrapene carolina*; [544]).

Sea turtles demonstrate natal homing behavior — the ability to return over great distances to their exact birth location to reproduce [89] and because of anthropogenic disruptions of nesting grounds along beaches, this reproductive homing drive imperils them today. The underlying mechanism is still imperfectly understood but involves ‘imprinting’ of the intensity and inclination angle of the geomagnetic field at the birth location [545]. The information is then later used in maturity to return to their place of origin.

Sea turtles are by far the most studied models for turtle magnetoreception, especially by the Lohmann Laboratory at the University of North Carolina, U.S. [323, 546–558].

Irwin and Lohmann [559] discussed the advantages and disadvantages of various research approaches used to investigate magnetic orientation behavior in turtles. These include the use of large magnetic coil systems in laboratory settings to generate relatively uniform fields over large areas [560] which allow the magnetic field to be artificially altered and carefully controlled to determine changes in behavioral orientation. This approach, however, is unsuited for manipulating exposures around animals in natural environments or for studying localized body magnetoreceptors, which in turtles are still a mystery. Another approach is to attach a small magnet or electromagnetic coil to an animal to disrupt magnetic orientation behavior — a far easier approach in hatchlings than in juvenile or mature free-swimming species. They note that if the imposed field from an attached magnet or coil is strong enough to interfere with the Earth’s field, behavioral orientation changes [116, 544, 561] and the performance of a conditioned response [367, 562] can be observed. This latter approach has been used in field studies for the purpose of blocking access to normal magnetic information [544, 561, 563–565] and to localize magnetoreceptors by disrupting the field around a specific terrapin body part [562]. This technique’s disadvantage, however, is that fields rapidly change with distance from the source, making it difficult to quantify the fields that the animal actually experiences.

Most sea turtle studies have involved large magnetic coil systems but Irwin and Lohmann [559] attached small magnets greater in strength than the Earth’s fields to two groups of loggerhead sea turtle hatchlings (*Caretta caretta* L.) under laboratory conditions in which turtles are known to orient magnetically [473, 546, 548–550]. They found that magnetic orientation behavior in hatchling turtles can be disrupted via small magnets attached to the carapace which then create exposures over the entire body. They concluded that such an approach can be used to finally determine local magnetoreceptors by varying the location of the magnet and using smaller, weaker magnets that alter the field only around specific anatomical target sites.

In loggerhead sea turtles, there is evidence of an inclination compass [473, 550] that is functionally similar to the bird magnetic compass reported in European Robins [566, 567]. Lohmann and Lohmann [550] investigated an inclination compass in sea turtles and found it was a possible mechanism for determining latitude. Also investigated were detection of magnetic intensity [551]; natural regional magnetic fields used as navigational markers for sea turtles [557]; and sea turtle hatchlings’ mapping abilities [545]. Sea turtles are also known to have magnetite in their heads [104, 568]. Studies with young sea turtles have

shown that a significant portion of their navigational abilities involve magnetoreception following hatching [569] — imprinting with the Earth's magnetic field being one of several cues hatchlings use as they first migrate offshore [546, 554]. The magnetic fields that are unique to different areas at sea eventually serve as navigational markers to guide swimming direction to important migratory routes. As juveniles mature, they form topographical magnetic maps where they live that direct them to specific regions. But it has remained largely unknown if mature turtles, specifically nesting females, use such mechanisms in open-sea homing as this magneto-sense may change over time.

Field studies are notoriously difficult with large species at sea but Papi et al. [564] studied mature green turtles (*Chelonia mydas*) during their post-nesting migration over 1,243 mi (2,000 km) from their nesting grounds on Ascension Island in the middle of the Atlantic Ocean back to their Brazilian feeding grounds. They were investigating whether mature female turtles use an inclination compass and geomagnetic fields for direction, or by inference (once that sense is disturbed) by some other means as yet determined. Papi et al. [564] attached very strong DC magnets — significantly stronger than the Earth's fields — to disturb and overcome natural magnetoreception, and thereby determine if they could still navigate back to Ascension Island. Controls had nonmagnetic brass bars attached and some had transmitters glued to their heads. All had tracking devices that communicated with satellites, thus creating strong multi-frequency static and pulsed RFR exposures. Seven turtles were each fitted with six powerful static magnets that produced variable artificial fields surrounding the whole turtle, making reliance on a geomagnetic map impossible. The study's travel courses were very similar to those of eight turtles without magnets that had been tracked via satellite over the same period in the previous year. No differences between the magnetically exposed test turtles and untreated turtles were found regarding navigational performance and general course direction. They concluded that magnetic cues were not essential to turtles on the return trip and speculated that perhaps other factors such as smell or wave current direction may come into play.

Luschi et al. [563], like Papi et al. [564], also investigated the role of magnetoreception and homing in mature sea turtles but used a different design and found very different results. In a large field study in the Mozambique Channel, 20 mature pre-nesting green turtles were also equipped with both strong magnets and satellite tracking devices. The turtles were gathered at their nesting beach on Mayotte Island before egg-laying and transported to four

open-sea sites 62–75 mi (100–120 km, respectively) away. There were five releases of four turtles each with three different treatments: turtles magnetically 'disturbed' only during transportation with magnets removed before release; those treated only during the homing trip with magnets attached just prior to release; and controls with nonmagnetic brass discs attached to their heads. Treated turtles had very strong moveable magnets attached to their heads to induce varying magnetic fields around them either at the nesting beach at the start of the relocation journey or on the boat just prior to release for the homing trip. All groups had satellite transmitters attached to their carapaces, thereby creating in the opinion of the authors of this paper, an additional exposure that was not considered as a variable. The researchers also included ocean currents in their assessments, estimated by using oceanographic remote sensing measurements. All but one turtle eventually returned to Mayotte to complete delayed egg-laying. But treated turtles, whether treated during transportation or homing, took significantly longer to reach the destination vs. controls — a surprising finding. Most homing routes showed very long circuitous curved and looping patterns before reaching their target. Control paths were direct. Both treated turtle groups were clearly impaired by the MF exposure, indicating significant recovery time needed between exposure and correcting positional behavior. The researchers hypothesized the existence of a navigational role for geomagnetic information being gathered by those turtles in the passive transportation group, as well as the possibility that magnetic disturbance during transportation may have persisted for some time after the removal of the magnets in that group, thus rendering the two treated groups functionally equivalent during their homing journeys. They also noted that exposures may have physically altered magnetite particles, thus creating a longer lasting effect but they said that since long-lasting after-effects of magnet application have not been described, this theory could neither be inferred nor dismissed.

Lohmann [323] reviewed both of the above studies and added that in addition to the two causal hypotheses of Luschi et al. [563] regarding their unexpected findings of turtle circuitous migration routes, another explanation would include the positioning of the satellite transmitters in the Papi et al. [564] study on turtle heads vs. on the carapace of the Luschi models. He added that since satellite transmitters also produce magnetic fields capable of disrupting magnetoreception, and since the Papi group also attached satellite transmitters on the heads of several control turtles, that re-analyzing the Papi study using only turtles with satellite transmitters placed on the carapace

like the Luschi study could show evidence consistent with the hypothesis that adult turtles exploit magnetic cues in navigation. He concluded that sea turtles, like all other animals studied to date, likely exploit multiple cues for navigation since even with artificial magnetic disturbance causing impaired performance, the magnets in either study did not prevent turtles from eventually reaching their target beaches. This implies that turtles can also rely on other sources of information [570, 571] such as celestial compasses, wave direction [572], or olfactory cues like other species — a significant finding.

The sum total of the studies mentioned above is that sea turtle species are highly sensitive to Earth's fields and are capable of adapting to subtle anthropogenic disruption.

Turtles: RF-EMF

Turtles may also be sensitive to RFR, especially during incubation while on land, and/or initial hatchling stages if they are exposed to anthropogenic RF-EMF that could distort the imprinting memory they use in later life to locate their birthsite beaches again. For example, if a radar or communications base station is installed on or near the beach of a nesting site, could that affect the initial “imprinting” process? Perhaps augment imprinting and make return easier? Or conversely overwhelm the subtle imprinting process at the start and make return impossible? If the latter is valid, such technology could lead to extinction of sensitive species since it interrupts the reproduction process. In the very least, in sensitive species, disorientation might result as discussed above.

To characterize the underlying compass mechanisms in turtles, Landler et al. [92] studied freshwater juvenile snapping turtles' (*Chelydra serpentina*) ability for spontaneous magnetic alignment to the Earth's geomagnetic fields. Using exposure to low-level RFR near the Larmor frequency (1.2 MHz) that is related to free radical pair formation, turtles were first introduced to the testing environment without the presence of RFR (“RF off, RF off”) and they were found to consistently align toward magnetic north. But when subsequent magnetic testing conditions were initially free of RFR, then included an introduced signal (“RF off, RF on”), they became disoriented. Thus, introduction of a RFR field could affect the turtles' alignment response to the natural magnetic field. The RFR field used was only 30–52 nT (1.43 MHz). In the following reverse scenario, when the turtles were initially introduced to the testing environment with RFR present but then removed (“RF on, RF off”), they became disoriented when tested

without RFR. And with RFR on in both cases (“RF on, RF on”), they aligned in the opposite direction toward magnetic south. Clearly test turtles were affected by the exposures. The researchers concluded that the sensitivity of the spontaneous magnetic alignment response of the turtles to RFR was consistent with a radical pair mechanism (see “Mechanisms” above). In addition, they concluded that the effect of RFR appeared to result from a change in the pattern of magnetic input, rather than elimination of magnetic input altogether. Their findings indicated that turtles, when first exposed to a novel environment, form a lasting association between the pattern of magnetic input and their surroundings, and that they may form a larger internal GPS-like mapping ability when they meet any new magnetic reference framework based on natural magnetic cues, from multiple sites and localities.

They also showed that RFR at or near the Larmor frequency (1.2–1.43 MHz) had the ability to disrupt snapping turtle natural orientation, establish its own novel orientation, and completely reverse a natural orientation, leading back to the complex questions asked above regarding imprinting and possible reproductive disruption. Although the Landler et al. study [92] was conducted in a freshwater, non-homing species, snapping turtles are long-lived with a low reproduction success rate. Even small disruptions to this species from anthropogenic sources could have an outsized population effect over time. If this freshwater species is any indication of potential RFR effects, researchers need to further investigate RFR in long-distance migrating turtle species that imprint on land. We simply do not know the full range of possible effects across frequencies with which turtle species come in contact at vulnerable points throughout development and lifetimes.

Nematodes and smaller biota

There are reports of sensitivity to EMF in lesser taxa as well. EMF is known to affect numerous other species including: nematodes (Earth and aquatic worms), mollusks (snails), amoeba (single-celled organisms), molds, algae, protozoans, yeast, fungi, bacteria, and viruses (to a limited extent) — with ramifications for creation of antibiotic resistant bacteria strains. Below are some representative examples of observed effects.

Nematodes

Common soil-based nematode species like *C. elegans* serve as a useful whole-organism model for genetic and

multicellular organism investigations. They are routinely used as a research model to investigate key biological processes including aging, neural system functioning, and muscle degeneration, to name a few. This species' genetic and phenotypic traits are extremely well documented and they can thus be used as important proxies for quantitative analyses [573]. Nematodes have a short lifespan, are hermaphrodites, and demonstrate effects quickly. As lab models they are used primarily for information that can be applied to humans but we can also glean important information and extrapolate to environmental exposures under certain circumstances. Healthy soil worm populations are critical to soil health upon which we all depend.

Hung et al. [574] investigated static magnetic field (SMF) effects on life span and premature aging in *C. elegans*. Nematodes were grown in SMFs varying from 0 to 200 mT. They found that SMF's accelerated development and reduced lifespan in wild-type nematodes. They also found increases in heat shock proteins that were selective and dose dependent.

Vidal-Gadea et al. [66] investigated magnetic orientation in *C. elegans* to identify magnetosensory neurons and found that they orient to the Earth's geomagnetic field during vertical burrowing migrations. Well-fed worms migrated up, while starved worms migrated down. Populations isolated from around the world were found to migrate at angles to the magnetic vector that would vertically translate to their native soil, with northern- and southern-hemisphere worms displaying opposite migratory preferences in conjunction with natural geomagnetic fields. They also found that magnetic orientation and vertical migrations required the TAX-4 cyclic nucleotide-gated ion channel in the AFD sensory neuron pair while calcium imaging showed that these neurons respond to magnetic fields even without synaptic input. They hypothesized that *C. elegans* may have adapted magnetic orientation to simplify their vertical burrowing migration by reducing the orientation task from three dimensions to one.

C. elegans have also demonstrated sensitivity to electric fields via electrotaxis (also known as galvanotaxis) which is the directed motion of living cells or organisms guided by an electric field or current and often seen in wound healing. Sukul and Croll [575] found that nematodes exposed to an electrical current (0.02–0.04 mA, potential differences 2–6 V) demonstrated a directional sensorily-mediated orientation toward the current at first, but at 2 mm from the electrode, individual worms increased reversing behaviors which then remained uniform as they moved in a constant direction parallel to the exposure. A few which did not reverse direction died (presumably from

electrocution) at 6 V or 0.4 mA. They concluded that adult *C. elegans* move directionally at selected combinations of voltage and potential differences and that electrophoresis could be eliminated.

Gabel et al. [576] also investigated electric field effects on directionality on *C. elegans* with an eye toward better understanding how the nervous system transforms sensory inputs into motor outputs. They used time-varying electric fields modulated at 100 Hz across an agar surface with a defined direction and amplitude up to 25 V/cm. They found that the nematodes deliberately crawl toward the negative pole in an electric field at specific angles to the direction of the electric field in persistent forward movements with the preferred angle proportional to field strength. They also found that the nematodes orient in response to time-varying electric fields by using sudden turns and reversals (normal reorientation maneuvers). They also found that certain mutations or laser ablation that disrupt the structure and function of amphid sensory neurons also disrupted their electrosensory behavior and that specific neurons are sensitive to the direction and strength of electric fields via intracellular calcium dynamics among the amphid sensory neurons. This study showed that electrosensory behavior is crucial to how the *C. elegans* nervous system navigates and can be disrupted at some intensities found in the environment.

Maniere et al. [573] also found *C. elegans* was sensitive to electric fields and that when submitted to a moderate electric field, worms move steadily along straight trajectories. They hypothesized that imposing electric fields in research settings was an inexpensive method to measure worms' crawling velocities and a method to get them to self-sort quickly by taking advantage of their electrotactic skills.

An early RFR study of *C. elegans* by Daniells et al. [577] found this species to be a useful model for investigating stress-responses. In the majority of investigations, they used 750 MHz with a nominal power of 27 dBm; controls were shielded and all temperatures were strictly controlled. Stress responses were measured in terms of beta-galactosidase (reporter) induction above control levels. Response to continuous microwave radiation showed significant differences from 25 degrees C in controls at 2 and 16 h, but not at 4 or 8 h. Using a 5 × 5 multiwell plate array exposed for 2 h, the 25 microwaved samples showed highly significant responses compared with a similar control array. Experiments in which the frequency and/or power settings were varied suggested a greater response at 21 than at 27 dBm, both at 750 and 300 MHz indicating a nonlinear effect, although extremely variable responses were observed at 24 dBm and 750 MHz. Lower

power levels tended to induce greater responses — the opposite of simple heating effects. They concluded that microwave radiation causes measurable stress to transgenic nematodes via increased levels of protein damage within cells at nonthermal levels.

Tkalec et al. [578] found oxidative and genotoxic effects in earthworms (*Eisenia fetida*) exposed *in vivo* to RFR at 900 MHz, at 10, 23, 41 and 120 V m(-1) for 2 h using a Gigahertz Transversal Electromagnetic (GTEM) cell. All exposures induced significant effects with modulation increasing such effects. Their results also indicated antioxidant stress response induction with enhanced catalase and glutathione reductase activity, indicating lipid and protein oxidative damage. Antioxidant responses and damage to lipids, proteins and DNA differed depending on EMF level, modulation, and exposure duration.

Aquatic and semi-aquatic worm species also show sensitivity to EMF. Jakubowska et al. [579] investigated behavioral and bioenergetic effects of EMF at 50 Hz, 1 mT fields (comparable to exposures near underwater cables) in polychaete ragworms (*Hediste diversicolor*) that live and burrow in the sand/mud of beaches and estuaries in intertidal areas of the North Atlantic. While they found no attraction or avoidance behavior to EMF, burrowing activity was enhanced with EMF exposure, indicating a stimulatory effect. Food consumption and respiration rates were unaffected but ammonia excretion rate was significantly reduced in EMF-exposed animals compared to control conditions at only geomagnetic fields. The mechanisms remained unclear. The authors said this was the first study to demonstrate effects of environmentally realistic EMF values on the behavior and physiology of marine invertebrates.

Van Huizen et al. [67] investigated effects of weak magnetic fields (WMF) on stem-cells and regeneration in an *in vivo* model using free-swimming flatworms (*Planaria* spp) that are capable of regenerating all tissues including the central nervous system and brain. This regeneration ability is due to the fact that about 25% of all their cells are adult stem cells (ASC). Injury is followed by a systemic proliferative ASC response that initially peaks at ~ 4 h, followed by ASC migration to the wound site over the first 72 h when a second mitotic peak occurs. Like salamander regeneration (see “Amphibians” above) this activity produces a blastema — a group of ASC cell growth that forms the core of new tissues. Full regeneration of damaged planaria tissues or organs occurs through new tissue growth and apoptotic remodeling/scaling of old tissues within 2–3 weeks. Following amputation above and below the pharynx (feeding tube), they exposed amputation sites to 200 μ T WMF. At three days post-amputation, they found that 200 μ T exposure produced significantly reduced

blastema sizes compared to both untreated and earth-normal 45 μ T field strength controls, indicating a WMF interference effect to regeneration. They also found that the 200 μ T exposure was required early and had to be maintained throughout blastema formation to affect growth, and that shorter, single-day exposures failed to affect blastema size. In addition, they found weak magnetic fields produced field strength-dependent effects. These included significant reductions of blastema size observed from 100–400 μ T, but conversely, a significant increase in outgrowth occurred at 500 μ T. They hypothesized that WMF effects were caused by altered reactive oxygen species (ROS) levels, which peak at the wound site around 1-h post-amputation and are required for planarian blastema formation. This study shows that weak anthropogenic magnetic fields can affect stem cell proliferation and subsequent differentiation in a regenerative species, and that field strength can increase or decrease new tissue formation *in vivo*. This is a significant finding for regenerating species of all kinds, and may affect non-regenerating species as well. Sea lamprey eels (*Petromyzon marinus*), a fish species, are also known to regenerate even after multiple amputations [580].

Mollusks, amoeba, molds, algae, protozoans

Mollusks (marine versions are called chitons) are long known to manufacture magnetite in their teeth and to use fields weaker than the geomagnetic field for kinetic movement and direction [52, 117, 340, 524]. Lowenstam [118] first discovered that magnetite was the major mineral in the teeth of marine chitons, thought to give teeth their natural hardness. But Ratner [62] discovered chitons use magnetite as a magnetic compass when he found a number of chiton species have radulae (tongues) that are covered by ferro-magnetic (magnetite) denticles. The radulae of *Acomappleura granulata* and *Chiton squamosis* were also found to be ferro-magnetic but the shells were not. Live specimens of a chiton (*Chaetopleura apiculata*) that also have ferro-magnetic radulae were found to rotate more and move farther in a magnetic field weaker than in the Earth’s stronger geomagnetic field, indicating a nonlinear directionality. Ratner concluded that chitons are responsive to magnetic fields and demonstrate kinetic movements within them.

Some snails are sensitive to EMFs. Nittby et al. [581] observed analgesic effects in land snails (*Helix pomatia*) caused by GSM-1900 RFRs when snails lost sensitivity to pain on a hot plate test after nonthermal exposure to RFR.

Smaller organisms have also long shown effects from EMF. Goodman et al. [582] found delays in mitotic cell

division in slime mold (*Physarum polycephalum*) with ELF-EMF exposures. Friend et al. [583] found perpendicular and parallel elongation of the giant amoeba Chaos chaos (*Chaos carolinensis*) in alternating electric fields over a wide frequency range (1 Hz–10 MHz) with characteristic changes as a function of frequency. Marron et al. [584] found effects on ATP and oxygen levels in another species of slime mold (*P. polycephalum*) after exposures to 60 Hz sinusoidal electric and magnetic fields. Luchien et al. [585] found a stimulating effect on the productivity of the algal biomass (*Chlorella sorokiniana*) for a magnetic field of 50 Hz but an inhibitory effect at 15 Hz in these microalgae.

Protozoans, thought to be more related to animals than microbes, also show sensitivity to EMF. Protozoans, as single-celled eukaryotes, are generally larger than bacteria which are classified as prokaryotes. The two organisms are structurally different: bacterial cells lack a nucleus while protozoa contain organelles such as mitochondria. Bacteria generally absorb nutrients through their cell walls while protozoa feed on bacteria, tissue, and organic matter and can be both infectious and parasitic. These protozoa include human parasites that cause diseases such as amoebic dysentery, malaria, giardiasis, leishmaniasis, trichomoniasis, toxoplasmosis and others. Animal species are also affected by protozoans which can severely weaken and shorten their lifespans.

Rodriguez-de la Fuente et al. [586] tested ELF-EMF (60 Hz, 2.0 mT for 72 h) on two infectious protozoans, *Trichomonas vaginalis* and *Giardia lamblia*, and found growth alterations in both species which they attributed to alterations in cell cycle progression and cellular stress. Cammaerts et al. [587], used RFR (GSM 900-MHz at 2 W vs. control) on protozoans (*Paramecium caudatum*) and found individuals moved more slowly and sinuously than usual and that their physiology was affected. Paramecia became broader, pulse vesicles had difficulty expelling content to the outside of their cells, cilia moved less efficiently, and trichocysts became more visible — all effects that indicate poor functioning or cell membrane damage. They hypothesized that the first impact of RFR could be to cell membranes.

Clearly there are multiple effects at all levels documented in lower taxa from multi-frequency exposures that are now found in the environment.

Yeast and fungi

Yeast is often used in lab models, especially since 1996 when a complete genomic sequence of *Saccharomyces cerevisiae* was created. In fact it is now considered a

“premier model” [588] for eukaryotic cell biology as well as having helped establish whole new fields of inquiry such as “functional genomics” and “systems biology” which focus on the interactions of individual genes and proteins to reveal specific properties of living cells and whole organisms.

EMF research is rich with studies using yeast models too numerous to fully analyze here. However we include a small sample of recent EMF research with potential significance to environmental exposures.

Lin et al. [589] investigated glucose uptake and transcriptional gene response to ELF-EMF (50 Hz) and RFR (2.0 GHz) on several strains of budding yeast (*S. cerevisiae*). Results determined that ELF-EMF and RFR exposure can upregulate the expression of genes involved in glucose transportation and the tricarboxylic acid (TCA) cycle, but not glycolysis pathways, thus showing that such exposures can affect energy metabolism which is closely related with cellular response to environmental stress. Glucose metabolism is fundamental to all living cells’ need for energy, with related significance to many disease states including most cancers.

In a magnetic field study by Mercado-Saenz et al. [590], premature aging and cellular instability were found in yeast (*S. cerevisiae*) exposed to low frequency, low intensity sinusoidal magnetic fields (SMF continuous exposure at 2.45 mT, 50 Hz) and pulsed magnetic fields (PMF 1.5 mT, 25 Hz, 8 h/day). Chronological aging was evaluated during 40 days and cellular stability was evaluated by a spontaneous mutation count and the index of respiratory competence (IRC). They found exposure to PMF produced accelerated aging while SMF did not, and decreased mitochondrial mutation during aging was also seen with PMF. No alterations in respiratory competence were observed for either SMF or PMF exposures. They concluded that exposure to PMF accelerated chronological aging and altered the spontaneous frequency of mitochondrial mutation during the aging process, whereas the SMF used had no effect, thus showing abnormal effects on cell activity from pulsed exposures.

Because yeast cells are known to be sensitive to magnetic fields, some industrial and therapeutic applications to human health have been investigated. These investigations serve to illuminate what we know about yeast and fungal reactions to EMF in general, as well as specific uses. For industrial applications, Wang et al. [591] investigated low level static magnetic fields (SMF) on mold (*Aspergillus versicolor*) growth which can have high impacts on metal corrosion in environmental conditions conducive to mold growth. This is especially problematic in fine electronic circuit boards produced today. Using a

10 mT static magnetic field (SMF) perpendicular to the surface of printed circuit boards, they found the magnetic field inhibited mold growth and surface corrosion which were slowed down, unlike control boards without applied magnetic fields where mold formed a spore-centered corrosion pit that then led to macroscopic regional uniform corrosion. This demonstrated changes in cell/spore growth at a low intensity exposure that can be found in the environment.

Also with an eye toward commercial possibilities, Sun et al. [592] found that a polysaccharide of *Irpex lacteus* (a white-rot fungus found widely in the environment which breaks down organic materials but also is commercially used to treat nephritis in humans) was sensitive to low-intensity ELF-EMF as demonstrated by increased biomass and polysaccharide content, as well as induced malformed twists on the sample cell surfaces. Polysaccharides are carbohydrates with a large number of sugar molecules used as energy sources in living cells. They identified varying changes in multiple differentially expressed genes after exposure to alternating current EMF (50 Hz, 3.5 mT, 3 h per day, for 4 days). They found initial sharp increases in growth rates in exposed samples that were then marked by significant declines in EMF's influence over time, although there were also important lasting effects. Global gene expression alterations from EMF indicated pleiotropic effects (capable of affecting multiple proteins or catalyzing multiple reactions) were related to transcription, cell proliferation, cell wall and membrane components, amino acid biosynthesis and metabolism. Polysaccharide biosynthesis and metabolism were also significantly enriched in the EMF-exposed samples. They concluded that EMF significantly increased amino acid contents and was therefore deemed a suitable method for increasing fermentation of microorganisms, presumably for commercial use. However, the significance of this study to environmental exposures relates to the multiple ways that ELF alternating current common to electric power generation changed yeast gene expression. There is at least one clinical case of a different strain of *I. lacteus* taking on a rare infectious and dangerous quality in an immunocompromised human [593]. The question is: can now-ubiquitous ELF-EMF contribute to potentially emerging new forms of yeast contagion?

The same question arises with *Candida albicans* and other pathogenic yeasts that have rapidly developed resistance to antifungal medications. *C. albicans* can live harmlessly in human microflora, but certain lifestyle circumstances or immunosuppression can turn it into an opportunistic pathogen. It can also infect some non-human animals. While chronic mucocutaneous candidiasis can

infect the skin, nails, and oral and genital mucosae, under high host immunodeficiency *C. albicans* can enter the bloodstream and induce systemic infections with mortality between 30 and 80% [594]. There has been increasing resistance of *C. albicans* to traditional antifungal agents, such as fluconazole and amphotericin B [595, 596]. Resistance mechanisms include overproduction of membrane drug efflux transporters and/or changes in gene expression [597].

Two investigations in search of new therapeutic strategies were conducted using EMF. Sztafrowski et al. [594] investigated the use of static magnetic fields (SMF, 0.5 T) on *C. albicans* cultures in the presence of two commonly used antifungal medications. Their aim was to assess whether SMF had any impact on general viability of *C. albicans* hyphal transition and its susceptibility to fluconazole and amphotericin B. They found reduction of *C. albicans* hyphal length in EMF-exposed samples. They also found a statistically significant effect on *C. albicans* viability when SMF was combined with amphotericin B. They hypothesized that this synergistic effect may be due to the plasma membrane binding effects of amphotericin B and that SMF could influence domain orientation in the plasma membrane. They concluded, with caution, that the use of a SMF in antifungal therapy could be a new supporting option for treating candida infections.

Novickij et al. [598] also focused on therapeutic possibilities given the multi-drug resistance and side effects to antifungal therapies. Their aim was to optimize the electroporation-mediated induction of apoptosis using pulses of varied duration (separately and in combination with formic acid treatment) and to identify yeast apoptotic phenotypes. They focused on nonthermal nanosecond pulsed electric fields (PEF 3 kV, 100 ns – 1 ms squarewave; and 250, 500, 750 ns duration 30 kV/cm PEF, 50 pulses, 1 kHz) as a therapeutic alternative and/or to enhance effects in combination with conventional treatments. In three yeast models, *S. cerevisiae* (as control) and drug resistant *Candida lusitanae* and *Candida guilliermondii*, they found that nanosecond PEF induced apoptosis in all three strains. Combining PEF with a weak formic acid solution improved induced apoptosis and inactivation efficacy in the majority of the yeast population. Yeast cells showed DNA breaks and other changes. They concluded that PEF could be a useful new non-toxic protocol to treat some fungal diseases and minimize tissue damage.

Choe et al. [599] studied ion transportation and stress response on a yeast strain (K667) to ELF-EMF (60 Hz, 0.1 mT, sinusoidal or square waves), specifically investigating internal ionic homeostasis via the cell membrane involving metal ions and cation transports (cations are

ionic species of both atoms and molecules with a positive charge). They found significantly enhanced intracellular cation concentrations as ELF-EMF exposure time increased, as well as other changes. This study has implications for soil health as yeast can be an integral aspect of how healthy organic soil matter is formed. They concluded that EMF and yeast could also play a role in the bioremediation processes in metal-polluted environments.

Lian et al. [600] studied effects of ELF-EMF (50 Hz, 0–7.0 mT) and RFR (2.0 GHz, 20 V/m, temperature at 30 °C, average SAR single cell/0.12 W/kg) on two budding yeast strains (NT64C and SB34) and prion generation/propagation. They found under both EMF exposures that *de novo* generation and propagation of yeast prions (URE3) were elevated in both yeast strains. The prion elevation increased over time and effects were dose-dependent. The transcription and expression levels of heat shock proteins and chaperones were not statistically significantly elevated after exposure but levels of reactive oxygen species (ROS), as well as superoxide dismutase (SOD) and catalase (CAT) activities were significantly elevated after short-term, but not long-term exposure. This work demonstrated for the first time that EMF exposure could elevate the *de novo* generation and propagation of yeast prions, supporting the researcher's hypothesis that ROS may play a role in the effects of EMF on protein misfolding. ROS levels also mediate other broad effects of EMF on cell function. They concluded that effects of EMF exposure on ROS levels and protein folding may initiate a cascade of effects negatively impacting many biological processes.

The effects of EMF on protein folding cannot be overstated. Proteins must fold into proper three-dimensional conformations to carry out their specific functions — intact proteins are critical to the existence of all life. Misfolding not only impairs function but leads to disease. Folding inside of cells does not happen spontaneously but rather depends on molecular helpers called chaperones. Protein misfolding has been implicated in Alzheimer's, Parkinson's, and Huntington's diseases, among others. The devastating Creutzfeldt–Jakob disease is caused by prion misfolding in the brain, which causes abnormal signaling in neurons that eventually leads to paralysis and death. Wildlife can also suffer from prion diseases such as chronic wasting in deer, elk, and other cervids, and cattle can suffer from so-called “mad-cow” disease. The two studies from above [599, 600] have implications for how such diseases are spread through soil with possible links to environmental EMFs.

It is clear from the above that ELF-EMF and RF-EMF, using multiple signaling characteristics, are biologically active in both temporary and permanent ways in yeast/

fungi species with wide environmental implications across numerous taxa.

Bacteria

Strains of bacteria are known to be magnetotactic and use geomagnetic fields for direction. Blakemore [63] was the first to suggest in 1973 that bacteria in North American saltwater marsh muds use magnetite as a sensor when he discovered not only that bacteria were highly attracted to an external magnet but they also had magnetite crystals that caused them to align with the lines of the Earth's magnetic fields. This was also discovered to be geolocation specific to the North Pole in northern samples and South Pole-seeking in southern species [52, 63, 511]. The bacteria showed “mud-up” and “mud-down” behavior along magnetic field gradients when mud was disturbed, indicating a magnetic compass. Since that early work, a whole new field called electromicrobiology has developed with discoveries that include some electro-active bacteria being responsible for magnetite formation, with others creating their own electric “wires” in mud flats with implications for new technologies [601].

Among the more troubling EMF effects are bacterial alterations with pressing implications for antibiotic resistance. Since the 1940s [602], nonthermal effects were documented in bacterial, viral, and tissue cultures with applied low-repetition 20-MHz pulses. Most studies spanning the 1940s though the 1980s focused on EMF's ability to kill microbes and fungi in human food sources at high intensity, consequently most research was focused on thermal intensities. That work still continues today as microwaves have been shown to be an efficient means for killing microbes [50]. But microbes also react to much lower nonlethal intensities and recent work finds effects from both ELF and RFR.

The common bacteria *Escherichia coli*, which can live harmlessly in the gut of humans and many other animal species, can also turn virulent and kill through food-borne illnesses. *E. coli* comes in many strains, is well studied, and now considered the most genetically and physiologically characterized bacterium. *E. coli* encounter varied and numerous environmental stressors during growth, survival, and infection, including heat, cold, changes in pH levels, availability of food/water supplies, and EMF. Along with other bacteria, they respond by activating groups of genes and heat shock proteins (see “Mechanisms” above) which can eventually lead to stress tolerance for survival purposes. But induced stress tolerance can also lead to increased virulence, as well as enhanced tolerance to other stressors that confer cross-protection [603].

Salmen and colleagues [604, 605] published papers of EMF effects on bacterial strains documenting the growing investigation of microbes related to antibiotic resistance with many findings stressing responses to EMF [606–610]. Cellini et al. [611] investigated *E. coli*'s adaptability to environmental stress induced by ELF exposures to 50-Hz magnetic fields at low intensities (0.1, 0.5, 1.0 mT) vs. sham controls. They found exposed samples and controls displayed similar total and culturable counts, but increased cell viability was observed in exposed samples re-incubated for 24 h outside of the test solenoid compared to controls. Exposure to 50 Hz EMF (20–120 min) also produced a significant change in *E. coli* morphotype with a presence of coccoid cells aggregated in clusters after re-incubation of 24 h outside of the magnetic field-solenoid. Atypically lengthened bacterial forms were also noted, indicating probable alteration during cell division. Some differences in RNA-AFLP analysis were also seen for all intensities evaluated. They concluded that exposure to 50-Hz ELF-EMF is a bacterial stressor as evidenced by its immediate response in modifying morphology (from bacillary to coccoid) and inducing phenotypical and transcriptional changes. Despite this stressor effect, it was also seen that exposed samples significantly increased viability, suggesting the presence of VBNC cells. They concluded that further studies were needed to better understand ELF-EMF in bacterial cell organization. They did not extrapolate to the obvious — that *E. coli* was changed in an abnormal way but nevertheless strengthened in viability — a recipe for antibiotic resistance.

Crabtree et al. [612], in a small human study, investigated the biomic relationship of human bacteria exposed to both static magnetic fields (SMF) and RFR. Using laboratory culture strains and isolates of skin bacteria collected from the hand, cheek, and chin areas of four volunteers who had different (self-reported) cell phone use histories, they found varied growth patterns of *E. coli*, *Pseudomonas aeruginosa*, and *Staphylococcus epidermidis* under static magnetic fields on different bacterial species. Isolates of skin microbiota showed inconsistent growth among the test subjects, likely due to their differing cell phone usage histories (classified as heavy, medium and light) and other variables. The growth of *Staphylococci* was increased under RFR in certain individuals while in others growth was suppressed. This was complicated by the different body areas tested, some with higher chronic exposures such as the hands, as well as other variables when one test subject used an antibacterial face wash. Volunteers in the heavy use category showed less bacterial growth on the hands, possibly due to microbe habituation. Overall, and despite the small sample, they concluded RFR can disrupt the balance in skin microbiota,

making it more vulnerable to infection by specific opportunistic and/or other foreign pathogens. They noted that both SMF and RF-EMFs have significant but variable effects on the growth of common human bacteria; that bacterial growth was either unaffected, increased, or suppressed depending on the species of bacteria; and that bacterial responses seemed to be determined by historic exposure to RF-EMF and life style. This study, even with inherent limitations, indicates changes in microbes with EMFs and may prove a novel way to study bacteria with significance for real-life exposures to humans and animals alike.

Salmen et al. [605] also found highly variable results from RFR (900 and 1,800 MHz) effects on DNA, growth rate, and antibiotic susceptibility in *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *P. aeruginosa*. Using an active cell phone handset, they exposed bacteria to 900 and 1,800 MHz for 2 h, then injected samples into a new medium where growth rate and antibiotic susceptibility were evaluated. Regarding DNA, they found no differences in *S. aureus* and *S. epidermidis* when exposed to 900 and 1,800 MHz vs. controls, but *P. aeruginosa* showed changes in DNA band patterns following such exposures. Regarding growth rates, with the exception of a significant decrease after 12 h exposure to 900 MHz, no significant effects on growth of *S. aureus* and *S. epidermidis* were seen. But the growth of *P. aeruginosa* was significantly reduced following exposure for 10 and 12 h to 900 MHz, while no significant reduction in growth followed exposure to 1,800 MHz. Regarding antibiotic susceptibility, in the drugs studied (i.e., amoxicillin 30 mg, azithromycin 15 mg, chloramphenicol 10 mg, and ciprofloxacin 5 mg), with the exception of *S. aureus* treated with amoxicillin (30 mg), EMF-exposure had no significant effect on bacterial sensitivity to antibiotics. This study shows variability among bacterial species not only to different frequencies common in the environment today but also to changes in sensitivity to some antibiotics but not others. There may have been design problems with this study, however.

Several studies investigated WiFi signals on bacterial strains. Taheri et al. [610] assessed exposure to 900-MHz GSM mobile phone radiation and 2.4-GHz RFR from common WiFi routers to see if cultures of *Listeria monocytogenes* and *E. coli* resulted in altered susceptibility to 10 different antibiotics. They found narrow windows in which microbes became more resistant: For *L. monocytogenes* no significant changes in antibacterial activity between exposed and nonexposed samples — except for Tetracycline (Doxycycline) — were noted. For *E. coli*, however, there was a significant change in antimicrobial activities suggesting RFR exposures can influence antibiotic susceptibility of *E. coli* more than in *Listeria*. For window and

pronounced effects, they found *L. monocytogenes* exhibited different responses to each antibiotic. For Doxycycline, the window occurred after 6 h exposure to WiFi and mobile phone-RFR. After 9 h of exposure to WiFi for Ciprofloxacin and Sulfonamide (Tremethoprin/sulfamethoxazole), bacteria tended to become more resistant. By contrast, the pattern for Levofloxacin and Penicillin (Cefotaxime/Def-triaxone) showed increased sensitivity. For *E. coli*, the pattern of the response to WiFi and mobile phone RFR was the same: maximum antibiotic resistance was seen between 6 and 9 h of exposure but after 12 h, a stress response lead to a return to preexposure conditions indicating an adaptive reaction. Taheri et al. [609] found similar nonlinear window effects and differences in growth rates in *Klebsiella pneumonia*, while Mortazavi et al. [613] found similar window effects in *E. coli*. In addition, they saw significant increased growth rates after radiation exposures in both Gram-negative *E. coli* and Gram-positive *L. monocytogenes*. They concluded that such window effects can be determined by intensity and dose rate; that exposure to RFR within a narrow window can make microorganisms resistant to antibiotics; and that this adaptive phenomenon is a human health threat. The same can be inferred for many non-human species.

Said-Salman et al. [614] evaluated non-thermal effects of WiFi at 2.4 GHz for 24 and 48 h (using a WiFi router as the source) on the pathogenic bacterial strains *E. coli* O157H7, *S. aureus*, and *S. epidermis* for antibiotic resistance, motility, metabolic activity and biofilm formation. Results found that WiFi exposure altered motility and antibiotic susceptibility of *E. coli* but there was no effect on *S. aureus* and *S. epidermis*. However, exposed cells (vs. unexposed controls) showed an increased metabolic activity and biofilm formation ability in *E. coli*, *S. aureus* and *S. epidermis*. They concluded that WiFi exposure acted as a bacterial stressor by increasing antibiotic resistance and motility of *E. coli*, as well as enhancing biofilm formation in all strains studied. They indicated the findings may have implications for the management of serious bacterial infections.

Movahedi et al. [615] also investigated antibiotic resistance, using short-term exposure to RFR from a mobile phone simulator (900 MHz, 24 h) on *P. aeruginosa* and *S. aureus* against 11 antibiotics. They found significant changes in structural properties and resistance to the numerous antibiotics studied. *P. aeruginosa* was resistant to all antibiotics after 24 h of exposure vs. non-exposed controls while *S. aureus* bacteria were resistant to about 50%. They also found structural changes in all exposed samples and increased cell wall permeability.

In a field study near cell towers, Sharma et al. [616] looked at changes in microbial diversity and antibiotic

resistance patterns in soil samples taken near four different base stations with control samples taken >300 m away. *Stenotrophomonas maltophilia*, *Chryseobacterium gleum*, and *Kocuria rosea* were isolated and identified in soil samples collected near the exposed zones. They found greater antibiotic resistance in microbes from soil near base stations compared to controls, with a statistically significant difference in the pattern of antibiotic resistance found with nalidixic acid and cefixime when used as antimicrobial agents. They concluded that cell tower radiation can significantly alter the vital systems in microbes and make them multi-drug resistant.

Researchers have also investigated ELF-EMF effects on bacterial growth and antibiotic sensitivity. Segatore et al. [608] investigated 2 mT, 50 Hz exposures on *E. coli* ATCC 25922 and *P. aeruginosa* ATCC 27853 and found EMF significantly influenced the growth rate of both strains, notably at 4, 6, and 8 h of incubation. The number of cells was significantly decreased in exposed bacteria vs. controls. And at 24 h incubation, the percentage of cells increased (*P. aeruginosa* ~ 42%; *E. coli* ~ 5%) in treated groups vs. controls which suggested to the researchers a progressive adaptive response. However, they saw no remarkable change in antibiotic sensitivity. Potenza et al. [617] also found effects at high-intensity static magnetic fields at 300 mT on growth and gene expression in *E. coli* but that would be a high environmental exposure.

Viruses

There is a paucity of research on viral species and EMF, likely due to the fact that viruses lack ferromagnetic materials, are difficult to study, and don't make good general lab models other than to investigate their direct impact on specific *in vivo* end points. Virology research thrives in its own specialized niche and has not been used for basic modeling like so many other living life forms as noted throughout this paper. There is long-standing debate on whether viruses are even alive.

However, one wide-ranging discussion by Zaporozhan and Ponomarenko [618] hypothesized a possible complex mechanistic link between influenza pandemics, natural sun spot cycles, and non-thermal effects of weak magnetic fields via cryptochromes/radical pairs, gene expression pathways, and stress-induced host immunological alterations favorable to influenza epidemics. Noting that most — though not all — major influenza epidemics occurred in time intervals starting 2–3 years before and ending 2–3 years after maximum solar activity, they hypothesized that solar cycles are able to both regulate and

entrain processes of biological microevolution in viral species (among others), as well as influence human biorhythms in synergistic ways that could lead to influenza epidemics. Although others have also noted links between influenza pandemics and sunspot activity — possibly based on changes in migratory bird patterns as viral vectors [619–621]— and some have linked sun spots with other adverse human health events, these effects remain of interest but are still hypothetical. UV radiation, which is not covered in this paper, is known to suppress cell-mediated immunity and is therefore capable of adversely affecting the course of a viral infection in some mammal species. Ambient EMF in lower frequency ranges may also be reducing immune viability across species which can theoretically foster opportunistic virulence. Far more EMF research needs to be conducted on viruses; one fruitful approach might be synergistic investigations in virus-infected plant species.

The previous studies of microbes show a pattern of sensitivity in microorganisms to EMF with associations that encompass a wide range of critical changes, including consistent stress responses, alterations in growth and viability, cell membrane alterations, and clear patterns of how easily antibiotic resistance forms in microbial life to now ubiquitous EMF levels.

Plants (see Part 2, Supplement 4, for a table of flora studies: ELF, RFR)

Plants have evolved in highly sensitive ways to natural and manmade EMF in all phases of germination, growth and maturation [31]. Magnetoreception, which is well documented in animals such as birds, has also been described in plants [622] and plant species can respond to subtle changes in EMF in the environment, including in whole plant communities [623]. They may even ‘communicate’ and gather various kinds of ‘information’ via electrical signals in neuron-like cells in root tips and elsewhere [624]. Some hypothesize [625] that a form of vibrational and acoustic sensitivity around 220 Hz may play a role in plant life, although not everyone agrees [626].

Almost all vegetation is subject to complex multi-frequency fields due to their soil-based root systems and high water content, plus above-ground ambient RFR exposures makes plants uniquely susceptible to effects near transmission towers [623, 627]. Many EMF studies have found both growth stimulation as well as dieback. The presence of numerous RFR-emitters in the German and Swiss Alps is thought to have played a role in the

deforestation there [628]. The ‘browning’ of treetops is often observed near cell towers, especially when water is near tree root bases [25]. Treetops, with their high moisture content and often thick vegetative canopy, are known RFR waveguides. In fact, military applications utilize this capability in treetops for communication signal propagation in remote areas and for guidance of low-flying weapons systems [629].

How flora interacts with EMF is still a mystery but a clear pattern has emerged in researching the database for this paper: static ELF-EMF has largely been found beneficial to plant and seed growth [630] while RFR is detrimental. Plants clearly have magnetoreception in their stationary condition. The normal ground state of magnetic fields for plants is the relatively constant natural geomagnetic field that averages between 25 and 65 μT depending on location and seasonal variations [631]. Atmospheric changes, such as thunderstorms and lightning, can cause intermittent changes in ambient magnetic fields. These activities are also generally associated with rainwater critical to virtually all plant life. Plants can detect these changes and prepare for growth using the upcoming rainfall. Trees are seen extending their branches skyward long before rain actually occurs and such changes match alterations in tree polarities [632].

There are many studies showing an increase in the growth rate in plants, such as studies of seed germination exposed to alternating magnetic fields. Plants also respond similarly to high intensity static magnetic fields. This may mean that the physiological mechanism in plants that causes magnetic field-induced growth is finely tuned to a certain intensity of magnetic flux. Any variation in intensity or shape of the ambient magnetic field could activate or hinder this growth mechanism.

Lightning, for instance, generates fast and intense electromagnetic pulses (EMP). EMP has consistently been shown to cause biological effects [633] with just one pulse. Plants may have mechanisms so sensitive that they can detect the energy of EMP from kilometers away. The pulse causes a transient change in the environmental magnetic field that may be detected by one or more of the mechanisms mentioned in the “Mechanisms” section above, as well as discussed below. EMP has been closely investigated for military applications for its ability at high intensities to disable electronics. While much of the military-supported research finds no biological effects from EMP exposure, non-military supported research does show effects. This parallels the same findings in industry vs. non-industry research patterns [165, 634].

There is a long history on the study of effects of EMF exposure on plant growth, notably, the work of the Indian

scientist Sir Jagadish Bose (1858–1937) who proposed the electric nature of plant responses to environmental stimuli and studied effects of microwaves on plant tissues and membrane potentials [635]. Interestingly, Bose investigated the effects of millimeter waves [636] now applicable to 5G technology. Bose, arguably, was a pioneer of wireless communication.

Another early pioneer in EMF effects on plants was Harold Saxon Burr (1889–1973) at Yale University who investigated the electric potential of trees in two tree species (a maple and an elm) located on one property and another maple tree for comparison growing 40 miles (64 km) away. Measurements of numerous parameters were taken using embedded electrodes that recorded hourly from 1953 to 1961 [637]. Simultaneous records of temperature, humidity, barometric pressure, sunlight, moon cycles, sunspot activity, weather conditions, atmospheric-potential gradients, earth-potential gradients, and cosmic rays were correlated with tree potentials. Burr also installed equipment that measured the potential between electrodes in the Earth (about 10 miles apart) and the potential gradient of the air, and found that the air and Earth potentials fluctuated exactly with the phase of the tree potentials although the trees were not always synchronous. Burr ultimately found that the electrical environment correlated closely with tree potentials in a kind of entrainment to diurnal, lunar and annual cycles. Meteorological parameters did not correlate in any immediate way other than when passing thunderstorms elicited anomalous behavior in the trees in direct parallel to measurements with the Earth electrodes. This follows the theory noted above that plants can sense EMP and take immediate information from it.

There are no other long-term field studies as detailed as Burr's of magnetic field effects on a plant species. However, another field study of RFR in Latvia [638] measured effects directly on trees near the Skrunda Radio Location Station, an early warning radar system that operated from 1971 to 1998. The system operated in the 156–162 MHz frequency range transmitting from four pulsed two-way antennas that had operated continuously for over 20 years by the time of the study. In permanent plots in pine forest stands, at varying distances from the radar station and in control areas, tree growth changes were measured and analyzed using retrospective tree ring data. They found a statistically significant negative correlation between the relative additional increment in tree growth and the intensity of the electric field with the radial growth of pine trees diminished in all plots exposed to RFR. The decreased growth began after 1970, which coincided with the initial operation of the station and was subsequently

observed throughout the period of study. The effects of many other environmental and anthropogenic factors were also evaluated but no significant effects on tree growth were correlated. This may have been the first detailed field study of plants and RFR.

Many studies of EMF and plants are today conducted in laboratories and have often focused on growth promotion to create higher yields of food-producing plants. Effects of static EMF, pulsed EMF, ELF-EMF, and RF-EMF have been reported. There are, in fact, over 200 studies on plants and EMF alone – too numerous to review here. See Part 2, Supplement 4, for a Table of studies on plant seedlings and development based on the types of EMF's tested.

As noted in Supplement 4 and in Halgamuge [627], frequently static and ELF-magnetic fields generally improve plant growth whereas RFR retards it. This is the opposite of results from animal and animal-cell culture experiments in which ELF-MF usually produces the same effects as RFR. It is interesting to note that Hajnorouzi et al. [639] and Radhakrishma et al. [640] proposed that MF decreases environmental stress in plants whereas Vian et al. [641, 642] considered RFR as a systemic stressor. A major morphological difference between animal and plant cells is that plant cells have a cell wall that is an active physiological organelle which regulates growth and cell division and controls cellular communications. The cell wall contains a considerable amount of water [643]. Is it possible that absorption of RFR by cell-wall water causes a microthermal effect that adversely affects plant cell functions and even causes cell death, whereas thermal effects are not likely to occur with ELF-EMF exposure.

Some plant roots have been found sensitive to both ELF and RFR. Belyavskaya [644] found a strong cytochemical reaction in pea root cells after exposure to low level magnetic fields. Kumar et al. [645] found cyto- and genotoxicity in root meristems of *Allium cepa* with 900-MHz and 1,800-MHz RFR. Chandel et al. [646] studied cytotoxic and genotoxic activity on DNA integrity in root meristems of *A. cepa* using 2,100-MHz RFR and found exposure caused DNA damage with a significant decrease in HDNA accompanied by an increase in TDNA while TM and OTM did not change significantly compared to controls. Biological effects were dependent on the duration of exposure with maximum changes seen at 4 h.

In a series of studies, Stefi et al. [647–649] investigated the effects of long term RFR exposure from the base units of common cordless DECT phone systems (pulsed transmission mode 1,882 MHz, 24 h/day, 7 d/week) on various plant species (*Arabidopsis thaliana*, *Pinus halepensis*, *Gossypium hirsutum* respectively) and found structural and biochemical alterations. Compared to controls in Faraday

cages, exposed plant biomass was greatly reduced and leaf structure was only half as thick. Leaves were thinner and possessed greatly reduced chloroplasts which contributed to overall reduced vitality. Root systems were also adversely affected. They concluded that RFR is a stressor and noxious to plant life. A study of similar design [650] did not find the same effects on maize (*Zea mays*) which they attributed to that plant's structural differences although chloroplasts were severely affected (see also Kumar et al. [651]).

Jayasanka and Asaeda [652] published a lengthy review that focused on microwave effects in plants. Studies indicate effects depend on the plant family and growth stage involved; and exposure duration, frequency, and power density, among other factors. They concluded that even for short exposure periods (<15 min to a few hours), nonthermal effects were seen that can persist for long periods even if initial exposures were very short. In addition, they noted that since base stations operate 24 h/day, neither short exposures nor recovery periods are possible in natural habitats as plants are continuously exposed throughout their life cycles. They said that variations in the power density and frequency of microwaves exert complex influences on plants, and that clearly diverse plant species respond differently to such factors. They concluded it is necessary to rethink the exposure guidelines that currently do not take nonthermal effects into consideration.

There are numerous reports of adverse RFR effects on mature flora. Waldman-Salsam et al. [653] reported leaf damage in trees near mobile phone towers/masts. In a detailed long-term field monitoring study from 2006 to 2015 in two German cities, they found unusual and unexplainable tree damage on the sides of trees facing the towers and correlated it to RFR measurements vs. control areas without exposures. They found that tree-side differences in measured values of power flux density corresponded to tree-side differences in damage. Controls, which consisted of 30 selected trees in low radiation areas without visual contact to any phone mast and power flux density under $50 \mu\text{W}/\text{m}^2$, showed no damage. They concluded that nonthermal RFR from mobile phone towers is harmful to trees and that damage that affects one side eventually spreads to the whole tree.

Vian et al. [642] published a review of plant interactions with high frequency RFR between 300 MHz and 3 GHz and noted that reports at the cellular, molecular, and whole plant scale included: numerous modified metabolic activities (reactive oxygen species metabolism, α - and β -amylase, Krebs cycle, pentose phosphate pathway, chlorophyll content, and terpene emission among others); altered gene expression (calmodulin, calcium-dependent

protein kinase, and proteinase inhibitor); and reduced growth (stem elongation and dry weight) after nonthermal RFR exposure. They said changes occur in directly exposed tissues as well as systemically in distant tissues and proposed that high-frequency RFR be considered a genuine environmental factor highly capable of evoking changes in plant metabolism.

Halgamuge [627] also published a review that found weak non-thermal RFR affects living plants. The author analyzed data from 45 peer-reviewed studies of 29 different plant species from 1996 to 2016 that described 169 experimental observations of physiological and morphological changes. The review concluded that the data substantiated that RFR showed physiological and/or morphological effects (89.9%, $p < 0.001$). The results also demonstrated that maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants are highly sensitive to RFR and that plants appear more responsive to certain frequencies between 800 and 1,500 MHz ($p < 0.0001$); 1,500 and 2,400 MHz ($p = 0.0001$); and 3,500 and 8,000 MHz ($p = 0.0161$). Halgamuge [627] concluded that the literature shows significant trends of RFR influence on plants.

There is particular concern for impacts to flora and 5G since millions of small antennas mounted on utility poles, transmitting in MMW and other broadband frequencies, already are — or will soon be — in very close proximity to vegetation, creating both near- and -far field exposures. As noted in Halgamuge [627], the following are some studies investigating GHz frequencies already in use or planned for 5G that found significant effects on plants: Tanner and Romero-Sierra [654] on accelerated growth of Mimosa plant (10 GHz, $190 \text{ mW}/\text{cm}^2$, 5–10 min); Scialabba and Tamburullo [655] on reduced hypocotyls growth rate in radish (*Raphanus sativus*) (10.5 GHz, 8 mW or 12.658 GHz, 14 mW for 96 h); Tafforeau et al. [656] induced meristem (actively dividing group of cells) production in *Linum usitatissimum* (105 GHz for 2 h at $0.1 \text{ mW}/\text{cm}^2$); and Ragha et al. [657] (9.6 GHz, 30 min) found germination depended on exposure parameters on *Vigna radiata*, *Vigna aconitifolia*, *Cicer arietinum* and *Triticum aestivum* plants. This is an area in immediate need of further investigation given the results from the previous studies.

A thorough review of RFR effects to trees and other plants was published by Czerwinski et al. [622] who reported that ecological effects on whole plant communities could occur at a very low exposure level of $0.01\text{--}10 \mu\text{W}/\text{cm}^2$ — certainly comparable to limits examined in this paper. They focused on frequencies between 0.7 and 1.8 GHz and included multiple complex indicators for plant types, biometrics, and environmental factors. It was the first comprehensive paper that extended beyond using

narrower research methods. They noted that although the literature on the effects of RFR on plants is extensive, not a single field study had assessed the biological response at the level of a whole plant community, biome, or ecosystem, but rather focused mostly on short-term laboratory studies conducted on single species. They said, "...This dissonance is particularly striking in view of the fact that alterations in a plant community's structure and composition have long been considered to be well founded, sensitive and universal environmental indicators." The paper serves as a predictive model for complex future field studies on larger ecosystems.

Interesting EMF synergistic effects were found with static magnetic fields and bacteria in plants. Seeking non-chemical methods to improve seed germination after prolonged periods of storage when seed viability can deteriorate, Jovičić-Petrović et al. [658] studied the combined effects of bacterial inoculation (*Bacillus amyloliquefaciens* D5 ARV) and static magnetic fields (SMF, 90 mT, 5 and 15 min) on white mustard (*Sinapis alba* L.) seeds. Their results found that biopriming with the plant growth-promoting *B. amyloliquefaciens* increased seed growth by 40.43%. Seed response to SMF alone was dependent on treatment duration. While SMF at 5 min increased the germination percentage, exposure at 15 min lowered seed germination compared with the control. However, the negative effect at the longer exposure was neutralized when combined with the bacterial inoculation. Both germination percentages were significantly higher when SMF was combined with the bacteria (SMF, 5 min, + D5 ARV; and SMF, 15 min + D5 ARV; 44.68 and 53.20%, respectively) compared with control. They concluded that biopriming and SMF treatment gave better results than bacterial inoculation alone. The highest germination percentage — 53.20% of germinated seeds — was seen with the bacterium and 15 min exposure to 90 mT, demonstrating a synergistic effect. They concluded that such techniques can be used for old seed revitalization and improved germination.

Even aquatic plants have been found sensitive to artificial electric fields. Klink et al. [659] assessed electric field exposures on growth rates and the content of trace metals of *Elodea canadensis*. Plants were exposed in a laboratory to an electric field of 54 kV/m for seven days. Plant length and Fe, Mn, Ni, Pb, and Zn were measured. Results showed the applied electric fields slightly enhanced root growth. They also found changes in mineral absorption; Mn and Ni were significantly lower while Pb and Zn were significantly higher in exposed plants. Fe content did not differ between control and exposed plants. They concluded that electric fields had potential use for

phytoremediation in trace metal contaminated waters. This study also has implications for long term aquatic plant health in general.

Also working with electric fields, Kral et al. [660] found fascinating regeneration in plant root tips in *Arabidopsis* at varying electric field exposures and time durations with the weaker exposures producing the most growth. They found that imposed electric fields can perturb apical root regeneration and that varying the position of the cut and the time interval between excision and stimulation made a difference. They also found that a brief pulse of an electric field parallel to the root could increase by up to two-fold the probability of its regeneration, perturb the local distribution of the hormone auxin, and alter cell division regulation with the orientation of the root towards the anode or the cathode playing a role.

While mechanisms are still unclear regarding how EMFs affect plants, oxidative effects appear to play a significant role. Oxidative changes have been reported in many studies in plants after exposure to EMF [578, 639, 661–671]. EMF-related stress has been proposed by Vian et al. [641, 642], Roux et al. [672, 673], and Radhakrishma et al. [640]. Other mechanisms affecting plants such as ferromagnetism, radical-pairs, calcium ions and cryptochromes have also been proposed [674, 675].

It is apparent that plant growth and physiology — with their root systems anchored in the ground while their 'heads' manifest in the air — are affected by exposure to EMF in complex synergistic ways and that they are susceptible to multi-frequency exposures throughout their life spans.

Conclusion

Effects from both natural and man-made EMF over a wide range of frequencies, intensities, wave forms, and signaling characteristics have been observed in all species of animals and plants investigated. The database is now voluminous with *in vitro*, *in vivo*, and field studies from which to extrapolate. The majority of studies have found biological effects at both high and low-intensity man-made exposures, many with implications for wildlife health and viability. It is clear that ambient environmental levels are biologically active in all non-human species which can have unique physiological mechanisms that require natural geomagnetic information for their life's most important activities. Sensitive magnetoreception allows living organisms, including plants, to detect small variations in environmental EMF and react immediately as well as over the long term, but it can also make some organisms

exquisitely vulnerable to man-made fields. Anthropogenic EMF may be contributing more than we currently realize to species' diminishment and extinction. Exposures continue to escalate without understanding EMF as a potential causative and/or co-factorial agent. It is time to recognize ambient EMF as a potential novel stressor to other species, design technology to reduce exposures to as low as reasonably achievable, keep systems wired as much as possible to reduce ambient RFR, and create laws accordingly — a subject explored more thoroughly in Part 3.

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Part 2: supplements

Supplement 1: Genetic Effects of RFR Exposure

Supplement 2: Genetic Effects at Low Intensity Static/ELF EMF Exposure

Supplement 3: Biological Effects in Animals and Plants Exposed to Low Intensity RFR

Supplement 4: Effects of EMF on plant growth

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Part 2. Supplement 1.
Genetic Effects at Low Level RFR Exposure

RFR studies	Power density/SAR (<0.1 W/Kg)	Effects observed
Aitken et al. (2005)	Mice to 900-MHz RFR for 7 days at 12 h/day; SAR 0.09 W/kg	Mitochondrial genome damage in epididymal spermatozoa.
Akdag et al. (2016)	Male Wistar-Albino rats to 2400 MHz RFR from a Wi-Fi signal generator for a year; SAR 0.000141 (min)-0.007127 (max) W/kg	DNA damage in testes.
Alkis et al. (2019a)	Rats exposed to 900 MHz (brain SAR 0.0845 W/kg), 1800 MHz (0.04563 W/kg), and 2100 MHz (0.03957 W/kg) RFR 2 h/day for 6 months	Increased DNA strand breaks and oxidative DNA damage in brain.
Alkis et al. (2019b)	Rats exposed to 900 MHz, 1800 MHz, and 2100 MHz RFR 2 h/day for 6 months; maximum SAR over the rat 0.017 W/kg	DNA strand breaks and oxidative DNA damage in testicular tissue.
Atasoy et al. (2013)	Male Wister rats exposed to 2437 MHz (Wi-Fi) RFR; 24 h/day for 20 weeks; maximum SAR 0.091 W/kg	Oxidative DNA damage in blood and testes.
Beaubois et al. (2007)	Leaves of tomato plant exposed to 900-MHz RFR for 10 min at 0.0066 mW/cm ²	Increased expression of leucine-zipper transcription factor (bZIP) gene.
Belyaev et al. (2005)	Lymphocytes from human subjects exposed to GSM 915 MHz RFR for 2 h ; SAR 0.037 W/kg;	Increased condensation of chromatin.
Belyaev et al. (2009)	Human lymphocytes exposed to UMTS cell phone signal (1947.4 MHz, 5 MHz band	Chromatin affected and inhibition of DNA double-strand break.

	width) for 1 h; SAR 0.04 W/kg	
Bourdineaud et al. (2017)	Eisenia fetida earthworms exposed to 900 MHz for 2 h; SAR 0.00013-0.00933 W/kg	DNA genotoxic effect and HSP70 gene expressions up regulated.
Campisi et al. (2010)	Rat neocortical astroglial to CW 900 MHz RFR for 5, 10, or 20 min; incident power density 0.0265 mW/cm ²	Significant increases in DNA fragmentation.
Chaturvedi et al. (2011)	Male mice exposed to 2450 MHz RFR, 2 h/day for 30 days; SAR 0.03561 W/kg	Increased DNA strand breaks in brain cells.
Deshmukh et al. (2013)	Male Fischer rats exposed to 900 MHz (0.0005953 W/kg), 1800 MHz (0.0005835 W/kg), and 2450 MHz (0.0006672 W/kg) RFR for 2 h/day, 5 days/week for 30 days.	Increased DNA strand breaks in brain tissues.
Deshmukh et al. (2015)	Male Fischer rats exposed to 900 MHz (0.0005953 W/kg), 1800 MHz (0.0005835 W/kg), and 2450 MHz (0.0006672 W/kg) RFR for 2 h/day, 5 days/week for 180 days.	Increased DNA strand breaks in brain tissues.
Deshmukh et al. (2016)	Male Fischer rats exposed to 900 MHz (0.0005953 W/kg), 1800 MHz (0.0005835 W/kg), and 2450 MHz (0.0006672 W/kg) RFR for 2 h/day, 5 days/week for 90 days.	Increased DNA strand breaks in brain tissues.
Eker et al. (2018)	Female Wistar albino rats exposed to 1800-MHz RFR for 2 h/day	Caspase-3 and p38MAPK gene expressions increased in eye tissues.

	for 8 weeks; SAR 0.06 W/kg	
Furtado-Filho et al. (2014)	Rats of different ages (0-30 days) exposed to 950 MHz RFR for 0.5 h/day for 51 days (21 days of gestation and 6-30 days old): SAR pregnant rat 0.01-0.03 W/kg; neonate 0.88 W/kg, 6-day old 0.51 W/kg, 15-day old 0.18 W/kg, 30-day old 0.06 W/kg.	Decreased DNA strand breaks in liver of 15-day old and increased breaks in 30-day old rats..
Gulati et al. (2016)	Blood and buccal cells of people lived close (<400 meters) to a cell tower; 1800 MHz, Maximum power density (at 150 meters) 0.00122 mW/cm ² , some subjects lived in the area for more than 9 yrs	Increased DNA strand breaks in lymphocytes and micronucleus in buccal cells.
Gürler (2014)	Wistar rats exposed to 2450 MHz RFR 1 h/day for 30 consecutive days; power density 0.0036 mW/cm ²	Increased oxidative DNA damage in brain and blood.
Hanci et al. (2013)	Pregnant rats exposed 1 h/day on days 13-21 of pregnancy to 900-MHz RFR at power density 0.0265 mW/cm ² .	Testicular tissue of 21-day old offspring showed increased DNA oxidative damage.
He et al. (2016)	Mouse bone marrow stromal cells exposed to 900 MHz RFR 3 h/day for 5 days; SAR 4.1 x 10 ⁻⁴ W/kg (peak), 2.5 x 10 ⁻⁴ W/kg (average)	Increased expression of PARP-1 mRNA
Hekmat et al. (2013)	Calf thymus exposed to 940 MHz RFR for	Altered DNA structure at 0 and 2 h after exposure.

	45 min; SAR 0.04 W/kg	
Keleş and Süt (2021)	Pregnant rats exposed to 900-MH RFR at 0.0265 mW/cm ² ; 1 h/day from E13.5 until birth; thoracic spine of offspring examined.	Down regulation of H3K27me ₃ gene, an epigenetic modification to the DNA packaging protein Histone H3 in motor neurons.
Kesari and Behari (2009)	Male Wistar rats exposed to 50 GHz RFR for 2 h/day for 45 days; SAR 0.0008 W/kg	Increased in brain tissue DNA strand.
Kumar R. et al. (2021)	Male Wistar rats exposed to 900, 100, 2450 MHz RFR at SARs of 5.84×10^{-4} W/kg, 5.94×10^{-4} W/kg and 6.4×10^{-4} W/kg respectively for 2 h per day for 1-month, 3-month and 6-month	Microwave exposure with increasing frequency and exposure duration brings significant ($p < 0.05$) epigenetic modulations which alters gene expression in the rat hippocampus. Global DNA methylation was decreased and histone methylation was increased.
Kumar S. et al. (2010)	Male Wistar rats exposed to 10-GHz RFR for 2 h a day for 45 days, SAR 0.014 W/kg	Increased micronucleus in blood cells.
Kumar S. et al. (2013)	Male Wistar rats exposed to 10 GHz RFR for 2 h a day for 45 days; SAR 0.014 W/kg	Increased micronucleus in blood cells and DNA strand breaks in spermatozoa.
Marinelli et al. (2004)	Acute T-lymphoblastoid leukemia cells exposed to 900 MHz RFR for 2-48 h, SAR 0.0035 W/kg	Increased DNA damage and activation of genes involved in pro-survival signaling.
Markova et al. (2005)	Human lymphocytes exposed to 905 and 915 MHz GSM signals for 1 h; SAR 0.037 W/kg	Affected chromatin conformation and 53BP1/gamma-H2AX foci
Markova et al. (2010)	Human diploid VH-10 fibroblasts and human	Inhibited tumor suppressor TP53 binding protein 1 (53BP1) foci

	adipose-tissue derived mesenchymal stem cells exposed to GSM (905 MHz or 915 MHz) or UMTS (1947.4 MHz, middle channel) RFR for 1, 2, or 3 hr; SAR 0.037-0.039 W/kg	that are typically formed at the sites of DNA double strand break location.
Megha et al. (2015a)	Fischer rats exposed to 900 and 1800 MHz RFR for 30 days (2 h/day, 5 days/week), SAR 0.00059 and 0.00058 W/kg	Reduced levels of neurotransmitters dopamine, norepinephrine, epinephrine, and serotonin, and downregulation of mRNA of tyrosine hydroxylase and tryptophan hydroxylase (synthesizing enzymes for the transmitters) in the hippocampus.
Megha et al. (2015b)	Fischer rats exposed to 900, 1800, and 2450 MHz RFR for 60 days (2 h/day, 5 days/week); SAR 0.00059, 0.00058, and 0.00066 W/kg	Increased DNA damage in the hippocampus
Nittby et al. (2008)	Fischer 344 rats exposed to 1800 MHz GSM RFR for 6 h; SAR whole body average 0.013 W/kg, head 0.03 W/kg	Expression in cortex and hippocampus of genes connected with membrane functions.
Odaci et al. (2016)	Pregnant Sprague - Dawley rats exposed to 900 MHz RFR 1 h each day during days 13 - 21 of pregnancy; whole body average SAR 0.024 W/kg	Testis and epididymis of offspring showed higher DNA oxidation.
Pandey et al. (2017)	Swiss albino mice exposed to 900-MHz RFR for 4 or 8 h per day for 35 days; SAR 0.0054-0.0516 W/kg	DNA strand breaks in germ cells.
Pesnya and Romanovsky (2013)	Onion (<i>Allium cepa</i>) exposed to GSM 900-MHz RFR from a cell	Increased the mitotic index, the frequency of mitotic and chromosome abnormalities, and

	phone for 1 h/day or 9 h/day for 3 days; incident power density 0.0005 mW/cm ²	the micronucleus frequency in an exposure-duration manner.
Phillips et al. (1998)	Human Molt-4 T-lymphoblastoid cells exposed to pulsed signals at cellular telephone frequencies of 813.5625 MHz (iDEN signal) and 836.55 MHz (TDMA signal) for 2 or 21 h. SAR 0.0024 and 0.024 W/Kg for iDEN and 0.0026 and 0.026 W/kg for TDMA)	Changes in DNA strand breaks
Qin et al. (2018)	Male mice exposed to 1800-MHz RFR 2 h/day for 32 days, SAR 0.0553 W/kg	Inhibition of testosterone synthesis might be mediated through CaMKI/ROR α signaling pathway.
Rammal et al. (2014)	Tomato exposed to a 1250-MHz RFR for 10 days at 0.0095 mW/cm ²	Increased expression of two wound-plant genes.
Roux et al. (2006)	Tomato plants exposed to a 900-MHz RFR for 2-10 min at 0.0066 mW/cm ²	Induction of stress gene expression.
Roux et al. (2008)	Tomato plants exposed to a 900-MHz RFR for 10 min at 0.0066 mW/cm ²	Induction of stress gene expression.
Sarimov et al. (2004)	Human lymphocytes exposed to GSM 895-915 MHz signals for 30 min; SAR 0.0054 W/kg	Condensation of chromatin was observed.
Shahin et al. (2013)	Female mice (Mus musculus) exposed to continuous-wave 2.45 GHz RFR 2 h/day for 45 days; SAR 0.023 W/kg	Increased DNA strand breaks in the brain.

Sun Y. et al. (2017)	Human HL-60 cells exposed to 900 Hz RFR 5 h/day for 5 days; peak and average 0.00041 and 0.00025 W/kg, respectively.	Increased oxidative DNA damage and decreased mitochondrial gene expression.
Tkalec et al. (2013)	Earthworm (<i>Eisenia fetida</i>) exposed to continuous-wave and AM-modulated 900-MHz RFR for 2 - 4 h; SAR 0.00013, 0.00035, 0.0011, and 0.00933 W/kg	Increased DNA strand breaks.
Tsybulin et al. (2013)	Japanese Quail embryos exposed in ovo to GSM 900 MHz signal from a cell phone intermittently (48 sec ON/12 sec OFF) during initial 38 h of brooding or for 158 h (120 h before brooding plus initial 38 h of brooding): SAR 0.000003 W/kg	The lower duration of exposure decreased DNA strand breaks, whereas higher duration resulted in a significant increase in DNA damage.
Vian et al. (2006)	Tomato plants exposed to a 900-MHz RFR for 10 min at 0.0066 mW/cm ²	Induction of mRNA encoding the stress-related bZIP transcription factor.
Yakymenko et al. (2018)	Quail embryos exposed to GSM 1800 GHz signal from a smart phone (48 s ON/12 s OFF) for 5 days before and 14 days during incubation, power density 0.00032 mW/cm ²	Increased DNA strand breaks and oxidative DNA damage.
Zong et al. (2015)	Mice exposed to 900 MHz RFR 4 h/day for 7 days; SAR 0.05 W/kg	Attenuated bleomycin-induced DNA breaks and repair,

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Table 1

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Part 2. Supplement 2.
Genetic Effects at Low Intensity Static/ELF EMF Exposure

Static and ELF EMF Studies	magnetic flux density	Effects observed
Agliassa et al. (2018)	Arabidopsis thaliana (thale cress) exposed to 0.00004 mT static magnetic field for 38 days after sowing	Changes in gene expression in leaf and floral meristem.
Baek et al. (2019)	Mouse embryonic stem cells exposed to hypomagnetic field (<0.005 mT) up to 12 days	Induced abnormal DNA methylation.
Bagheri Hosseinabadi et al. (2020)	Blood samples from thermal power plant workers; mean levels of exposure to ELF magnetic and electric fields were 0.0165 mT (± 6.46) and 22.5 V/m (± 5.38), respectively.	DNA strand breaks .in lymphocytes.
<u>Baraúna</u> et al. (2015)	Chromobacterium violaceum bacteria cultures exposed to ELF-EMF for 7 h at 0.00066 mT	Five differentially expressed proteins detected including the DNA-binding stress protein.
Belyaev et al. (2005)	Human lymphocytes exposed to 50 Hz magnetic field at 0.015 mT (peak) for 2 h (measurements made at 24 and 48 h after exposure).	Induced chromatin conformation changes.
Dominici et al. (2011)	Lymphocytes from welders (average magnetic field exposure from personal dosimeters 0.00781 mT (general environmental level 0.00003 mT)	Higher micronucleus frequency correlated with EMF exposure levels; decreased in sister chromatid exchange frequency.

<p>Heredia-Rojas et al. (2010)</p>	<p>Human non-small cell lung cancer cells (INER-37) and mouse lymphoma cells (RMA E7) (transfected with a plasmid with hsp70 expression when exposed to magnetic field and contains the reporter for the luciferases gene) exposed to a 60-Hz magnetic field at 0.008 and 0.00008 mT for 20 min.</p>	<p>An increased in luciferase gene expression was observed in INER-37 cells.</p>
<p>Liboff et al. (1984)</p>	<p>Human fibroblasts during the middle of S phase exposed to 15 Hz-4 kHz sinusoidal MF</p>	<p>Enhanced DNA synthesis at between 5-25 μT</p>
<p>Sarimov et al. (2011)</p>	<p>Human lymphocytes exposed to 50-Hz magnetic field at 0.005-0.02 mT for 15-180 min</p>	<p>Magnetic field condensed relaxed chromatin and relaxed condensed chromatin.</p>
<p>Villarini et al. (2015)</p>	<p>Blood leukocytes from electric arc welders presumably exposed to 50-Hz EMF (mean 0.0078 mT; range: 0.00003-0.171 mT)</p>	<p>Decreased DNA strand breaks.</p>
<p>Wahab et al. (2007)</p>	<p>Human peripheral blood lymphocytes exposed to 50 Hz sinusoidal (continuous or pulsed) or square (continuous or pulsed) magnetic fields at 0.001 or 1 mT for 72 h.</p>	<p>Increase in the number of sister chromatid exchange/cell</p>
<p>Zendehdel et al. (2019)</p>	<p>Peripheral blood cells of male power line workers in a power plant. The median value of the magnetic</p>	<p>Increased in DNA strand breaks.</p>

	field at the working sites was 0.00085 mT.	
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Part 2. Supplement 3
Biological Effects in Animals and Plants Exposed to Low-Intensity RFR

		SAR (W/kg)	Power density ($\mu\text{W}/\text{cm}^2$)	Effects reported
Aitken et al. (2005)	Mice exposed to 900 MHz RFR, 12/day. 7 days	0.09		Genotoxic effect in sperm.
Akdag et al. (2016)	Rats exposed to 2400 MHz RFR from a Wi-Fi signal generator for a year	0.000141 (min)- 0.007127 (max)		DNA damage in testes.
Alimohammadi et al. (2018)	pregnant mice exposed to 915 MHz RFR; 8h/day, 10 days.		0.045	Offspring had increased fetal weight, enlarged liver and tail deformation
Alkis et al. (2019a)	Rats exposed to 900; 1800; and 2100 MHz RFR; 2 h/day. 6 months	Brain SAR: 900 MHz - 0.0845; 1800 MHz- 0.04563; 210 MHz- 0.03957		DNA single strand break and oxidative damages in frontal lobe.
Alkis et al. (2019b)	Rats exposed to 900; 1800; and 2100 MHz RFR; 2 h/day. 6 months	maximum SAR over the rat body 0.017		DNA strand breaks and oxidative DNA damage in testicular tissue.
Atasoy et al. (2013)	Rats exposed to 2437 MHz (Wi-Fi) RFR; 24 h/day for 20 weeks	maximum SAR 0.091		Oxidative DNA damage in blood and testes.

Balmori et al. (2010)	Frog (<i>Rana temporaria</i>) exposed to 88.5 – 1873.6 MHz, cell phone base station emissions; 2 months from egg phase to tadpole		0.859-3.25 (1.5-3.8 V/m)	Retarded development and increased mortality rate.
Balmori et al (2015)	White stocks lived within 200 m of a Phone mast, GSM-900 MHz and DCS-1800 MHz signals		1.48	Affected reproduction rate.
Bartos et al. (2019)	Cockroach exposed to broadband RF noise		429 nT	Light-dependent slowing of circadian rhythm.
Beaubois et al. (2007)	Tomato plant exposed to 900-MHz RFR for 10 min		6.6	Increased expression of leucine-zipper transcription factor (bZIP) gene in leaves.
Bedir et al. (2018)	Rat exposed to 2100 MHz RFR, 6 or 19 h/day, 30 days	0.024		Oxidative stress-mediated renal injury.
Belyaev et al. (1992)	<i>E. coli</i> exposed to 51.62-51.84 and 41.25-41.50 GHz RFR, 5-15 min		1	Suppressed radiation-induced repair of genome conformation state.
Belyaev et al. (2005)	915 MHz GSM signal, 24 & 48 hr	0.037		Genetic changes in human white blood cells
Belyaev et al. (2009)	915 MHz, 1947 MHz; GSM, UMTS signals 24 & 72 hr	0.037		DNA repair mechanism in human white blood cells
Bourdineaud et al. (2017)	Earthworm (<i>Eisenia fetida</i>) exposed to 900 MHz RFR, 2 hr	0.00013-0.009		DNA modification.

Burlaka et al. (2013)	Japanese quail embryos exposed to GSM 900 MHz RFR; 158-360 hr		0.25	Oxidative DNA damage and free radical formation
Capri et al. (2004)	900 MHz, GSM signal, 1 hr/day, 3 days	0.07		Cell proliferation and membrane chemistry
Cammaerts and Johansson (2015)	Brassicaceae lepidium sativum (cress d'alinois) seed exposed to 900 and 1800 MHz RFR, 4, 7, and 10 days		0.007-0.01	Defect in germination.
Cammaerts et al. (2013)	Ants exposed to GSM signal for 180 h		0.1572	Affected food collection and response to pheromones.
Cammaerts et al. (2014)	Ants exposed to GSM signal for 10 min		0.5968	Affected social behavior.
Campisi et al. (2010)	Rat neocortical astroglial cells exposed to 50-Hz modulated 900 Mhz RFR, 5-20 min		26	Free radical production and DNA fragmentation.
Czerwinski et al. (2020)	Plant community exposed to cell phone base station radiation		0.01-0.1	Biological effects observed.
Chaturvedi et al. (2011)	Rat brain cells exposed to 2450 MHz RFR, 2 h/day for 30 days	0.03561		Increased DNA strand breaks.
Comelekoglu et al. (2018)	Rat sciatic nerve exposed to 1800 MHz RFR, 1 hr/day, 4 weeks	0.00421		Changes in electrical activity, increased catalase, and degeneration of myelinated fibers.

De Pomerai et al. (2003)	Protein exposed to 1 GHz RFR, 24 & 48 hr	0.015		Protein damages
Deshmukh et al. (2013)	Rats exposed to 900, 1800, and 2450 MHz RFR ; 30 days	0.0006-0.0007		DNA strand breaks in brain.
Deshmukh et al. (2015)	Rats exposed to 900, 1800, and 2450 MHz RFR; 180 days	0.0006-0.0007		Declined cognitive functions, increased brain HSP70 and DNA strand break.
Deshmukh et al. (2016)	Rats exposed 900, 1800, and 2450 MHz; 90 days	0.0006-0.0007		Declined cognitive functions, increased brain HSP70 and DNA strand break in rats
Dutta et al. (1984)	human neuroblastoma cells exposed to 915 MHz RFR, sinusoidal AM at 16 Hz	0.05		Increase in calcium efflux.
Dutta et al. (1994)	Escherichia coli cultures containing a plasmid with a mammalian gene for enolase were exposed for 30 min to 147 MHz RFR AM at 16 or 60 Hz	0.05		Enolase activity in exposed cultures RFR at AM at 16 Hz showed enhanced activity enhanced, and AM at 60 Hz showed reduced activity. (Modulation frequencies. 16 and 60 Hz, caused similar effects.)
Eker et al. (2018)	Rats exposed to 1800 MHz RFR, 2 hr/day for 8 weeks	0.06		Increased caspase-3 and p38MAPK expressions in eye.
Fesenko et al. (1999)	Mice exposed to 8.15 – 18 GHz RFR, 5 hr to 7 days, direction of response depended on exposure duration		1	Changes in immunological functions.

Forgacs et al. (2006)	Mice exposed to 1800 MHz RFR, GSM- 217 Hz pulses, 576 μ s pulse width; 2 hr/day, 10 days	0.018		Increase in serum testosterone.
Frątczak et al. (2020)	Ticks exposed to 900 MHz RFR		0.1	Ticks attracted to the RFR, particularly those infected with Rickettsia (spotted fever).
Friedman et al. (2007)	Rat and human cells exposed to 875 MHz RFR, 30 min		5	Activation of signaling pathways.
Furtado-Filho et al. (2014)	Pregnant rats exposed to 950 MHz RFR for 0.5 h/day for 51 days (21 days of gestation and 6-30 days old)	SAR pregnant rat 0.01-0.03 W/kg; neonate 0.88 W/kg, 6-day old 0.51 W/kg, 15-day old 0.18 W/kg, 30-day old 0.06 W/kg		Decreased DNA strand breaks in liver of 15-day old and increased breaks in 30-day old offspring.
Gandhi et al. (2015)	People who lived within 300 m of a mobile-phone base station.		1.15	Increased DNA damage in lymphocytes, more in female than in male subjects.
Garaj-Vrhovac et al. (2011)	Operators of two types of marine radars (3, 9.4, and 5.5 GHz); average time on job 2-16 yrs	0.0005-0.004 (time averaged)		Increased genetic damages in blood lymphocytes

Gremiaux et al. (2016)	Rose exposed to 900 MHz RFR, 3x 39min every 48 h at 2 stages of development	0.00072		Delayed and reduced growth.
Gulati et al. (2016)	People lived close (<400 meters) to a cell tower; 1800 MHz, , some subjects lived in the area for more than 9 yrs		Maximum power density (at 150 meters) 1.22	Increased DNA strand breaks in lymphocytes and micronucleus in buccal cells.
Gulati et al. (2020)	DNA damage in human lymphocytes	Cells exposed to UMTS signals at different frequency channels used by 3 G mobile phone (1923, 1947.47, and 1977 MHz) for 1 or 3 h; SAR 0.04 W/kg		DNA damage found only in cells exposed to 1977-MHz field.
Gupta et al. (2018)	Rats exposed to 2450 MHz RFR; 1h/day 28 days	0.0616		Cognitive deficit, loss of mitochondrial functions, activation of apoptotic factors in hippocampus; affected cholinergic system.
Gurler et al. (2014)	Rats exposed to 2.45 GHz RFR, 1 h/day, 30 days		3.59	Increased DNA damage in brain.

Halgamuge et al. (2015)	Growth parameters of soybean seedlings	GSM 217 Hz-modulated (4.8×10^{-7} , 4.9×10^{-5} , and 0.0026 W/kg) SAR or CW (0.00039 and 0.02 W/kg) 900-MHz RFR for 2 h		Modulated and CW fields produced different patterns of growth effects. There was an amplitude effect and extremely low-level modulated field (4.8×10^{-7} W/kg) affected all parameters.
Hanci et al. (2013)	Pregnant rats exposed 1 h/day on days 13-21 of pregnancy to 900-MHz RFR		26.5	Testicular tissue of 21-day old offspring showed increased DNA oxidative damage.
Hanci et al. (2018)	Rats exposed to 900 MHz RFR, 1 h/day to postnatal day 60.	0.0067		Changes in morphology and increase in oxidative stress marker in testis.
Hassig et al. (2014)	Cows exposed to 916.5 MHz signal similar to GSM base station, 30 days 16 h 43 min per day		38.2	Changes in redox enzymes (SOD, CAT, GSH-px)
He et al. (2016)	Mouse bone marrow stromal cells exposed to 900 MHz RFR 3 h/day for 5 days	2.5×10^{-4}		Increased expression of PARP-1 mRNA
Hekmat et al. (2013)	Calf thymus exposed to 940 MHz RFR, 45 min	0.04		Conformational changes in DNA.

Ivaschuk et al. (1997)	Nerve growth factor-treated PC12 rat pheochromocytoma cells 836.55 MHz TDMA signal, 20 min	0.026		Transcript levels for c-jun altered.
Ji et al. (2016)	Mouse bone-marrow stromal cells exposed to 900 MHz RFR, 4 hr/day for 5 days		120	Faster kinetics of DNA-strand break repair.
Keleş et al. (2019)	Rats exposed to 900 MHz RFR; 1h/day, 25days	0.012		Higher number of pyramidal and granule neurons in hippocampus.
Kesari and Behari (2009)	Rats exposed to 50 GHz RFR; 2hr/day, 45 days	0.0008		Double strand DNA breaks observed in brain cells
Kesari and Behari (2010)	Rats exposed to 50 GHz RFR; 2 hr/day, 45 days	0.0008		Changes in oxidative processes and apoptosis in reproductive system.
Kesari et al. (2010)	Rats exposed to 2450 MHz RFR at 50-Hz modulation, 2 hr/day, 35 days	0.11		DNA double strand breaks in brain cells
Kumar et al. (2010a)	Rats exposed to 10 GHz RFR, 2h/day 45 days	0.014		Cellular changes and increase in reactive oxygen species in testes
Kumar et al. (2010b)	Rats exposed to 10 GHz RFR, 2 h/day, 45 days; or 50 GHz, 2h/day, 45 days	0.014 (10 GHz) 0.0008 (50 GHz)		Genetic damages in blood cells.

Kumar et al. (2013)	Rats exposed to 10 GHz RFR for 2 h a day for 45 days	0.014		Increased micronucleus in blood cells and DNA strand breaks in spermatozoa.
Kumar et al. (2015)	maize seedlings exposed to 1899 MHz RFR, 0.5-4 h		33.2	Retarded growth and decreased chlorophyll content.
Kumar et al. (2021)	Epigenetic modulation in the hippocampus of Wistar rats	Rats exposed to 900 MHz, 1800 MHz, and 2450 MHz RFR at a specific absorption rate (SAR) of 5.84×10^{-4} W/kg, 5.94×10^{-4} W/kg and 6.4×10^{-4} W/kg respectively for 2 h per day for 1-month, 3-month and 6-month periods.		Significant epigenetic modulations were observed in the hippocampus, larger changes with increasing frequency and exposure duration.
Kwee et al. (2001)	Transformed human epithelial amnion cells exposed to 960 MHz GSM signal, 20 min	0.0021		Increased Hsp-70 stress protein.
Landler et al. (2015)	Juvenile snapping turtle (<i>c. serpentina</i>) exposed to 1.43 MHz RFR, 20 min		20-52 nT	Disrupted magnetic orientation.

Lazaro et al. (2016)	50, 100, 200, 400 m from ten mobile telecommunication antennas		0.0000265 - 0.106	Distance-dependent effects on abundance and composition of wild insect pollinators
Lerchl et al. (2008)	383 MHz (TETRA), 900 and 1800 MHz (GSM) 24 hr/day, 60 days	0.08		Metabolic changes in hamster.
López-Martín et al. (2009)	Pulse-modulated GSM and unmodulated signals; 2 hr	0.03-0.26		c-Fos expression in brain of picotoxin-induced seizure-prone rats
Magras and Xenos (1997)	Mice in 'antenna park'-TV and FM-radio, exposure over several generations		0.168	Decrease in reproductive functions.
Marinelli et al. (2004)	Human leukemia cell exposed to 900 MHz CW RFR 2 - 48 hr	0.0035		Cell's self-defense responses triggered by DNA damage.
Makova et al. (2005)	human white blood cells exposed to 915 and 905 MHz GSM signal, 1 hr	0.037		Altered chromatin conformation.
Markova et al. (2010)	in human diploid VH-10 fibroblasts and human adipose-tissue derived mesenchymal stem cells exposed to GSM (905 MHz or 915 MHz) or UMTS (1947.4 MHz, middle channel) RFR for 1, 2, or 3 hr;	0.037-0.039		Inhibited tumor suppressor TP53 binding protein 1 (53BP1) foci that are typically formed at the sites of DNA double strand break location.

Megha et al. (2015a)	Rats exposed to 900 and 1800 MHz RFR for 30 days (2 h/day, 5 days/week)	0.00059 and 0.00058		Reduced levels of neurotransmitters dopamine, norepinephrine, epinephrine, and serotonin, and downregulation of mRNA of tyrosine hydroxylase and tryptophan hydroxylase (synthesizing enzymes for the transmitters) in the hippocampus.
Megha et al. (2015b)	Rats exposed to 900, 1800, and 2450 MHz RFR for 60 days (2 h/day, 5 days/week)	0.00059, 0.00058, and 0.00066		Increased DNA damage in the hippocampus.
Monselise et al. (2011)	Etiolated duckweed exposed to AM 1.287 MHz signal form transmitting antenna		0.859 (1,8-7.8 V/m)	Increased alanine accumulation in cells.
Navakatikian and Tomashevskaya (1994)	Rats exposed to 2450 MHz CW and 3000 MHz pulse-modulated 2 μ s pulses at 400 Hz, Single (0.5-12 hr) or repeated (15-60 days, 7-12 hr/day)	0.0027		Behavioral and endocrine changes, and decreases in blood concentrations of testosterone and insulin. CW-no effect
Nittby et al. (2007)	Rats exposed to 900 MHz GSM signal, 2 hr/wk, 55wk	0.0006		Reduced memory functions.
Nittby et al. (2008)	Rats exposed to 915 MHz GSM signal, 6 hr	0.013 (whole body average); 0.03 (head)		Altered gene expression in cortex and hippocampus.

Novoselova et al. (1999)	Mice exposed to RFR from 8.15 -18 GHz, 1 sec sweep time-16 ms reverse, 5 hr		1	Changes in Functions of the immune system.
Novoselova et al. (2004)	Mice exposed to RFR from 8.15 -18 GHz, 1 sec sweep time-16 ms reverse, 1.5 hr/day, 30 days		1	Decreased tumor growth rate and enhanced survival.
Novoselova et al. (2017)	Mice exposed to 8.15 -18 GHz RFR, 1 Hz swinging frequency, 1 hr		1	Enhanced plasma cytokine.
Odaci et al. (2016)	Pregnant Sprague - Dawley rats exposed to 900 MHz RFR 1 h each day during days 13 - 21 of pregnancy	0.024		Testis and epididymis of offspring showed higher DNA oxidation.
Özsobacı et al. (2020)	Human kidney embryonic cells (HEK293) exposed to 3450 MHz RFR, 1 h		1.06	Changed oxidative enzyme activity and increased apoptosis.
Panagopoulos and Margaritis. (2010a)	Flies exposed to GSM 900 and 1800 MHz RFR, 6 min/day, 5 days		10	'Window' effect of GSM radiation on reproductive capacity and cell death.
Panagopoulos and Margaritis. (2010b)	Flies exposed to GSM 900 and 1800 MHz RFR, 1- 21 min/day, 5 days		10	Reproductive capacity of the fly decreased linearly with increased duration of exposure.
Panagopoulos et al. (2010)	Flies exposed GSM 900 and 1800 MHz RFR, 6 min/day, 5 days		1-10	Affected reproductive capacity and induced cell death.
Pandey et al. (2017)	Mice exposed to 900-MHz RFR for	0.0054-0.0516		DNA strand breaks in germ cells.

	4 or 8 h per day for 35 days			
Pavicic et al. (2008)	Chinese hamster V79 cells exposed to 864 and 935 MHz CW RFR, 1-3 hrs	0.08		Cell growth affected.
Perov et al. (2019)	Rats exposed to 171 MHz CW RFR, 6h/day, 15 days	0.006		Stimulation of adrenal gland activity.
Persson et al. (1997)	Rats exposed to 915 MHz RFR -CW and pulse-modulated (217-Hz, 0.57 ms; 50-Hz, 6.6 ms) 2-960 min.	0.0004		Increase in permeability of the blood-brain barrier. CW more potent.
Pesnya and Romanovsky (2013)	Onion exposed to GSM 900-MHz RFR from a cell phone for 1 h/day or 9 h/day for 3 days.		0.5	Increased mitotic index, frequency of mitotic and chromosome abnormalities, and micronucleus frequency.
Phillips et al. (1998)	Human leukemia cells exposed to 813.5625 MHz (iDEN); 836.55 MHz (TDMA) signals, 2 hr and 21 hr	0.0024		DNA damage observed.
Piccinetti et al. (2018)	Zebrafish exposed to 100 MHz RFR, 24-72 h post-fertilization	0.08		Retarded embryonic development.
Postaci et al. (2018)	Rats exposed to 2600 MHz RFR, 1 h/day, 30 days	0.011		Cellular damages and oxidative damages in liver.

Pyrpasopoulou et al. (2004)	Rats exposed to 9.4 GHz GSM (50 Hz pulses, 20 μ s pulse length) signal, 1-7 days postcoitum	0.0005		Exposure during early gestation affected kidney development.
Qin et al. (2018)	Mice exposed to 1800-MHz RFR, 2 h/day for 32 days	0.0553		Inhibition of testosterone synthesis.
Rafati et al. (2015)	Frog gastrocnemius muscle exposed to cell phone jammers; 1 m away, 3x 10 min periods	For different jammers:0.01-0.05		Latency of contraction of prolonged.
Ranmal et al. (2014)	Tomato exposed to 1250-MHz RFR for 10 days.		9.5	Increased expression of two wound-plant genes.
Roux et al. (2006)	Tomatoes exposed to 900-MHz RFR for 2-10 min		6.6	Induction of stress gene expression in tomato.
Roux et al. (2008a)	Tomatoes exposed to 900 MHz RFR		6.6	Changes in Gene expression and energy metabolism.
Roux et al. (2008b)	Tomato plants exposed to 900 MHz RFR (>30 min)		6.6	Changes in energy metabolism in leave of tomato plant.
Salford et al. (2003)	Rats exposed to 915 MHz GSM, 2 hr	0.02		Nerve cell damage in brain.
Sarimov et al. (2004)	Human lymphocytes exposed to 895-915 MHz GSM signal, 30 min	0.0054		Chromatin affected similar to stress response.

Schwarz et al. (2008)	Human fibroblasts exposed to 1950 MHz UMTS signal, 24 hr	0.05		Changes in genes.
Shahin et al. (2013)	Mice exposed to 2450 MHz RFR, 2 h/day for 45 days	0.023		Increased DNA strand breaks in the brain.
Singh et al. (2012)	Hung beans exposed to 900 MHz RFR, 0.5-2 h		8.54	Reduced root length and number of roots per hypocotyls.
Sirav and Seyhan (2011)	Rats exposed to CW 900 MHz or 1800 MHz for 20 min	CW 900 MHz (0.00426 W/kg) or 1800 MHz (0.00146 W/kg)		Increased blood-brain barrier permeability in male rats, no significant effect on female rats.
Sirav and Seyhan (2016)	Rats exposed to pulsed-modulated (217 Hz, 517 μ s width) 900 MHz or 1800 MHz 6 RFR for 20 min	0.02		In male rats, both frequencies increased blood-brain barrier permeability, 1800 MHz is more effective than 900 MHz; in female rats, only 900 MHz filed caused an effect.
Somosz et al. (1991)	Rat embryo 3T3 cells exposed to 2450-MHz 16-Hz square modulated RFR	0.024		Increased the ruffling activity of the cells, and caused ultrastructural alteration in the cytoplasm. CW was less effective.
Soran et al. (2014)	Plants exposed to GSM and WLAN signals		10 (GSM) 7 (WLAN)	Enhanced release of terpene from aromatic plants; essential oil contents in leaves enhanced by GSM radiation but reduced by WLAN radiation in some plants.

Stagg et al. (1997)	Glioma cells exposed to 836.55 MHz TDMA signal, duty cycle 33%, 24 hr	0.0059		Glioma cells showed significant increases in thymidine incorporation, which may be an indication of an increase in cell division.
Stankiewicz et al. (2006)	Human white blood cells exposed to 900 MHz GSM signal, 217 Hz pulses-.577 ms width, 15 min	0.024		Immune activities of human white blood cells affected.
Sun Y. et al. (2017)	Human HL-60 cells exposed to 900 Hz RFR, 5 h/day for 5 days	peak and average SAR 4.1×10^{-4} and 2.5×10^{-4} W/kg		Increased oxidative DNA damage and decreased mitochondrial gene expression.
Szymanski et al. (2020)	Human cells exposed to Pulse-modulated 900 MHz RFR, two 15-min exposure	0.024		Human blood mononucleus cells demonstrated high immunological activity of monocytes and T-cell response to concanavalin A.
Tkalec et al. (2013)	Earthorn exposed to continuous-wave and AM-modulated 900- MHz RFR for 2 - 4 h	0.00013, 0.00035, 0.0011, and 0.00933		Increased DNA strand breaks.
Tsybulin et al. (2012)	Japanese Quail embryos exposed to GSM 900 MHz signal during first 38 h or 14 days of fertilization		0.2	Enhanced development and survival in Japanese Quail embryos probably via a free radical-induced mechanism.
Tsybulin et al. (2013)	Japanese Quail embryos exposed to GSM 900 MHz signal, 48 sec on/12 sec off; 38 or 158 h	0.003		Decreased DNA strand break at 38 h and increased in 158h exposure in cells.

Vargová et al. (2017)	Ticks exposed to 900 MHz RFR		0.07	Ticks showed greater movement activity, with jerking movement of whole body or first pair of legs.
Vargová et al. (2018)	Ticks exposed to 900 MHz and 5000 MHz RFR		0.105	In a tube with half shielded for RFR, ticks exposed to 900 MHz concentrated on exposed side, and escaped to shielded side when exposed to 5000 MHz
Velizarov et al. (1999)	Human epithelial amnion cells exposed to 960 MHz GSM signal, 217 Hz square-pulse, duty cycle 12%, 30 min	0.000021		Decreased proliferation
Veyret et al. (1991)	Exposure to 9.4 GHz 1 μ s pulses at 1000 pps, also with or without sinusoidal AM between 14 and 41 MHz, response only with AM modulation, direction of response depended on AM frequency	0.015		Changes in functions of the mouse immune system.
Vian et al. (2006)	Tomato plants exposed to 900 MHz RFR		6.6	Stress gene expression in plant.

Vilić et al. (2017)	Oxidative effects and DNA damage in honey bee (<i>Apis mellifera</i>) larvae		Honey bee larvae were exposed to 900-MHz at unmodulated field at 27 $\mu\text{W}/\text{cm}^2$ and modulated (80% AM 1 kHz sinusoidal) field at 140 $\mu\text{W}/\text{cm}^2$, for 2 hr.	Oxidative effect with exposure to unmodulated field. DNA damage increased after exposure to modulated field.
Waldmann-Salsam et al. (2016)	Mobile phone mast, long-term exposure		>0.005	Damages to trees
Wolke et al. (1996)	Heart muscle cells of guinea pig exposed to 900, 1300, 1800 MHz, square-wave modulated at 217 Hz; Also 900 MHz with CW, 16 Hz, 50 Hz and 30 KHz modulations	0.001		Changed calcium concentration in heart muscle cells.
Yakymenko et al. (2018)	Quail embryos exposed to GSM 1800 GHz signal from a smart phone (48 s ON/12 s OFF) for 5 days before and 14 days during incubation		0.32	Increased DNA strand breaks and oxidative DNA damage.

Yurekli et al. (2006)	945 MHz GSM, 217 Hz pulse- modulation 7 hr/day, 8 days	0.0113		Free radical chemistry.
Zong et al. (2015)	Mice exposed to 900 MHz RFR, 4 h/day for 7 days	0.05		Attenuated bleomycin- induced DNA breaks and repair.

***Author Note:** Many of the biological studies are acute, mostly one-time, exposure experiments, whereas exposure to ambient environmental man-made EMF is chronic. Acute and chronic exposures will likely end up with different consequences. Living organisms can compensate for the effect at the beginning of exposure and growth promotion in plants could be a result of over-compensation. After prolonged exposure, a breakdown of the system could occur, leading to detrimental effects. This sequence of response is basically how a living organism responds to stressors. The timeline of response depends on the physiology of an organism and also the intensity of exposure*

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Supplement 4. Effects of EMF on plant growth

	<u>Experimental conditions</u>	<u>Results</u>
<u>STATIC MAGNETIC FIELD</u>		
Abdani Nasiri et al.(2018)	medicinal sage;15-30 mT, 5 min	enhanced growth
Baghel et al. (2016)	soybean; 200 mT, 1h,	increased growth
Bahadir et al. (2018)	sweet pea ; 125 mT, 24-72 h	promoted germination
Bhardwaj et al. (2012)	cucumber; 100-250 mT, 1-3 h	increased germination rate, length of seedling and dry weight
Ćirković et al. (2017)	wheat ; 340 mT, 16 h	increased growth rate
Florez et al. (2007)	maize;125 and 250 mT, 1 min to 10 days	increased growth rate
Jovičić-Petrović et al. (2021)	White mustard seed, 90 mT, 5 or 15 min	suppressed germination, but synergistic with a plant growth-promoting bacterial strain <i>Bacillus amyloliquefaciens</i> D5 ARV
Kataria et al. (2020)	soybean; 200 mT, 1 h	stimulated germination and promoted growth
Kim et al. (2016)	agricultural plants ; 130-250 mT, 4 days	increased stem and root lengths
Patel et al. (2017)	maize; 200 mT, 1 h	enhanced germination
Payez et al. (2013)	wheat; 30 mT, 4 days	promoted growth
Razmioo and Alinian (2017)	Cumin seed; 150, 250 500 mT or 1T for min	improved germination, growth and oil and essential contents
Shabrangy et al. (2021)	barley seeds, 7 mT, 1,3, or 6 h	Improved seed germination rate, root and shoot lengths, and biomass weight
Vashisth and Joshi (2017)	maize; 50-250 mT, 1-4 h	enhanced seed growth
Vashisth and Nagarajan (2008)	chickpea; 0-250 mT, 1-4 h	increased speed of germination, seedling length and dry weight
Xu et al. (2013)	rock cress, removal of the local geomagnetic field (~45 μ T)	suppressed growth
<u>PULSED MAGNETIC FIELD</u>		

Bhardwaj et al. (2016)	green pea; 100 mT, 1 h, 6-min on/off	enhanced germination and growth
Bilalis et al. (2012)	corn; 3 Hz; 12.5 nT, 1 x 10 ⁻⁶ wave duration, 0-15 min	promoted plant growth and yield
Efthimiadou et al. (2014)	tomato; 3 Hz, 12.5 mT, 1 x 10 ⁻⁶ s duration, 0-15 min	enhanced plant growth
Radhakrishnan et al. (2012a)	soybean; 1 Hz, 1.5 μT, 5 h/day for 20 days	improved plant growth
Radhakrishnan et al. (2012b)	soybean; 10 Hz, 1.5 μT, 5 h/day for 20 days	improved plant growth
ELF MAGNET FIELD		
De Souza et al. (2008)	lettuce; 60-Hz, 120-160 mT, 1-5 min	enhanced growth and final yield
Fischer et al. (2004)	sunflower and wheat; 16.67 Hz; 20 μT, 12 days	increased fresh and dry weights and growth rate
Huang and Wang (2008)	Mung bean; 10-60 Hz modulated, 12 h, 6.38-16.20 μT	20 and 60 Hz, enhanced growth; 30, 40 and 50 Hz inhibited growth
Leelapriya et al. (2003)	cotton; 10 Hz, 0.1 mT, 5 h/day for 20 days	enhanced germination
Naz et al. (2012)	okra; 50 Hz, 99 mT, 3 and 11 min	increased germination
Novitskii et al. (2014)	radish; 50 Hz, 500 μT, 5 days	stimulated lipid formation
Shine et al. (2011)	soybean; 50 Hz, 0-300 mT, 30-90 min	improved germination parameters and biomass
Yano et al. (2004)	radish; 60 Hz, 50 μT plus a parallel 48-μT static magnetic field, 10-15 days	decreased CO ₂ uptake, fresh and dry weights and leaf area
RFR		
Cammaerts and Johansson (2015)	Garden cress; 900 and 1800 MHz, 0.007-0.01 μW/cm ² , 10 days	decreased germination
Grémiaux et al. (2016)	rose, 900 MHz, 0.00072 W/kg, 3 hr once or 3 times, every 48 hr	delayed and reduced growth
Halgamuge et al. (2015)	Soybean seedling. 900 MHz GSM pulsed or CW, 0.45 mW/cm ² , 2 h	GSM radiation reduced outgrowth of epicotyls; CW exposure reduced outgrowth of roots and hypocotyls.
Kumar et al. (2015)	maize; 1800 MHz, 0.5-4 h, 33.2 μW/cm ²	retarded growth and reduced chlorophyll content

Mildažienė et al. (2019)	sunflower seed; 5.28 MHz, 5, 10, 15 min 0.74 mT	changes in phytohormone balance, development and leaf protein expression
Payez et al. (2013)	wheat; 10 KHz, 4 days, 25 mW/cm ²	reduced water intake, increased speed of growth, reduced seeding vigor index I
Senavirathna et al. (2014)	Parrot feather (<i>Myriophyllum aquaticum</i>), 2000 MHz, 0.142 mW/cm ² , 1 h	Reduction in growth
Singh et al. (2012)	Mung bean; 900 MHz, 8.54 μW/cm ² , 0.5-2 h	reduced root length and number of roots per hypocotyls
Tkalec et al. (2009)	Onion; 400 and 900 MHz, 2h, 446 μW/cm ²	induced mitotic aberrations due to impairment of the mitotic spindle

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Secretary Jennifer M. Granholm
U.S. Department of Energy
1000 Independence Ave. SW
Washington DC 20585
Sent via Email: the.secretary@hq.doe.gov

April 29, 2022

Subject: Uranium Mining Concern

Dear Secretary Granholm:

Eastern Navajo Diné Against Uranium Mining (ENDAUM) is writing to express concern about the U.S. Department of Energy's consideration of a "strategic uranium reserve." ENDAUM was formed in 1994 in response to a proposed *in situ* leach (ISL) uranium mining project in the Diné (Navajo) towns of Crownpoint and Churchrock, New Mexico. The proposed ISL project, called the Crownpoint Uranium Project (CUP), targets uranium ore bodies in important underground sources of drinking water for our towns and if begun, would destroy the sole source of drinking water for the town of Crownpoint.

As a member of the Multicultural Alliance for a Safe Environment, we previously submitted comments to you on October 13, 2021 in response to the RFI. We are deeply concerned with ongoing discussions taking place to increase uranium mining in the United States due to Russia's invasion of Ukraine. While we understand the United States' position on potentially banning uranium imports from Russia, we cannot stress enough that any corporate subsidies that prop up the domestic uranium mining industry will have significant, long term and devastating effects on our communities and Indigenous communities across the country. A horrible war in Europe should not be used as an excuse to harm our communities, other Diné communities under threat of new uranium development, and other Indigenous communities located here in the United States.

The Crownpoint Uranium Project is currently owned by a Canadian mining company Laramide Resources, through its U.S. subsidiary NuFuels, Inc. While part of the CUP is on tribal lands and therefore ostensibly ineligible to participate in the federal uranium program, part of the CUP is on private land adjacent to tribal lands, yet still within Diné communities. Allowing the CUP

to participate in a U.S. uranium mine reserve program under your Department will essentially shift the sacrifice of lives in the war-torn Ukraine for lives of the Diné tribal members. This is how serious we see this issue. President Biden ran for office pledging to protect tribal communities and restore tribal sovereignty. We need you to support his pledge to us and not allow the Crownpoint Uranium Project to participate under any federal uranium program. Doing so would cut directly against President Biden's pledge and promises.

Further, the United States has a duty under its trust responsibility to protect our Diné communities. We live in the year 2022, and the voice of our people should not go unheard.

While we appreciate prior statements from the Department of Energy that there is no intention to initiate or expand mining "on Tribal lands, expand the Office of Legacy Management's (LM) Uranium Leasing Program, or expand access to additional uranium deposits located on other Federal lands," the Department misses a key understanding of the true issues involved. Most of the potential damage to tribal interests occurs from activities on traditional aboriginal territories, sacred sites, and lands adjacent to tribal lands, not "on tribal lands" itself. This is where the federal trust responsibility should be at its strongest. Indian tribes, like the Navajo Nation, rely on the federal government to protect its people from the harmful effects of uranium mining. It should not matter where the mining occurs.

We have lived in our homeland, between the Four Sacred Mountains, in what are now the states of New Mexico, Arizona, Colorado and Utah, for hundreds of years and the single largest threat to our survival over these millennia has been the uranium industry. Mining for uranium not only harms the surface environment but also contaminates our groundwater resources. Widespread contamination from historic uranium development has already proven disastrous to the health of our people. Subsidizing future uranium development on and near the Navajo Nation and at sites within our traditional territory may well extinguish the Diné as a People. Polluting our land, air and water with new uranium production will not only add additional health burdens, it will also adversely affect our very identity as Diné. Our relationship with our land, air and water is sacred and inextricably tied to our individual and collective identity.

We urgently ask the Department of Energy to uphold President Biden's pledge and promise to protect the Navajo Nation and restore tribal sovereignty. We need you and others to hear our voices. We ask that you prohibit participation of the Crownpoint Uranium Project and any other future uranium development within the boundaries of the Four Sacred Mountains in any federal uranium program or from accepting any federal funding to operate.

Respectfully,

/s/ Jonathan Perry

Jonathan Perry
Executive Director

Eastern Navajo Diné Against Uranium Mining
President, Becenti Chapter

/s/ Rita Capitan

Rita Capitan
ENDAUM Founder
President, Crownpoint Chapter

/s/ Larry King

ENDAUM Member
President, Churchrock Chapter

Cc:

The Honorable Sen. Martin Heinrich
The Honorable Sen. Ben Ray Lujan
The Honorable Rep. Teresa Leger Fernandez
The Honorable Jonathan Nez, Navajo Nation President
Deb Haaland, Secretary of the Interior
Michael Regan, Administrator, U.S. EPA
Dr. Earthea Nance, Regional Administrator, EPA Region VI
National Environmental Justice Advisory Council
White House Environmental Justice Advisory Council

RACIAL EQUITY & SOCIAL JUSTICE: CELL TOWERS AND ZTA 19 07*

• **Vulnerable households are disproportionately placed at risk by Montgomery County's lax practices for reviewing and monitoring antennas on multi family dwellings. ZTA 19 07 exacerbates that gross inequity, rather than reducing or eliminating it.**

Over a recent one year period, the Montgomery County **Tower Committee** greenlighted applications for at least 70 rooftop wireless facilities at residential buildings that predicted levels of exposure to radio frequency (RF) radiation that would exceed the limits set by the Federal Communications Commission (FCC) for the general public. In fact, the predicted or simulated excesses for these applications ranged from just over the federal limits to as much as *114 times the FCC limits*.

Most of these multi-family homes provide relatively affordable shelter in our high priced County and also disproportionately serve residents of color and immigrant communities. The high predictions of RF radiation thus pose serious issues of environmental injustice, given how little attention the County has paid to date to ensure that residents and workers at these locations are not being illegally exposed to harmful levels of RF radiation that exceed federal limits.

All the applications were favorably recommended by the Tower Committee with no plan by any agency in the County – not the Tower Committee, the Department of Permitting Services (DPS), or the Department of Housing and Community Affairs (DHCA) – to ever inspect the sites to make sure these buildings comply with federal regulations governing RF emissions.

The FCC has provisions intended to assure that:

- Hazardous rooftops are tightly restricted,
- Legally required warning signs are posted,
- Any needed barriers are in place, and
- In general, residents and workers are not exposed to RF radiation over federal limits.

But the FCC has no program for verifying that prescribed safety measures are applied. All the FCC requires to bring a wireless site into "compliance" is the proper placement of signs – *in English* – and/or barriers around the antennas to warn the general public and workers not to get too close. A "barrier" could be a fence, a chain, a rope – or just painted stripes on the rooftop.

All the County requires of the applicants is to *promise* to do those things. The County has no inspection regime for wireless safety at multi family buildings. In fact, the County has no process for verifying the accuracy of the compliance reports related to their RF emissions that applicants may (or may not) submit or, for that matter, the accuracy and completeness of antenna inventories that applicants *choose* to use in preparing simulations. Errors in applications go undetected.

Furthermore, any over-exposures in residents' actual living spaces – on balconies, at windows, or inside apartment units – constitute violations of federal law. And yet no County agency has any process to ever measure whether residents and workers at these multi-family dwellings are being exposed to harmful levels of RF radiation, in excess of federal limits!

ZTA 19-07 ignores these urgent problems, and the evidence they reveal of how extremely inept the County's overall process is for reviewing the safety of wireless facilities. Instead, this ZTA would extend the risks of this broken process to affect all residents – in fact, *adding new risks to those already living under rooftop antennas*. They could face antennas on poles directly across from their windows as well – something that is not currently allowed in the residential zones where many of these multi-family dwellings are located.

• By shrinking setbacks from homes, ZTA 19-07 imposes inequitable harms and risks on our most modestly-scaled residential neighborhoods.

Imposing a routine setback of 30 feet across all County residential and rural neighborhoods *sounds* equitable. But a little critical thinking uncovers the systemic flaw in that assumption: A cell tower that is 30 feet from a home on a small lot is likely to be far closer to the front porch, high-rise balcony, or bedroom windows of that dwelling than it is for homes sited much further back on more spacious – and often more expensive – properties. That means, of course, that *the constant new exposure to the health risks of RF radiation would also be higher*, as distance from the antennas matters greatly.

Property values are also more likely to go down disproportionately in modestly scaled neighborhoods. The visual impact and other aesthetic downsides of streets lined with cell towers – including tree pruning and tree removals to clear “line of sight” for 5G cellular transmission – would also be more intense and unappealing for homes on small lots that are much closer to right-of-way poles than for homes which set much further back from the road. More spacious front yards would visually shield the latter from the unattractive paraphernalia of wireless facilities, including bulky equipment boxes at ground level or mounted on poles, and from the sad aftermath of butchered trees near the rights-of-way.

In other words, *residents who own or rent smaller properties, with homes closer to the rights-of-way, will bear an unfair share of all the unpleasant consequences of ZTA 19-07.* That will be the case whether or not the household can afford – or desires – 5G service from the particular telecom carrier that has commandeered the use of the right-of-way in front of their home.

• ZTA 19-07, contrary to the wireless industry's favorite talking points, has nothing to do with ending digital inequities in our County. That goal requires affordable, equitable access to high-speed, secure, reliable, and safe Internet service.

But the proposed zoning change includes not a single requirement or incentive for the wireless industry to expand such access to vulnerable households in the County who are currently struggling, or unable, to afford or access such service.

In fact, the shift to 5G requires more expensive service and more expensive devices, which are not likely to be as accessible to families of limited means as previous generations of either wired or wireless service. So no, [5G will not close the digital divide](#).

If the County is serious about that goal, it should scale up and fully fund, as the priority it deserves to be, a plan to extend the County's own internal FiberNet Internet service, free or at a much reduced cost, to vulnerable households that find it difficult or impossible to afford fast,

secure, reliable, and safe Internet service – which is wired Internet service – in any other way. Ending inequities requires providing affordable, equitable access to fiber-optic connections to the premises of all homes – including individual households in multi-unit dwellings. County efforts to increase access to digital literacy education are also important.

• **ZTA 19-07 reaffirms the horrific provision the County Council passed in 2018, allowing cell towers just 10 feet – 10 feet! -- from multi-family residences in areas zoned for mixed commercial and residential use. It does nothing to correct that inequity.**

Environmental justice demands immediate action on the part of the County Council to fix that unfair exception. All residents – home renters and home owners, regardless of the zone they live in – deserve far more protective setbacks than either that 2018 loophole or this radically bad ZTA provide from the health and safety hazards and other negative impacts that too-close cell towers pose. (Note, however, that many, if not most, multi-family residences in the County are actually in the residential zones that would be affected by the added new injustices that ZTA 19-07 would impose.)

• **What ZTA 19-07 is really about is the County – under intense pressure from a powerful industry – bending over backward to speed up that industry’s roll out of a dense network of small cell towers in residential neighborhoods. And doing so by eliminating meaningful public participation in decisions about siting and regulating them. That does not bode well for vulnerable households.**

If the history of rubberstamping applications for cell towers in the County is any guide, locations with higher ratios of Black and Brown residents, immigrant families, and residents with limited means are likely to suffer the most from the lack of protections in this ZTA for public participation in decision-making.

Note, for example, that even for special, “conditional-use” permits, ZTA 19-07 requires prior notification to families who *own* homes, but not to families who *rent* homes near proposed cell towers. And there is nothing in the ZTA requiring notifications in multiple languages. English appears to be the assumed default. Such obvious inequities, which would be codified in the (much reduced) notification provisions in this ZTA, are unacceptable.

The points explored above are by no means the kind of full, official analysis of the racial-equity and social-justice impacts of ZTA 19-07 that the County Council should pursue before voting on this zoning change. However, the exploration here clearly indicates that ZTA 19-07, if subjected to such a full analysis, will earn a failing grade.

* A report from Tech Wise Mo Co MD
Montgomery County, MD.
info@techwisemocomd.org



Mx. Yvette Arellano
Executive Director,
Mr. Shiv Srivastava
Policy Research

*Submitted electronically via:
whejac@epa.gov subject: WHEJAC May 2022 Meeting
WHEJAC comment submission form*

Chair Brenda Mallory
Council on Environmental Quality
705 Jackson Place NW
Washington, DC 20503
Dock ID No.EPA-HQ-OA-2022-0050

Re: Comments on WHEJAC, Climate and Economic Justice Screening Tool, Docket No.EPA-HQ-OA-2022-0050

My name is Yvette Arellano and I am the founder and director of Fenceline Watch, a Houston community based environmental Justice effort dedicated to the eradication of toxic multigenerational harm on communities living along the fenceline of industry. I am also a resident of an environmental justice community in the East End of Houston. We appreciate the WHEJAC and EPA for extending the public comment across multiple platforms.

After a review of the Climate and Economic Justice screening tool, we have identified critical issues around user ease and understanding. I would first preface these issues by stating that I have been an avid user of the EJSCREEN for over five years. As a participant in the EPA workshops and walk-throughs, I have been a proponent of EPA's efforts supporting EJSCREEN in my community outreach. I welcomed another vital EPA Climate and Economic Justice tool until I became overly frustrated at the lack of information and muddled data delivery. My comment will touch on three critical issues with the CEJ beta project on barriers for users of all expertise levels, linguistic isolation, and demographic, and the removing ambiguity in the health burden factor.

I. BARRIERS TO USE OF CEJ SCREENING TOOL

Unlike EJSCREEN, users cannot download site-specific data points and add the rich layers to create a complete picture. EJSCREEN provided a visual component filled with charts called the explore reports function while also offering an in-depth report called the Printable Standard Report. Both types of reports provided information in discernable forms for larger groups of community members. Additionally, presenting data in percentiles without a visual component creates confusion about how a health factor affects a community.¹ In numerous reports, EPA itself has acknowledged the importance of

"Communicating with groups of individuals with varied levels of understanding and different learning styles requires a diverse approach"²

¹ <https://archive.epa.gov/water/archive/web/html/vms62.html>

² https://www.epa.gov/sites/default/files/2017-01/documents/tech_memo_5_dec_30_2016.pdf



This tool only allows the downloading of data sources in massive packets requiring a community member to open zip files. After exploring these massive files, it is clear that the target audience for the downloadable information is not for community members and grassroots advocates like myself.

II. LINGUISTIC ISOLATION, HISTORIC ECONOMIC AND ENVIRONMENTAL HARM & TRACKING PROGRESS

At Fenceline Watch, one of our pillars of work with our communities is language justice. Although we appreciate EPA identifying linguistic isolation in census tracts, this does not go far enough. Unlike its predecessor EJSCREEN the CEJ tool falls short in excluding ethnicity. The erasure of ethnicity ignores the amount of time a community has been impacted by systemic and institutional discriminatory practices that limit certain groups' economic mobility. Moreover, it limits the agency's ability to track the impact of specific services in environmental justice communities of color.

III. NOT LEGACY CONTAMINATION BUT HEALTH BURDENS

Identifying RMP zones and Proximity to Hazardous Waste Facilities under the Legacy Pollution category gives users a misrepresentation in whether the danger is current or past. Similarly, PM 2.5 in the Air is under Clean Energy and Energy Efficiency without giving users a clear understanding of why. These factors must be reclassified as Health Burdens to profile community issues. The Health Burden category also requires a more robust data set that includes a community's low-birth-weights, uninsured rates and disabled populations. These three additional health burdens are significant indicators of community health.

If the CEJ tool is targeted for specific audiences with an identified goal of resourcing communities, it should be clearly stated. Otherwise, the EJSCREEN provides a wealth of information that EPA and environmental justice efforts have poured time, resources and dedication to enriching. I appreciate the extended opportunity to file comment with EPA and appreciate the efforts of all of those who are advocating tirelessly to improve public resources to give us a better understanding of the conditions and vulnerabilities our communities face.

Respectfully,

Yvette Arellano

Pronouns: They/Them

Executive Director, Fenceline Watch

Fencelinewatch@gmail.com



May 25, 2022

White House Environmental Justice Advisory Council (WHEJAC)
Docket Number EPA-HQ-OA-2022-0050

RE: Request for public comments relevant to federal disaster preparedness and relief and community resilience

Dear WHEJAC members,

The Just Solutions Collective and the National Partnership for New Americans thank you for the opportunity to submit this joint comment. We are submitting a letter to address WHEJAC's request for public comments relevant to Federal disaster preparedness and relief and community resilience.

The Just Solutions Collective (JSC) works to broaden and deepen the understanding of equitable and effective environmental and climate justice policies and projects to build the capacity of BIPOC and frontline communities to replicate, scale, and build support for justice-centered solutions. JSC is building a national disaster resilience policy and research program leveraging disaster expertise in our staff and our partnerships with BIPOC Community-based organizations who have responded to disasters and have dealt firsthand with the limits of federal disaster relief.

The National Partnership for New Americans (NPNA) is a network of 60 of the country's largest statewide and regional organizations building power for immigrant communities. NPNA advances an immigrant equity and inclusion agenda through policy, advocacy, and service programs that create vast opportunities for immigrant and refugee communities to achieve full civic, social, and economic justice. NPNA leads the new Climate Justice Collaborative, a project at the intersection of climate and migration, to advocate for immigrant and refugee communities on the frontlines of climate change in the U.S. and for the rights of climate-displaced people seeking safety in the U.S.

We are grateful for the work of members of the WHEJAC. Please let us know if we can provide any additional information about our recommendations and comment below.

Sincerely,

Cristina Muñoz De La Torre
Director of Programs Research
Just Solutions Collective

Ahmed Gaya and Stephanie Teatro
The Climate Justice Collaborative at the
National Partnership for New Americans

The Just Solutions Collective and the National Partnership for New Americans submit the following recommendations as public comment in response to the WHEJAC’s questions:

- *What type of support is needed for disadvantaged communities to participate in federal disaster preparedness or relief programs?*
- *How can federal disaster relief and aid programs better serve disadvantaged communities that have historically received fewer federal benefits?*
- *What process steps and information would help eliminate these disparities?*
- *What steps can federal agencies and the White House take to reduce disparities in climate change impacts for communities, including, but not limited to risks from, extreme heat, flood, wildfire, drought, and coastal challenges?*

Extensive research and reporting have been done on the deep disparities in federal disaster aid programs, including FEMA’s Individual Assistance program, the Hazard Mitigation Grant Program, and HUD’s Community-Development Block Grant for Disaster Recovery. As shown in several case studies, low-income households, Black, Latinx, Indigenous, and communities of color, renters, and elderly communities are less likely to receive adequate amounts of federal disaster assistance despite having similar disaster damage as more affluent white communities¹²³. These disparities exist for both individual recipients, whole communities, and local government recipients, such as counties that have higher proportions of low-income and communities of color. It clearly indicates systemic inequities that exist in federal programs, especially along the lines of income and race.

As reported in the New York Times⁴, “[t]he impact from this disparity is long-lasting. White people in counties with significant disaster damage that received FEMA help saw their personal wealth jump years later while Black residents lost wealth, research published in 2018 shows.”

The disparity in federal assistance is due to systemic inequities in its implementation, including basing disaster assistance on property values, which are subject to the structural racism embedded in real estate, federal programs not placing significant allocations for renters, landlords being poorly incentivized to quickly repair properties and avoid rent spikes after a disaster, and many other issues that are currently being investigated.

¹ Domingue, S. J., & Emrich, C. T. (2019). Social Vulnerability and Procedural Equity: Exploring the Distribution of Disaster Aid Across Counties in the United States. *American Review of Public Administration*, 49(8), 897-913. doi:10.1177/0275074019856122

² Elliott, James R, Phylcia Lee Brown, and Kevin Loughran. "Racial Inequities in the Federal Buyout of Flood-Prone Homes: A Nationwide Assessment of Environmental Adaptation." *Socius : Sociological Research for a Dynamic World* 6 (2020): Socius : Sociological Research for a Dynamic World, 2020-02, Vol.6.

³ Muñoz, C. E., & Tate, E. (2016). Unequal Recovery? Federal Resource Distribution after a Midwest Flood Disaster. *International journal of environmental research and public health*, 13(5), 17. doi:10.3390/ijerph13050507https://www.nytimes.com/2021/06/07/climate/FEMA-race-climate.html

⁴ https://www.nytimes.com/2021/06/07/climate/FEMA-race-climate.html

Centering equity in climate adaptation and addressing environmental injustice are essential for reducing disparities of climate impacts. Disaster recovery efforts and investments in resilience and hazard mitigation should not increase environmental injustice and should not lead to displacement of low-income and communities of color.

Ensuring equitable outcomes in disaster recovery will require much deeper structural reforms than increasing support and access. But in response to the questions posed by WHEJAC here we offer our experience and findings on the barriers that BIPOC communities and immigrant communities in particular face in accessing disaster recovery programs.

These recommendations are written with an understanding that broader structural reforms are required to address the deep inequities and outcomes in our nation's disaster recovery programs.

Inequities in the structure of federal programs

The highly bureaucratic process of disaster declarations and disaster assistance distribution limits the access to these resources for low-income and communities of color. We find there is a need to coordinate efforts federally, to evaluate programs with regards to equity and accountability, and to increase access to assistance through community-based efforts and organizations.

Implementation, Evaluation, and Accountability of Federal Programs

To ensure federal disaster recovery efforts do not exacerbate inequities, federal agencies should conduct annual equity assessments of each of their programs and determine progress on specific equitable outcomes. In addition, there should be a measure indicating the extent to which federal agencies incorporate recommendations from community-based advisory councils. The implementation of all equity plans, assessments, and evaluations should be sufficiently resourced, transparent, and take into account community input.

For example, FEMA recently released an Equity Action Plan, where it recognizes its need to “build more equitable outcomes, reduce administrative burdens, increase eligibility for underserved and vulnerable applicants, increase access, and improve external messaging⁵”. However, neither the equity plan or FEMA’s Strategic Plan defined specific equitable outcomes. The Equity Plan and Strategic Plan lacked many of the recommendations included in FEMA’s National Advisory Council (NAC) 2020 report⁶, including the recommendation that FEMA should define equity to mean “*provid[ing] the greatest support to those with greatest need to achieve a certain minimum outcome. It is separate from equality, which is providing the same resources to everyone regardless of need.*” Overall, the Equity Action Plan and the Strategic Plan

⁵ https://assets.performance.gov/cx/equity-action-plans/2022/EO%2013985_FEMA_Equity%20Action%20Plan_2022.pdf

⁶ https://www.fema.gov/sites/default/files/documents/fema_nac-report_11-2020.pdf

seem to be less robust than the NAC 2020 report specifically around equity. Advisory councils can only provide advice and their recommendations are not mandated. However, the extent to which these agencies accept and implement advisory recommendations into their programs should be measured as part of agency and program evaluations. Further, it should be standardized that agencies provide an explanation for each recommendation that is not accepted or modified.

Targeted Outreach and Support Program to Streamline Applications

Federal agencies such as FEMA and HUD should establish interagency, targeted programs specifically aimed to help the most disadvantaged communities gain access to their disaster relief programs and streamline the application processes.

Eligibility assessments for all federal disaster relief programs, within and across federal agencies, should be streamlined into a single intake process, helping applicants to understand the variety of recovery programs they are eligible for. This would reduce the application burden, miscommunication, and prolonged wait times for application results. Outside of eligibility for federal programs, this intake process could also be a hub for referrals to other local service providers for any other needs such as food, clothes, childcare, etc.

These programs would be most effective with dedicated staffing and sufficient resources; by centering equity, cultural competency, and diversity; and by maintaining strong partnerships with other federal agencies and community-based organizations and service providers.

We acknowledge this recommendation is aligned with components of the Biden Administration's executive order, *Putting the Public First: Improving Customer Experience and Service Delivery for the American People*, and urge its implementation.

Federal investment in Community-Based Organizations

The disaster declaration process and the distribution of federal assistance is highly bureaucratic. Disaster relief works through systems that are inaccessible and marginalizing to low-income and communities of color. In addition, low-income and communities of color lack relationships, access, and trust with federal and state level agencies and offices. These result in inaccessible systems of disaster relief.

On the other hand, BIPOC frontline communities have deep and more trusted relationships with community-based organizations, especially BIPOC-led organizations⁷. These relationships have been built and nurtured through providing essential social services and community-building spaces long before disaster strikes. These organizations are often among the first responders in

⁷ <https://www.justsolutionscollective.org/blog-posts/the-unique-role-of-bipoc-frontline-environmental-justice-cbos-in-disaster-resilience>

the wake of a disaster because of their deep roots in a community and existing service infrastructure.

Often these organizations are responding without dedicated staffing or funding, but quickly stand-up services to respond to the most urgent needs of their constituents. With more capacity and dedicated resources from federal agencies (including funding, training, and technical assistance), and if given authority to act as direct intermediaries between disadvantaged communities and state and federal relief programs, the organizations' services could be scaled and leveraged to dramatically increase access and participation in federal disaster relief programs for low-income and BIPOC communities.

These organizations can play an essential role in increasing access to federal disaster relief for disadvantaged communities across a variety of functions, including community outreach and education and direct application assistance. Many organizations also have physical spaces, that are familiar and comfortable to community members, that can be used as a site to distribute or coordinate federal recovery programs. The model of Resilience Hubs developed by the Asian Pacific Environmental Network in California are a model that could be resourced and replicated across the country.

Federal disaster relief programs and the agencies should directly build relationships with BIPOC and frontline CBO and intermediaries before a disaster to learn more about vulnerable communities, build their capacity, and provide technical assistance to identify and deliver disaster relief to most disadvantaged communities.

Addressing disparities at the individual and community level

Low-income households, communities of color, the elderly, people with disabilities, renters, and rural communities often do not receive equitable amounts of federal disaster assistance, accounting for disaster damage and other related impacts. Immigrant communities, especially undocumented immigrants, and individuals with Limited English Proficiency, also face unique and compounding barriers and are often left behind in response and recovery.

Language Access

Across every stage of disaster preparedness, rapid response, and recovery, there should be robust language access plans to ensure that individuals with Limited English Proficiency are safe and have access to emergency services and recovery programs. Federal agencies should work with state and local governments and community partners to ensure that all services and information are provided in the languages most commonly spoken in that area.

There is also a need for significant investment in culturally competent community education, including through trusted messengers, and that it is communicated and advertised in channels that will reach disadvantaged populations and non-native English speakers.

Federal responders delivering services to LEP communities should either use qualified interpreters or work with local CBOs and agencies with appropriate language competency. Language access mandates should be accompanied by an allocation of sufficient resources to carry them out, including funding for CBOs who support federal, state, and local governments with language access.

Immigration Status Barriers

There are an estimated 11 million undocumented immigrants living in the United States. There are large populations of undocumented community members in states that frequently experience disasters, including nearly three million residents of California, nearly 800,000 residents of Florida, and nearly two million residents of Texas⁸.

All disaster recovery benefits should be made available to all members of a community that are impacted by a disaster, regardless of immigration status. Currently, undocumented people and some other non-citizens are ineligible for many essential federal disaster recovery benefits and programs.

Due to confusion about status requirements, many non-citizens and mixed-status households may not apply for the benefits that they are eligible for. Even when individuals or households understand their eligibility, they may choose not to apply based on fears of immigration or other financial consequences. For example, how receiving benefits may impact the credit score of the applicant, whether a U.S. citizen minor who applies on behalf of the household would be able to serve as a sponsor for their family members residency applications in the future, the likelihood of triggering the public charge rule, and other immigration consequences. These concerns should also be explicitly addressed in application forms and websites and through targeted communication.

Use of Immigration Enforcement & Military Personnel

Undocumented immigrants and mixed-status families often avoid encounters with government agencies, out of fear that the interaction may result in detention or deportation. In the context of disasters, these fears will lead many to refuse to seek help, safety, or relief. Strengthening and expanding policies to prohibit immigration enforcement activities in disaster zones, including but not limited to CBP and ICE's protected areas policy, - protecting disaster victims, first responders, recovery workers, and volunteers - are essential to increasing equitable recovery from disasters. Similar to eligibility requirements, these

⁸ Population estimates from the Migration Policy Institute: migrationpolicy.org/programs/us-immigration-policy-program-data-hub/unauthorized-immigrant-population-profiles

prohibitions must be communicated broadly through trusted messengers before, during, and after disasters.

Even if they are performing disaster response duties and not enforcement operations, the presence of uniformed law enforcement, ICE, CBP, and military personnel for disaster relief can heighten trauma and increase mistrust for many individuals recovering from a disaster. For many immigrant communities, seeing uniformed ICE And CBP agents as first responders in a disaster will deter people from seeking critical emergency services and recovery support.

Increased Relief and Recovery Dollars for Renters and Multi-Family Homes

Disaster recovery and relief programs should be updated to reflect the realities and diversity of American households, including increasing the amount of assistance that is available to occupants of damaged properties.

Many low-income communities, immigrants, and communities of color are renters and not the owners of affected properties. Renters should be given sufficient resources to recover from a disaster, even if the owner/landlord is given separate resources to repair the property. Policies to prevent rent spikes and renter displacements after disasters should also be expanded and strengthened. In addition, assistance amounts should account for multi-generational & multi-family unit households. Application and assessment systems that are based on a model of traditional, single-family-occupied homes do not provide sufficient or equitable support and relief to many communities.



HAVASUPAI TRIBAL COUNCIL

P.O. Box 10 • Supai, Arizona 86435
(928) 448-2731 • Fax (928) 448-2551

March 25, 2022

Secretary Jennifer M. Granholm
U.S. Department of Energy
1000 Independence Ave. SW
Washington DC 20585

Sent via Email: the.secretary@hq.doe.gov

Subject: Uranium Mining Concern

Dear Secretary Granholm,

The Havsuw 'Baaja, the People of the Blue-Green Water (Havasupai Tribe) is writing to you again to express the concern about the U.S. Department of Energy's consideration of a uranium reserve. We previously submitted a letter to you on October 4, 2021 in response to the RFI. We are deeply concerned with ongoing discussions taking place to increase uranium mining in the United States due to Russia's invasion of Ukraine. While we understand the United States' position on potentially banning uranium imports from Russia, we cannot stress enough that any uranium mining at the Pinyon Plain Mine (formerly known as the Canyon Mine) located on federal lands near our reservation will have devastating effects for our Tribe. A horrible war across the world should not be grounds for harming the Havasupai Tribe, its members, and other Indigenous communities located here in the United States.

Energy Fuels, Inc. currently operates the Pinyon Plain Mine (Canyon Mine) next to our reservation and on our aboriginal lands and traditional cultural property – Red Butte. This mine has a history of problems, including that it pierced a major aquifer digging what it claimed would be a dry mineshaft, and then sprays the now-contaminated water into the national forest. This mine should not be eligible for participation in any federal program or to receive funding to operate. Allowing the Pinyon Plain Mine (Canyon Mine) to participate in a U.S. uranium mine reserve program under your Department will essentially shift the sacrifice of lives in the war-torn Ukraine for lives of the Havasupai tribal members. This is how serious we see this issue. President Biden ran for office pledging to protect tribal communities and restore tribal sovereignty. We need you to support his pledge to us and not allow the Pinyon Plain Mine (Canyon Mine) to participate under any federal uranium program. Doing so would cut directly against President Biden's pledge and promises.

Letter to Secretary J. Granholm
Re: Uranium Mining Concern
March 25, 2022
Page 2


Further, the United States has a duty under its trust responsibility to protect the Havasupai Tribe. We live in the year 2022, and the voice of our people should not go unheard. Our Tribe, our members, our land, our water should not be sacrificed when this vast country has other uranium deposits located in areas where mining does not pose a serious threat to the human element.

While we appreciate prior statements from the Department of Energy that there is no intention to initiate or expand mining "on Tribal lands, expand the Office of Legacy Management's (LM) Uranium Leasing Program, or expand access to additional uranium deposits located on other Federal lands," the Department misses a key understanding of the true issues involved. Most of the potential damage to tribal interests occurs from activities on aboriginal territories, sacred sites, and lands adjacent to tribal lands, not "on tribal lands" itself. This is where the federal trust responsibility should be at its strongest point. Indian tribes, like the Havasupai Tribe, rely on the federal government to protect its people from the harmful effects of uranium mining. It should not matter where the mining occurs.

We have lived in our homeland, deep in the Grand Canyon, for thousands of years and the single largest threat to our survival over these thousands of years has been the uranium industry. Mining for uranium not only harms the surface environment but also contaminates our groundwater resources. Our Tribe's sole source of water comes from the very aquifers that sit directly below the Pinyon Plain Mine (Canyon Mine) on our aboriginal lands. If you permit the Pinyon Plain Mine (Canyon Mine) to supply uranium under any federal uranium reserve program then our water aquifers that supply our drinking water and life in the canyon will be contaminated and our existence as a Tribe, as we have known it since time immemorial, will die; not to mention one of the seven natural wonders of the world will be contaminated along with the Colorado River. Why put all of this at risk?

We urgently ask the Department of Energy to uphold President Biden's pledge and promise to protect the Havasupai Tribe and restore tribal sovereignty. We need you and others to hear our voices. We ask that you withhold participation of the Pinyon Plain Mine (Canyon Mine) in any federal uranium program or funding to operate. Not doing so, will place our existence as a Tribe in harm's way.

Sincerely,



Thomas Siyuja Sr.
Chairman, Havasupai Tribe

Cc: Havasupai Tribal Council

Letter to Secretary J. Granholm
Re: Uranium Mining Concern
March 25, 2022
Page 3

Denten Robinson, Havasupai General Counsel
Mark Kelly, U.S. Senator
Kyrsten Sinema, U.S. Senator
Joe Manchin, U.S. Senator
Raul Grijalva, U.S. Representative
Tom O'Halleran, U.S. Representative
Deb Haaland, Secretary of Interior, Department of Interior
Bryan Newland, Assistant Secretary, Indian Affairs
Brenda Mallory, Chair of White House Council on Environmental Quality
Gina McCarthy, National Climate Advisor
Michael S. Regan, EPA Administrator
Cecilia Martinez, PhD, Senior Director for Environmental Justice, CEQ
Corey Solow, Deputy Director for Environmental Justice, CEQ
White House Environmental Justice Interagency Council
Members of the White House Environmental Justice Advisory Council



National Association of Conservation Districts

May 25th, 2022

Dear White House Environmental Justice Advisory Council,

Re: EPA-HQ-OA-2022-0050

The National Association of Conservation Districts (NACD) represents America's nearly 3,000 locally-led conservation districts, working with millions of landowners and operators to help them manage and conserve land and water resources on private and public lands. Established under state law, conservation districts share a single mission: to work cooperatively with federal, state, and local resource and land management agencies, and private sector interest groups to provide technical, financial, and other assistance to help landowners and operators apply conservation to the landscape. Because conservation districts were created to be the link between the federal government's various natural resource agencies and local communities across the country, conservation districts work hand-in-hand with all levels of government to ensure that local resource needs help inform major decisions.

Executive Order 14008 Tackling the Climate Crisis at Home and Abroad, Sec. 223 – Justice40 initiative established the goal of directing 40 percent of certain Federal investments to benefit disadvantaged communities. Executive Order 14008 also established the White House Environmental Justice Advisory Council (WHEJAC) to offer recommendations to the Chair of the Council on Environmental Quality (CEQ) and the White House Environmental Justice Interagency Council (IAC). The WHEJAC advises on how the federal government can increase its support of disadvantaged communities in the areas of resilience, disaster management, conservation, clean water infrastructure and beyond.

On April 13, 2022, the WHEJAC published its intent to hold a public meeting to discuss climate resilience and consider recommendations to better serve disadvantaged communities through federal disaster relief funding. For more than 75 years, conservation districts have served as leaders in locally-led efforts to conserve our nation's natural resources and address local natural resource needs in the face of natural disasters and extreme weather by working with private landowners and other members of the community.

Understanding Local Resource Needs

NACD supports tailored technical assistance to best fit the unique needs of different communities across the country. Grassroots efforts to engage local community members and leaders is necessary to understand how communities may have been excluded from past funding opportunities and what barriers still exist in that community to access existing programs. Many communities across the United States and its territories are impacted by low-income levels, high unemployment rates, and limited access to state or federal resources. These obstacles, as well as



National Association of Conservation Districts

other historical barriers, put communities at a disadvantage, and can result in excluding them from participating in programs. For the purposes of cost-sharing requirements, some federal programs have specific parameters to determine if a community is considered to be a disadvantaged community or Limited Resource Area (LRA). To determine the amount of support required for disadvantaged communities to participate in federal programs, and to ascertain how those programs can better serve those communities, outreach and capacity building must be done at the local level. Program parameters and eligibility flexibility is also key to ensuring that local needs can be addressed across unique circumstances. Providing flexibility within program requirements is key to helping each community address their unique environmental concerns.

In addition to recognizing the varying needs of each community, it is also important to consider the barriers that exist for individuals to access these programs, as opposed to larger groups or local governments. Community organizations and governments often do not have the time nor resources necessary to focus on all individual needs. To address this issue, it is important that that community-based organizations, such as conservation districts, are provided the tools and resources necessary to build the capacity needed to meaningfully participate in these programs. Whether individuals lack financial resources, training, or land, it is critical to consider the needs of all stakeholders in order to support the entire community.

Disaster preparedness planning should include the input from all community stakeholders. It is imperative that all stakeholders have a seat at the table when establishing plans for community preparedness to properly account for all available resources in the community, and to avoid excluding groups from project eligibility or future funding opportunities. It is also critical to ensure that a diverse set of stakeholders from across the community are included in discussions to develop program parameters and funding eligibility requirements.

Programmatic Barriers

The United States Department of Agriculture (USDA) Natural Resource Conservation Service's (NRCS) **Emergency Watershed Protection Program** works to protect vulnerable infrastructure and land from future flood and soil erosion damage and does not require a disaster declaration from federal or state government officials. Through this program, NRCS provides financial and technical assistance for activities such as debris removal and streambank repair.

Rigid project requirements and a lack of resources or funding to meet sponsor requirements can act as barriers to EWPP participation. Increasing the flexibility of project and sponsor requirements could serve to bolster participation and increase access to project benefits for many LRAs. Under current program requirements, sponsors are required to support maintenance and provide match requirements, which is difficult for many sponsors. For communities that have been designated as LRAs, NRCS covers 90 percent of construction costs. However, this support does not cover expenses to submit the application nor maintenance costs after the conclusion of



National Association of Conservation Districts

the project. More extensive support is required for many LRAs take advantage of EWPP benefits.

Program eligibility requirements also restrict participation under the property requirement by limiting the participation of some rural areas due to lower concentrations of man-made structures. Despite the damage that weather events may inflict on other structures in the area, protection cannot be supported under current EWPP eligibility requirements. Providing additional flexibility for projects would help to protect more watersheds from severe damage.

The **Watershed Rehabilitation Program (REHAB)** supports public health and addresses safety concerns by providing assistance to sponsors to rehabilitate aging dams that are past their designed lifespans. This program also has several barriers that reduce participation, notably among LRAs and other historically underserved communities. Some areas with low incomes, housing values, or high unemployment may not have received funding or resources needed to build eligible watershed infrastructure in the first place. It is important to consider the kinds of communities these projects support explore opportunities for the program to better support disadvantaged communities.

The Federal Emergency Management Agency's (FEMA) **Building Resilient Infrastructure and Communities (BRIC)** Program offers support for communities to mitigate hazards and reduce the risks posed by natural disasters. Participants of these programs often experience similar barriers to program access across several different kinds of disasters, including floods and wildfires.

Lack of coordination between all stakeholders during the planning stages of BRIC reduces overall participation in the program. Expanding coordination within the community and across all levels of government can increase the number of stakeholders participating in hazard mitigation planning and ultimately bolster the implementation of mitigation activities. Disjointed coordination among relevant entities restricts eligibility for local stakeholders who may lack capacity or training to support these activities independently, but who offer valuable contributions to the process at large. In addition to expanding coordination between these groups, it may also be useful to develop a disaster plan template or program to help stakeholders develop the expertise required to implement plans independently. Groups that would traditionally lack adequate staffing or training to develop a plan on their own would then be able to develop a template to address resource concerns in their area.

The U.S. Forest Service's **Good Neighbor Authority (GNA)** and other federal programs that address forestry and wildfire related natural disasters can raise barriers stemming from a lack of coordination. The GNA is an important program that allows non-federal stakeholders and partners, such as conservation districts, to conduct forest management and clearing on federal lands. Partners participating in this program can experience low demand for harvested products and insufficient training opportunities for natural resource and forest management professionals. The lack of adequate staffing, training, and demand for forest products requires partners to individually source markets for harvested products and train their own staffs. This places lower-



National Association of Conservation Districts

income communities at a disadvantage, as they do not have the capacity or financial resources to consistently support these efforts. Large-scale disasters often involve a large influx of management workers, which are difficult to manage without strong structures and plans in place. Additionally, communities with fewer financial resources may be less likely to participate in this program due to the limited availability of timber sales for future GNA activities.

USDA's Forest Service's **Community Wildfire Defense Grants** present a great opportunity to help vulnerable and low-income communities across the country mitigate the many risks posed by wildfires. This program provides funding to communities at high risk of wildfire to develop and begin the implementation of wildfire plans. The testing of prescribed practices is an important part of verifying program effectiveness and ensuring community preparedness, but it can also act as a barrier to community participation. Some communities do not have adequate resources or funding to carry out testing effectively and may need additional support. While testing exercises are critical, lower-income communities may see this as a barrier to participation.

The USDA's Forest Service supports urban forestry through their **Urban and Community Forestry Program**, which provides funding to state agencies to implement projects, sometimes with the help of local partners. To be eligible for funding, states must have a full-time coordinator, provide technical assistance to communities, convene a Community Forestry Council, and create a strategic plan to guide their work. State agencies and their partners should be encouraged to engage with local stakeholders during this process. Activities supported by this program may include landscape scale restoration, invasive species work, education, and outreach. Efforts to support urban forestry can also play a significant role in mitigating the effects of disasters and extreme weather, such as through canopy cover to prevent extreme heat. To fully harness the potential of urban forestry to combat extreme heat, it should be considered in the strategic planning stages at the state and local levels. Underserved areas have a lower percentage of urban canopy cover, which makes their residents more susceptible to health issues caused by extreme heat. Promoting urban forestry practices in underserved areas can provide substantial environmental and health benefits to those communities.

Conclusion

In conclusion, there are several areas where barriers repeatedly appear and can impact a sponsoring entity's ability to contribute financially or meet other programmatic requirements. The first area in which overall more focus and support is needed is in staffing capacity and training. Many of these programs include complex application processes and the implementation of funding often requires specialized experience that may not be present in all sponsor offices. More support from the funding agency is needed to support these sponsors by providing training and guidance throughout the application and implementation process. Accessing the resources for these programs often requires substantial dedication of staff time and an understanding of the complicated application systems. Information and program resources should be accessible to



National Association of Conservation Districts

easily understood by stakeholders from all backgrounds. Historically, long and difficult application forms and convoluted communications have discouraged communities that do not have adequate staff and resources from applying for federal disaster assistance programs. Expanding outreach, education, resources could encourage consistency among regions and make it easier to address common issues. Additionally, more focus is needed to support the training and hiring of a diverse workforce. It is important to emphasize recruiting a diverse and skilled workforce to ensure natural resource management professions are accessible by all communities across the country. Capacity issues also continue to be a concern. Sponsors may not have the resources to dedicate staff to completing program applications or to continue maintenance of projects after completion. We must ensure that all communities, regardless of their socioeconomic standing, have the ability to participate in these important programs.

Due to the broad impact of natural disasters such as floods, wildfire, extreme heat and coastal challenges, actions to decrease disparities cannot be done on a community-by-community basis. These impacts are rarely limited to a single community and it is important that federal programs provide equitable access and support to protect against and prepare for natural disasters. Addressing climate resilience and preparing communities for natural disasters starts at the local level. It is critical that both communities and individuals are provided with equitable opportunities to benefit from federal programs. If individuals across a community are supported and provided with the opportunity to participate in federal programs, the community as a whole will benefit.

Thank you for the opportunity to participate in this process and submit comments on federal support to underserved communities through programs on disaster preparedness and community resilience. We appreciate your consideration and look forward to continuing to work with you to strengthen federal programs.

Sincerely,

Michael Crowder
President
National Association of Conservation Districts

NRDC

May 2, 2021
Via Electronic Mail

Ms. Lee Ann Veal, Director
U.S. Environmental Protection Agency
Radiation Protection Division
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
Veal.Lee@epa.gov

RE: NRDC, *et al.*, Next Request to EPA to Recommence and Finalize In Situ Leach Uranium Rulemaking.

Dear Director Veal:

Over a year ago the Natural Resources Defense Council (NRDC), the New Mexico Environmental Law Center, Earth Works, Powder River Basin Resource Council, Earthjustice, Southwest Research & Information Center, Concerned Citizens for Nuclear Safety, the Multicultural Alliance for a Safe Environment and the Grand Canyon Trust wrote to you in hopes that the Biden Administration U.S. Environmental Protection Agency (EPA) would move forward on the long delayed revisions for 40 C.F.R. § 192, the overdue first set of meaningful environmental protections for the in situ leach (ISL) uranium recovery industry.¹ As of this date, EPA has yet to re-issue a new proposed set of standards and time grows short and pressures mount. We urge the agency to reissue a strong set of draft uranium recovery standards for public comment as soon as possible.

As a first matter and putting it directly at the front so there can be no mistaking or mischaracterizing this letter – the undersigned, each and every one, entirely concur with the policy position that the United States should explicitly ban imports of uranium from the Russian Republic. The dreadful military assault on Ukraine and its people outstrips every consideration and we stand with the civilized world in making every effort to restrict every possible form of commerce in the hopes of ending this war as soon as possible. Further, we have every expectation that the uranium supply from the Russian Republic will not be used in our domestic market for years, potentially decades, and even though it provides only 16 percent of that market, proper planning should inform how we address this small gap in supply.

Unfortunately, rather than undertaking careful analysis to address an incremental supply issue, industry champions that have worked for years to restrict EPA's efforts at new uranium

¹ See 40 CFR Part 192: Proposed Rulemaking and Background Documents, found online at <https://www.epa.gov/radiation/40-cfr-part-192-proposed-rulemaking-and-background-documents>.

protections are attempting to force the Department of Energy (DOE) to move forward with an ill thought out strategic uranium reserve under the guise of limiting Russian and Chinese uranium imports.²

Again, banning Russian uranium imports is the right thing to do. But EPA's role in this profound moment is also clear, especially if it's the case that some measure of the domestic uranium recovery industry may be artificially revived, whether it comes in the form of a uranium reserve or direct subsidies for purchase of domestic uranium.³ Any ban on Russian uranium must be accompanied by EPA finally moving forward on environmental standards that ensure U.S. uranium mining projects don't foul precious underground aquifers and water supplies or sicken and kill wildlife. It's long past time for EPA to issue the uranium mining standards that were put on hold in 2018.⁴ We are well into the second year of a Biden Administration and yet EPA still provides no public timeline on when it might conclude its review and take action.

The current situation places in even more stark relief the need for EPA to act. Years ago EPA addressed why, especially with the onset of artificially spurred domestic recovery, leaving the current situation in place is untenable:

Groundwater is one of our nation's most precious resources ... Groundwater is also a valuable and dwindling resource, particularly in western states where most ISR activities are anticipated. EPA views protecting groundwater as a fundamental part of its mission. Particularly in cases where groundwater is directly threatened by an activity, as it is by the ISR technology, EPA believes it has a special duty to ensure that the authority of all applicable federal statutes (e.g., UMTRCA and the SDWA) are used to help protect the groundwater and that appropriate standards to protect public health, safety and the environment are developed and implemented.

Proposed Rule at 4171.

² See Senator Cramer's National Opportunity to Restore Uranium Supply Services In America (NO RUSSIA) Act of 2022, <https://www.cramer.senate.gov/news/press-releases/sen-cramer-colleagues-introduce-legislation-to-establish-strategic-uranium-reserve-increase-domestic-production>. (Also, China supplies a *de minimis* percentage to the US market, so we are unsure of the basis for its inclusion in the proposal).

³ See the recently introduced legislation from Senators Manchin and Risch, International Nuclear Energy Act of 2022, <https://www.energy.senate.gov/2022/4/manchin-risch-introduce-the-international-nuclear-energy-act-of-2022#:~:text=The%20International%20Nuclear%20Energy%20Act%20would%20provide%20the%20necessary%20resources,nuclear%20plants%20across%20the%20globe>.

⁴ Specifically, we reference 40 C.F.R. § 192, 80 Fed. Reg. 4156-4187 (Jan. 26, 2015) (EPA-HQ- OAR-2012-0788) ("first draft rule"). That rule would have been finalized by the end of the Obama Administration, but as it was likely to be the subject of attack under the Congressional Review Act, the EPA wisely took another course to preserve its future options – at the close of the Obama Administration, the EPA re-proposed an updated set of revisions at 82 Fed. Reg. 7400-7430 (Jan. 19, 2017) ("second draft rule") (together "proposed rules"). The Trump Administration subsequently withdrew any effort to provide any protections and shelved the rule. 83 Fed. Reg. 54,543 (Oct. 30, 2018).

Continued delay in re-issuing and implementing the Proposed Rule is particularly concerning because of the environmental justice implications that ISL mining raises. The majority of ISL mining occurs or is proposed in low-income communities and communities of color, particularly Native communities. The health effects and natural resource destruction from historic uranium development already overburden these communities. Further delay in implementing the Proposed Rule would be antithetical to the Administration's stated commitment to environmental justice and equity. Additionally, we are aware of several expressions of concern from indigenous and vulnerable communities across the West about new uranium recovery and potential reserves that have been directed to several different parts of the administration.⁵ We remind EPA that all methods of uranium recovery carry with them a disproportionate and contaminating burden. Moving forward with all speed on the long awaited ISL uranium rule is only one important step. Simply, any creation of a uranium reserve or marked increase in direct subsidies to the industry in order to artificially ramp up the domestic market will dramatically affect scarce sources of western groundwater and associated vulnerable communities, endangers over the long term iconic western landscapes, and further creates a host of potential security concerns.

And so, we again request another meeting with you, Director Veal, and also Deputy Administrator McCabe, as she was the relevant Assistant Administrator during the final months of President Obama's tenure and it was under her authority that EPA sought to finalize the carefully crafted and protective standards we seek. If it would substantially delay any opportunity for a meeting, then we are happy to schedule separately and at a slightly later date with the Deputy Administrator. In either case, we request EPA provide precise answers on the timing for the agency's review of necessary steps on this overdue rule. Specifically, when will the agency conclude its review and on what timeline is the agency attempting to finalize the rule? And if it is not taking these steps and is not able to present its timeline, we'd like to understand the Biden EPA's policy basis for such a drastic departure from the positions held prior to the Administration of former President Trump.

We look forward to hearing from you.

Sincerely,

/s/(electronic signature)
Geoffrey H. Fettus
Senior Attorney
Natural Resources Defense Council
1152 15th St. NW, #300
Washington, D.C. 20005
(202) 271-4037
gfettus@nrdc.org

/s/(electronic signature)
Eric Jantz
Staff Attorney
New Mexico Environmental Law Center
1405 Luisa St., STE 5
Santa Fe, NM 87505
Ph: 505-989-9022 x 120
ejantz@nmeclc.org

⁵ See, as one example, the attached April 29, 2022 letter from Eastern Navajo Dine' Against Uranium Mining to Energy Secretary Granholm.

/s/(electronic signature)
Aaron Mintzes
Senior Policy Counsel
Earthworks
1612 K St. NW, Suite 904
Washington, DC 20006
919-302-6393 (cell)
amintzes@earthworks.org

/s/(electronic signature)
Shannon Anderson
Attorney
Powder River Basin Resource Council
934 N. Main St., Sheridan, WY 82801
307-672-5809
sanderson@powderriverbasin.org

/s/(electronic signature)
Blaine Miller-McFeeley
Senior Legislative Representative
Earthjustice
1001 G Street NW, Suite 1000
Washington, DC 20001
(202) 745-5225
bmcfeeley@earthjustice.org

/s/(electronic signature)
Chris Shuey, MPH
Director, Uranium Impact Assessment
Program
Southwest Research and Information Center
P.O. Box 4524
Albuquerque, NM 87196
office 505-262-1862
cell 505-350-0833
src.chris@gmail.com

/s/(electronic signature)
Amber Reimondo
Energy Director
Grand Canyon Trust
4401 Alcott St.
Denver, CO 80211
(303) 477-1486
apaul@grandcanyontrust.org

/s/(electronic signature)
Joni Arends
Executive Director
Concerned Citizens for Nuclear Safety
P. O. Box 31147
Santa Fe, NM 87594-1147
505 986-1973

/s/(electronic signature)
Susan Gordon
Coordinator
Multicultural Alliance For A Safe
Environment
P.O. Box 4524
Albuquerque, NM 87196
505-577-8438
sgordon@swuraniumimpacts.org

/s/(electronic signature)
Lilias Jarding, Ph.D.
Executive Director
Black Hills Clean Water Alliance
P.O. Box 591
Rapid City, SD 57709
605-787-2872
nobhuranium@gmail.com

NRDC *et al.*, Letter to Director Veal
Request to Re-propose ISL Uranium Rule, Docket #EPA-HQ-2012-0788-0001
May 2, 2022
Page 5 of 5

CC: Janet McCabe, Deputy Administrator; Dan Utech, Chief of Staff; Alison Cassady, Deputy Chief of Staff for Policy; Jonathan Edwards, Director, Office of Radiation & Indoor Air; Matthew Tejada, Office of Environmental Justice



Secretary Jennifer M. Granholm
U.S. Department of Energy
1000 Independence Ave. SW
Washington DC 20585
Sent via Email: the.secretary@hq.doe.gov

April 29, 2022

Subject: Uranium Mining Concern

Dear Secretary Granholm:

Eastern Navajo Diné Against Uranium Mining (ENDAUM) is writing to express concern about the U.S. Department of Energy's consideration of a "strategic uranium reserve." ENDAUM was formed in 1994 in response to a proposed *in situ* leach (ISL) uranium mining project in the Diné (Navajo) towns of Crownpoint and Churchrock, New Mexico. The proposed ISL project, called the Crownpoint Uranium Project (CUP), targets uranium ore bodies in important underground sources of drinking water for our towns and if begun, would destroy the sole source of drinking water for the town of Crownpoint.

As a member of the Multicultural Alliance for a Safe Environment, we previously submitted comments to you on October 13, 2021 in response to the RFI. We are deeply concerned with ongoing discussions taking place to increase uranium mining in the United States due to Russia's invasion of Ukraine. While we understand the United States' position on potentially banning uranium imports from Russia, we cannot stress enough that any corporate subsidies that prop up the domestic uranium mining industry will have significant, long term and devastating effects on our communities and Indigenous communities across the country. A horrible war in Europe should not be used as an excuse to harm our communities, other Diné communities under threat of new uranium development, and other Indigenous communities located here in the United States.

The Crownpoint Uranium Project is currently owned by a Canadian mining company Laramide Resources, through its U.S. subsidiary NuFuels, Inc. While part of the CUP is on tribal lands and therefore ostensibly ineligible to participate in the federal uranium program, part of the CUP is on private land adjacent to tribal lands, yet still within Diné communities. Allowing the CUP

to participate in a U.S. uranium mine reserve program under your Department will essentially shift the sacrifice of lives in the war-torn Ukraine for lives of the Diné tribal members. This is how serious we see this issue. President Biden ran for office pledging to protect tribal communities and restore tribal sovereignty. We need you to support his pledge to us and not allow the Crownpoint Uranium Project to participate under any federal uranium program. Doing so would cut directly against President Biden's pledge and promises.

Further, the United States has a duty under its trust responsibility to protect our Diné communities. We live in the year 2022, and the voice of our people should not go unheard.

While we appreciate prior statements from the Department of Energy that there is no intention to initiate or expand mining "on Tribal lands, expand the Office of Legacy Management's (LM) Uranium Leasing Program, or expand access to additional uranium deposits located on other Federal lands," the Department misses a key understanding of the true issues involved. Most of the potential damage to tribal interests occurs from activities on traditional aboriginal territories, sacred sites, and lands adjacent to tribal lands, not "on tribal lands" itself. This is where the federal trust responsibility should be at its strongest. Indian tribes, like the Navajo Nation, rely on the federal government to protect its people from the harmful effects of uranium mining. It should not matter where the mining occurs.

We have lived in our homeland, between the Four Sacred Mountains, in what are now the states of New Mexico, Arizona, Colorado and Utah, for hundreds of years and the single largest threat to our survival over these millennia has been the uranium industry. Mining for uranium not only harms the surface environment but also contaminates our groundwater resources. Widespread contamination from historic uranium development has already proven disastrous to the health of our people. Subsidizing future uranium development on and near the Navajo Nation and at sites within our traditional territory may well extinguish the Diné as a People. Polluting our land, air and water with new uranium production will not only add additional health burdens, it will also adversely affect our very identity as Diné. Our relationship with our land, air and water is sacred and inextricably tied to our individual and collective identity.

We urgently ask the Department of Energy to uphold President Biden's pledge and promise to protect the Navajo Nation and restore tribal sovereignty. We need you and others to hear our voices. We ask that you prohibit participation of the Crownpoint Uranium Project and any other future uranium development within the boundaries of the Four Sacred Mountains in any federal uranium program or from accepting any federal funding to operate.

Respectfully,

/s/ Jonathan Perry

Jonathan Perry
Executive Director

Eastern Navajo Diné Against Uranium Mining
President, Becenti Chapter

/s/ Rita Capitan

Rita Capitan
ENDAUM Founder
President, Crownpoint Chapter

/s/ Larry King

ENDAUM Member
President, Churchrock Chapter

Cc:

The Honorable Sen. Martin Heinrich
The Honorable Sen. Ben Ray Lujan
The Honorable Rep. Teresa Leger Fernandez
The Honorable Jonathan Nez, Navajo Nation President
Deb Halland, Secretary of the Interior
Michael Regan, Administrator, U.S. EPA
Dr. Earthea Nance, Regional Administrator, EPA Region VI
National Environmental Justice Advisory Council
White House Environmental Justice Advisory Council



National Wildlife Federation

National Advocacy Center

1200 G Street NW, Suite 900 • Washington, DC 20005 • 202-797-6800

April 22, 2022

Chair Brenda Mallory
Council on Environmental Quality
730 Jackson PI NW
Washington, DC 20506

RE: Comments on CEQ's Climate and Economic Justice Screening Tool Beta Version (docket number CEQ-2022-0002)

Dear Chair Mallory:

The National Wildlife Federation (NWF) is America's largest and most trusted conservation organization. We represent over six million members, supporters, and affiliates and work across the country to protect people and preserve wildlife habitats. NWF thanks CEQ for the opportunity to comment on the *Climate and Economic Justice Screening Tool Beta Version*. NWF is a strong proponent of using geospatial tools to further environmental and climate justice.

Climate and environmental justice screening and mapping tools are important in their own right for providing data-driven evidence to support community voices on environmental injustices and climate vulnerabilities. But it is a missed opportunity when they are not meaningfully incorporated into policy. A comprehensive screening tool is one that not only includes environmental and demographic indicators, but also measures factors such as economic progress, health, and resiliency—it is only with these kinds of indicators that we have a holistic, accurate understanding of environmental justice, and climate equity and justice.

The *Climate and Economic Justice Screening Tool* is intended to “help Federal agencies identify disadvantaged communities that are marginalized, underserved, and overburdened by pollution” to aid in the implementation of Executive Order 14008, including the Justice40 Initiative, as stated on the Screening Tool’s website. Below, the National Wildlife Federation outlines key recommendations that address these monumental goals and will aid the Administration in achieving Justice40 and we encourage CEQ to carefully evaluate and consider them for inclusion in the Screening Tool.

Include Race as a Socioeconomic Indicator

A multitude of studies have shown that race is the most important predictor of the distribution of environmental hazards. These include, a [2010 study by Crowder and Downey in the American Journal of Sociology](#), a [2015 study by Cushing et al. in the American Journal of Public Health](#) and a [2017 study by Clark et al. in Environmental Health Perspectives](#) among many others. We understand that the use of race-neutral criteria is intended to aid the tool in surviving legal challenges, however we cannot expect proxy indicators to be sufficient in addressing the tangible, historical, and routine federal discrimination and divestments in communities of color.

Based on the Beta Version of CEQ’s Screening Tool and existing indicators, as the number of non-white residents in a census tract increases, a tract becomes more likely to be considered disadvantaged. This illustrates that by prioritizing communities with the greatest pollution burdens the tool automatically prioritized communities of color. However, the system also flags about 3,500 census tracts where 20 percent or fewer residents identify as non-white and leaves out more than 2,200 tracts where 80 percent or more of the population identify as non-white. Some census tracts are surrounded by disadvantaged tracts but aren’t being flagged as disadvantaged by the Screening Tool (barely exceeding the cut off in the income criteria), despite suffering from similar issues on the ground.

Therefore, we propose that these criteria are not serving as an effective enough proxy for race, leaving many communities in need without the designation of a ‘disadvantaged community’ and that race should be included as a separate socioeconomic criterion.

Utilize Multiple Levels of Spatial Granularity

To build off of the previous recommendation, the use of census tract level data is helpful and granular enough to capture certain disparity ‘hotspots’, however the Screening Tool should utilize and overlay other levels of granularity such as the county and zip code levels in the designation of disadvantaged communities as well. By taking all of this data into account in identifying disadvantaged communities, fewer areas that may surround census tracts that are flagged as disadvantaged but aren’t flagged themselves, despite facing similar issues, may be counted within the tool as well.

Incorporate Cumulative Impacts

In order to be flagged as a disadvantaged community within the Screening Tool, a census tract must meet an income metric and one of the eight environmental/climate metrics. The Screening Tool as it is currently designed does not allow for examining the cumulative effects of various environmental, health, and socioeconomic burdens— and how they might combine to create a greater burden than each indicator alone might suggest. Disadvantaged communities do not experience each indicator in isolation and within the category of ‘disadvantaged’ there is significant variation in the types of burdens each community faces and in the cumulative burden. [CalEnviroScreen](#) is a great example of a screening tool that provides assessments of cumulative impacts, in this case across communities in California.

In an analysis of the *Climate and Economic Justice Screening Tool*, the World Resources Institute found that nearly 79 percent of the population living in a community flagged as disadvantaged are in census tracts that meet the threshold for five or fewer indicators. However, about 1 million people live in the 2 percent of communities above the threshold for 11 or more indicators. Therefore, the people within this latter group face the most acute burden due to the interactions of individual indicators, but are rated with the same level of priority.

To address long-standing environmental and health burdens, including disparities compounded by racial and socioeconomic injustice, a realistic assessment of the combined effects of multiple stressors in communities is required.

Include Future Climate Impact Projections

The Screening Tool uses historic data on natural hazards and losses to assess vulnerability, while using frequency of past events, severity of their damages, and weighting recent years more heavily in those measurements. As these hazards work to exacerbate existing inequalities, leaving low-income and minority populations more exposed to risks and racial disparities in the administration of recovery funds, relying on historical data will not provide an accurate picture of the most vulnerable communities. This is further demonstrated by the U.S. Government Accountability Office’s 2017 report, [Climate Change: Information on Potential Economic Effects Could Help Guide Federal Efforts to Reduce Fiscal Exposure](#).

Extreme weather events will become more frequent, intense, and impact broader swaths of the country. The latest IPCC report warns that if warming exceeds 1.5 degrees C in tropical regions for example, the combined effects of heat and drought may trigger sudden and significant losses in agricultural yields. This would increase heat-related mortality while labor productivity decreases, so people will not be able to work harder to overcome drought-related losses. Together, these impacts will lower families' incomes while raising food prices — a devastating combination that jeopardizes food security and exacerbates health risks. Considering future climate projections of all indicators within the Screening Tool is essential so that we may be aware of potential future conditions and can use the information to mitigate future harms and losses.

Additional Recommendations & Resources

Our recent publication in collaboration with Center for Community Engagement, Environmental Justice, and Health at the University of Maryland, [*Gaps in Environmental Justice Screening and Mapping Tools and Potential New Indicators*](#), includes a list of policy recommendations to help ensure EJ screening and mapping tools inform decision-making at the federal and state levels, and are used to target attention – including investment and enforcement actions – to communities that need it the most.

This report provides additional recommendations in response to the questions posed in the Federal Register notice, including recommendations for additional datasets that would enhance and improve upon the set of indicators currently in the tool, key indicators for further consideration, and a collaborative problem-solving model to help ensure an equitable application to policy and decision-making. The report is also attached to these comments.

Conclusion

The National Wildlife Federation appreciates the CEQ's request for comment and input on the development of the *Climate and Economic Justice Screening Tool* and we look forward to further supporting the development of the Screening Tool and in advancing climate equity and justice.

Sincerely,

Simone Lightfoot
Associate Vice President for Environmental Justice and Climate Justice

Shannon Heyck-Williams
Senior Director for Climate and Energy Policy



Secretary Jennifer M. Granholm
U.S. Department of Energy
1000 Independence Ave. SW
Washington DC 20585
Sent via Email: the.secretary@hq.doe.gov

May 2, 2022

Subject: Uranium Mining Concern

Dear Secretary Granholm:

The Red Water Pond Road Community Association (RWPRCA) is writing to express concern about the U.S. Department of Energy's consideration of a "strategic uranium reserve." The Red Water Pond Road community is located near Churchrock, Navajo Nation, New Mexico, between three Superfund sites related to historic uranium exploitation: the Northeast Churchrock Mine, the Kerr-McGee/Quivira Mine and the UNC uranium mill. Consequently, members of the RWPRCA have been exposed to unsafe concentrations of radiation and toxic heavy metals for decades.

As a member of the Multicultural Alliance for a Safe Environment, we previously submitted comments to you on October 13, 2021 in response to the RFI. We are deeply concerned with ongoing discussions taking place to increase uranium mining in the United States due to Russia's invasion of Ukraine. While we understand the United States' position on potentially banning uranium imports from Russia, we cannot stress enough that any corporate subsidies that prop up the domestic uranium mining industry will have significant, long term and devastating effects on our communities and Indigenous communities across the country. A horrible war in Europe should not be used as an excuse to harm Diné (Navajo) communities and other Indigenous communities located here in the United States under threat of new uranium development.

President Biden ran for office pledging to protect tribal communities and restore tribal sovereignty. We need you to support his pledge to us and not allow any new uranium exploitation projects in or near the Navajo Nation, including within traditional Diné territory, to

participate under any federal uranium program. Doing so would directly contradict President Biden's pledge and promises.

While we appreciate prior statements from the Department of Energy that there is no intention to initiate or expand mining "on Tribal lands, expand the Office of Legacy Management's (LM) Uranium Leasing Program, or expand access to additional uranium deposits located on other Federal lands," the Department misses a key understanding of the true issues involved. Much of the potential damage to tribal interests occurs from activities on traditional Indigenous territories, sacred sites, and lands adjacent to tribal lands, not "on tribal lands" itself. This is where the federal trust responsibility should be at its strongest. Indian tribes, like the Navajo Nation, rely on the federal government to protect its people from the harmful effects of uranium mining. It should not matter where the mining occurs.

We have lived in our homeland, between the Four Sacred Mountains, in what are now the states of New Mexico, Arizona, Colorado and Utah, for hundreds of years and the single largest threat to our survival over these millennia has been the uranium industry. Mining for uranium not only harms the surface environment but also contaminates our groundwater resources. Widespread contamination from historic uranium development has already proven disastrous to the health of our people. Subsidizing future uranium development on and near the Navajo Nation and at sites within our traditional territory may well extinguish the Diné as a People. Polluting our land, air and water with new uranium production will not only add additional health burdens, it will also adversely affect our very identity as Diné. Our relationship with our land, air and water is sacred and inextricably tied to our individual and collective identity.

We urgently ask the Department of Energy to uphold President Biden's pledge and promise to protect the Navajo Nation and restore tribal sovereignty. We need you and others to hear our voices. We ask that you withhold participation of all future uranium development within the boundaries of the Four Sacred Mountains in any federal uranium program and prohibit any future uranium development within the boundaries of the Four Sacred Mountains from receiving federal funding to operate.

Respectfully,

/s/ Edith Hood

Edith Hood

Red Water Pond Road Community Association

Cc:

The Honorable Sen. Martin Heinrich

The Honorable Sen. Ben Ray Lujan

The Honorable Rep. Teresa Leger Fernandez

The Honorable Jonathan Nez, Navajo Nation President

Deb Haaland, Secretary of the Interior

Michael Regan, Administrator, U.S. EPA

Dr. Earthea Nance, Regional Administrator, EPA Region VI

National Environmental Justice Advisory Council

White House Environmental Justice Advisory Council



April 14, 2022

Senator Michael J. Rodrigues, Chair
Senate Committee on Ways and Means
24 Beacon Street, Room 212
Boston, MA 02133

Dear Senator Rodrigues and Members of the Senate Committee on Ways and Means,

You have before you a bill critically urgent to the Commonwealth's public safety and climate change efforts: Senator Cyr's [S.186 Resolve relative to disclosure of radio frequency notifications](#).

The Backstory

When my daughters were in school, we kept hearing about the 21st Century Classroom and how our children would need this new technology to succeed in today's world. Our town budgets could not afford this so I spent eight years fundraising to bringing wireless technology into Ashland Public Schools as the President of the Ashland Education Foundation and later as the district's grant coordinator. I was honored to serve alongside Senator Spilka in these efforts.

Then an electrical engineer friend tipped me off there could be biological harm from the electromagnetic fields (EMFs) of radiofrequency microwave radiation used to carry the signals and data back and forth between our devices and the routers and cell towers with which they communicate.

I am a technical writer by trade so I began to research the peer-reviewed science and was astounded to discover there are literally thousands of studies all over the world documenting extensive harm to both people and the environment. Then I tried to help others:

First, through a long and difficult School Committee process in 2014, I helped Ashland Public Schools become the [first in the nation](#) to implement Best Practices for Mobile Devices. Although we have a sign hanging in all of our classrooms to turn off the devices and the wi-fi when not in use, they are not enforcing it and the children continue to be radiated. Our administrators are waiting for higher authorities to tell them to remove this electropollutant from the classroom.

Second, after three attempts I secured a grant to place a [radiofrequency radiation \(RF\) detection meter on loan](#) in the Ashland Public Library so residents can measure these invisible exposures and safeguard their loved ones. This has become a model program deployed by the Newton and Pittsfield libraries, and others across the country.

Third, I showed Senator Spilka and Puja Mehta the science and [Ashland's school sign](#), then measured the radiation coming off of Karen's cell phone and Puja's laptop. Both devices sent the RF meter off the charts into to the red zone. Senator Spilka put me with **Aaron Carty** and together we wrote the nation's first commission bill to investigate wireless radiation. It was assigned to the Joint Committee on Public Health in 2015.

I arranged for world leading EMF scientists, doctors, public health experts, technologists and injured citizens to send in testimony. The bill was advanced by Public Health but sent to study by Health Care Finance. In 2017, Karen introduced the bill as a Resolve under her own name and again it advanced but Senate Ways and Means sent it to study. In the third session Karen was elected Senate President and no longer introduced legislation.

Senator Cyr's Bills

Fortunately, by then, Senator Cyr had introduced two bills to address wireless radiation risks too. One would form a commission and the other would protect children from handheld devices.

Did you know the current [Resolve S. 186](#) was written by the Joint Committee on Consumer Protection and Professional Licensure? When Senator Cyr first filed these bills in 2017, I once again arranged for world leading doctors, scientists, technologists and injured citizens to send in testimony.

When Consumer Protection saw the evidence of harm coming in and after I walked Chairs L'Italien and Chan through the issue, they assigned a research analyst to investigate further. Jay Santos asked what I considered to be the top 10 reasons to pass these bills and I provided him with a list.

They did their due diligence and verified the facts, then in 2018 Consumer Protection wrote [S. 2431](#) to form a commission to investigate wireless radiation. Although the bill has been voted out of committee favorably each session since, it has failed to pass.

In the meantime, Massachusetts began battling unprecedented epidemic proportions of anxiety, depression, insomnia and other mental health deteriorations in both children and adults. Our pollinators began to disappear, climate change escalated. The science shows wireless radiation is a major contributing factor. It is a neurotoxin and it kills insects, and wireless systems consume 10x more energy than the responsible technology solution of fiber-optics to and through the premises.

Yet Massachusetts continues to allow the wireless industry to immerse our families and environment in electropollution at alarming rates. The message is not no technology, it's safe technology, and we know how to get there.

Much has advanced with wireless radiation science, public policy, and legal actions since 2017 when Consumer Protection wrote what is now before you as [Resolve S. 186](#).

Here are today's top 10 urgent reasons to pass [Resolve S. 186](#) and form an expert commission this session, perhaps as an emergency measure:

1. Massachusetts Used to Lead the Nation

We are falling behind. For nearly a decade Massachusetts led the nation with many bills to address the wireless radiation issue. This session alone, we have [20 bills filed](#) to form a commission to investigate, protect children in schools, require a no-fee opt-out from utility “smart” meters and more.

Our public record is solidly populated with the facts to enable you to act to protect the Commonwealth. Here is a [600-page compilation of testimonies](#) I produced in 2018 and gave to Senator Spilka and Dennis Giombetti. I will forward under separate cover many of the testimonies that have come in this session too so you are empowered with the current public record on wireless radiation risks and remediation solutions.

In ten years Massachusetts has yet to pass a wireless radiation bill. However, armed with the same facts as we’ve brought forth in the Commonwealth, **New Hampshire passed a law to investigate in just seven months.**

2. New Hampshire’s Groundbreaking Commission Report

New Hampshire has already done the hard work to enable Massachusetts to now follow suit.

Citizens harmed by wireless radiation introduced NH Rep. Patrick Abrami to the science. He is an engineer, and as such had only been taught you must have heat from a wireless antenna to have harm. The FCC public radiation limits were set in 1996 to these thermal, or heating effects and that is what is still in place today.

Rep. Abrami did his due diligence though and personally began investigating the peer-reviewed scientific literature. He discovered a vast body of science showing extensive harm at the non-thermal level, meaning our FCC guidelines allow far too much radiation to protect the public or the environment.

He then met with me and his constituent and we helped him connect the dots further on the magnitude of wireless harm.

In 2019, Rep. Abrami introduced [NH HB.522](#), a bipartisan bill to form a commission to answer the following eight questions:

1. Why does the [insurance industry](#) recognize wireless radiation as a leading risk and has placed exclusions in their policies not covering damages by the pathological properties of electromagnetic radiation?
2. Why do cell phone manufacturers have in the [legal section](#) within the device saying keep the phone at least 5mm from the body?
3. Why have [1,000s of peer-reviewed studies](#), including the recently published U.S Toxicology Program 16-year [\\$30 million study](#), that are showing a wide range of statistically significant DNA damage, brain and heart tumors, infertility, and so many other ailments, been ignored by the Federal Communication Commission (FCC)?

4. Why are the FCC-sanctioned guidelines for public exposure to wireless radiation based only on the thermal effect on the temperature of the skin and do not account for the non-thermal, non-ionizing, biological effects of wireless radiation?
5. Why are the FCC radiofrequency exposure limits set for the United States 100 times higher than countries like Russia, China, Italy, Switzerland, and most of Eastern Europe?
6. Why did the World Health Organization (WHO) signify that wireless radiation is a [Group B Possibly Carcinogenic to Humans](#) category, a group that includes lead, thalidomide, and others, and why are some experts who sat on the WHO committee in 2011 [now calling for it to be placed in the Group 1, which are known carcinogens](#), and why is such information being ignored by the FCC?
7. Why have more than 220 of the world's leading scientists signed an [appeal to the WHO and the United Nations](#) to protect public health from wireless radiation and nothing has been done?
8. Why have the **cumulative** biological damaging effects of ever-growing numbers of pulse signals riding on the electromagnetic sine waves not been explored, especially as the world embraces the Internet of Things, meaning all devices being connected by electromagnetic waves, and the exploration of the number of such pulse signals that will be created by implementation of 5G technology?

Following compelling expert testimonies akin to what we have in MA, the NH House Committee on Science, Technology and Energy advanced the bill to the Senate Committee on Health and Human Services which also voted it out favorably. Governor Sununu signed HB. 522 into law and within seven months of the bill's introduction New Hampshire formed a commission composed of highly qualified medical doctors, scientists, physicists and engineers as well as state agency representatives and members of the wireless industry.

They reviewed thousands of peer-reviewed studies from all over the world documenting very serious biological harm to children, adults and the environment, from low-level, non-thermal, non-ionizing exposures and posted their findings on the NH [State website](#).

In a publicly transparent process, they also interviewed world-leading microwave radiation scientists and doctors, the retired President of Microsoft Canada, World Health Organization advisors, and industry representatives as well.

They repeatedly invited the FCC and FDA to meet with them and our federal agencies refused, signaling that this issue needs to be addressed at the state level. Investigation revealed these agencies are [captured by industry](#).

Even during the COVID-19 pandemic, New Hampshire kept the wireless investigation a priority and their work culminated in the groundbreaking [New Hampshire Final Report on Commission to Study the Environmental and Health Effects of Evolving 5G Technology](#).

The 390-page report is thorough yet easy to read. The Summary and Recommendations are all in the first 17 pages and the bulk of the document is comprised of the appendices which

contain the science and other supporting facts, as well as minutes from their 13 publicly accessible meetings.

The report also contains a minority report written by industry in pages 18-27 before the appendix begins. This is the industry playbook which the majority of commission members saw right through after investigating the facts. The minority report is something of a gift though, as it contains the messaging routinely given by wireless representatives to our towns, legislators and the public. Commission members Senator Denise Ricciardi and Dr. Paul Heroux counter many of the points of disinformation from the minority report on [pages 384-5 of the electronic copy](#), or pages 5 and 6 of 11 in the final meeting minutes of Appendix O.

New Hampshire makes 15 recommendations to engage federal delegates to protect the public and the environment, and in the meantime at the state level educate the public, label all RF emitting equipment, measure exposures, establish setbacks, and begin transitioning away from harmful wireless technology to fiber to and through the premises.

The NH commission report is the strongest fact-based investigation in the nation. In December 2020 the European Parliament began an [investigation into wireless radiation](#), especially 5G. They held a two-hour session with six representatives from industry and science. In the final minute the moderator recommends emulating the [NH commission's process](#) and [report](#).

The New York legislature now has [S.5926](#) and [A.06448](#) to emulate the New Hampshire report, and many [other states](#) have made inroads toward responsible technology too.

MA would do well to get going on this ASAP. We are falling behind and it is showing in the declining health of our populace and environment.

Note: the Oregon legislature tasked the Oregon Health Authority (OHA), through an [emergency law](#), to investigate wireless radiation, especially as it impacts children in schools. A good report was drafted at the same time NH did its review, but unfortunately, as an [in-depth journalism investigation](#) reveals, the credible science was scrubbed from the final report by industry-friendly OHA authorities which has left Oregon's children immersed in toxic levels of radiation – just as Massachusetts' children are today.

New Hampshire has taken next steps and in January introduced [HB. 1644](#) to begin implementing the commission's report recommendations, starting with prohibiting new cell towers or small cells within 500 meters /1,640' of homes, schools, parks, medical facilities, senior centers, etc. That is the distance where the [science indicates the increased death rate](#) slope begins to go down. The bill also establishes an industry funded state-level registry of harm.

Following public testimony their House Committee on Science, Technology and Energy unanimously voted not to kill the bill, and has formed a bipartisan 8-member Interim Study committee to decide how to move forward. They will execute their work starting this spring.

3. Legal Actions:

In 2019, when the FCC ignored [11,000 pages](#) of scientific, medical and citizen evidence of harm entered into the public record and reaffirmed its toxic levels of public radiation exposure, the FCC was sued by the Environmental Health Trust and others.

In August 2021, the [9th District Circuit Court of Appeals in D.C. ruled](#) the FCC was arbitrary and capricious in its decision to continue to expose the public to today's levels of wireless radiation and remanded it back to the FCC to reassess their radiation limits, especially as they impact children and the environment. This is where it stands today, the proverbial fox still watching the hen house.

Knowing the FCC will aim to drag this out indefinitely, the non-profit Americans for Responsible Technology has consulted with leading attorneys in telecom law and filed an [Imminent Hazard Petition with the FDA](#). Massachusetts resident and business owner Robert Strayton is a co-petitioner as he was injured by a cell tower installed next to his home in Chappaquiddick.

The Massachusetts Association for Boards of Health now includes cell tower risks in the last four pages of the [Legal Handbook and Public Health Guidebook for Massachusetts Boards of Health](#).

There are many Massachusetts lawsuits too, here are a few examples:

- Citizens in **Hull** are trying to protect their homes from 5G small cell installations
- **Pittsfield** residents have sued for lack of proper notification to residents of applications for cell towers
- Parents in **Southborough** sued under ADA for the harm done to their son by the wireless radiation emissions at the prestigious Fay School; for the first time in U.S. history, the courts recognized biological harm at the non-thermal level; Rep. Carolyn Dykema has had bills for years to protect all students in schools, see this session's [H. 115](#).
- **Cambridge** successfully won a suit when industry failed to adhere to due process
- **Boston** joined mayors in other states in suing the FCC and wireless industry for usurping local control
- Cape residents worked with **Barnstable** to sue for protections from close-range cell antennas mounted in a church steeple
- **Ashfield** residents successfully sued to stop a cell tower

Please know Boston has been trying to avert wireless risks for years. In 2013, the cities of [Boston and Philadelphia filed a submission](#) to the Federal Communications Commission (FCC) (Dockets [#13-84](#) and [#03-137](#)) that accused the FCC and federal health agencies of negligence for failing to investigate whether electrosensitive persons are harmed by wireless radiation.

In 2020, the City of Boston filed a submission to the FCC's 19-226 docket stating, "Boston believes that the concerns of the public are real and that the Commission has done a disservice to itself, local government, consumers, and even the wireless industry in failing to understand and respond to the broadly shared mistrust of the safety of RF emissions." See the [full submission here](#).

Many towns in Massachusetts are rising up against harmful utility "smart" meters as well as close range cell towers and small cell antennas being imposed in their communities. See the [News](#) page at Massachusetts for Safe Technology for articles from communities across the Commonwealth. See also the [Events](#) page for educational forums and performances being held to educate the public.

A few examples are:

- Residents worked with their town in **Lenox** to stop cell tower antennas from being installed on top of The Curtis, the state-owned housing for senior citizens and the disabled
- Citizens in **Wayland** years ago worked with their town to put a 900' setback in their zoning code to protect residential areas, which allowed them to lawfully deny an industry application in recent years to put a cell tower on their rod and gun club, which abuts a neighborhood.
- **Burlington**, MA adopted a small cell policy requiring all 5G antennas to be recertified each year and the vendor would have to pay for it. Verizon withdrew their small cell applications. Americans for Responsible Technology incorporated this into their [sample ordinance](#) being brought by citizens to their municipalities all over the country.
- **Dover-Sherborn** parents staved off two cell towers on the high school
- **Westwood** parent succeeded in having the schools refuse to renew cell tower leases on the roof of the middle school
- **Pittsfield, after a two-year investigation, this week broken ground as the first Board of Health in the nation to issue a cease-and-desist order to Verizon to remove a cell tower** activated the first week of the pandemic. Children and adults immediately became ill and symptoms worsened over time to the point where residents have had to abandon their homes. The pollinators have also disappeared. Rep. Patricia Farley-Bouvier lives in this neighborhood and [testified](#) before the Joint Committee on Consumer Protection and Professional Licensure on the need for Massachusetts to address the wireless issue.

Our citizens and towns should not have to fight these battles. The Commonwealth needs to take a stand to protect all citizens from wireless radiation. Passing S. 186 ASAP would be a good start.

4. Havana Syndrome & Public Exposures

Much has been reported lately on [Havana Syndrome](#), where U.S. diplomats and their families have experienced extensive harm from microwave radiation exposures.

This is the SAME microwave radiation deployed widely today in the public sector via wireless technology. Harmful electromagnetic fields (EMFs) of radiofrequency microwave radiation are continually pulsed from our own cell phones, earbuds, routers, tablets, laptops, wearables, baby monitors, gaming devices, Roku, Chromecast, Alexis, appliances, automobiles and all electronics geared for the Internet of Things (IoT).

At the community level, this radiation is emitted 24x7 from [utility “smart” meters](#) for electric, gas, propane, water and solar systems. Toxic emissions are constantly radiated by [cell towers](#) plus macro cell antennas mounted on buildings. The electropollution is growing exponentially with [5G small cells](#) being installed at bedroom height *inside* neighborhoods in the public accessway. 5G adds a whole new layer of harmful beam-forming radiation on top of the existing 3G and 4G pulses, upping the total body burden of electropollution to new heights.

Our bodies did not evolve to adapt to these extremely high levels of man-made radiation, and with constant exposure we can never get a break to do proper cell repair and regeneration.

5. The Science: Human Harm

Wireless technology was developed for use by our militaries, starting with radar systems and then biological warfare. Now [declassified military studies](#) indicate our government knew of the biological harm decades ago, long before wireless technology products were sold to the public.

The industry has known too. See this [2000 report from T-Mobile](#), the German parent company of our T-Mobile.

[The science](#) has continued to advance and thousands of peer-reviewed studies published in highly credible journals report wireless radiation causes **cancers, DNA damage, infertility, ADD/ADHD, autism, and Alzheimer’s disease coming on at earlier and earlier ages.**

In the short-term, the science documents wireless radiation is a neurotoxin and immunosuppressant which contributes significantly to our escalating rates of **anxiety, depression, anger, insomnia, headaches, nosebleeds, pain, nausea, skin abnormalities, heart irregularities, cognitive impairment and behavior issues.**

The science indicates **children, fetuses, the elderly and those with existing health compromises are even more vulnerable than the general population.**

6. The Science: Flora and Fauna

There is another large body of science documenting the [environmental impact](#) of blanketing our world in radiation signals that are 1,000,000,000,000,000,000 times greater than the earth’s natural electromagnetic field. **Pollinators are disappearing, birds’ navigation systems are disoriented, and every ecosystem is impacted.**

As if it weren’t bad enough what we are doing with electropollution here on the ground, the industry is now launching thousands of 5G satellites into the sky to blanket every corner of the earth with wireless radiation beams connecting to devices on the land. Soon there will be no place left to go without being radiated unless we take bold action.

7. Climate Impact

The engineering community reports [wireless systems consume 10x more energy](#) than the safer, responsible technology solutions of fiber to and through the premises. As far back as 2012 a Greenpeace analyst reported **if the telecom industry were a country, it would be the [fifth largest consumer of energy in the world](#)**. If 5G and the Internet of Things are allowed to proliferate, energy consumption is expected to multiply exponentially.

8. Data Security and Privacy

When our data is sent through the air using microwaves, it is easily hacked. When signal is run through secure cables, it is not. As you are likely aware, this goes beyond personal data as intruders can shut down our whole grid by hacking into wireless systems more easily.

Another privacy issue is that utility “smart” meters can [harvest private data](#) from ratepayers’ usage patterns which can then be sold to third party vendors interested in selling the ratepayer products, or used by criminals to detect when you are not home and plan their break-ins accordingly. Massachusetts should not be investing in more wireless infrastructure for grid modernization. We should **work with the utility companies to install meters that are hard-wired to the premises and forego any wireless transmitters**. Rep. Tommy Golden’s [H. 3309](#) could be amended accordingly.

9. 5G Good for Telecom, Bad for the Public and Environment

Wireless technology is highly profitable and has a short life, thereby creating a repeated revenue stream for industry as upgrades and replacement cycles are imposed. The [e-waste](#) is terrible for our planet, from the human atrocities inflicted to mine the many minerals needed in each wireless product, to the mounds of unrecyclable materials in the landfills.

With 5G, the industry intends to put a cell tower called a small cell at bedroom, right inside our neighborhoods at the curb in the public accessway on poles or wires.

[PC Magazine](#) and others report there is **no need for 5G**, it is not delivering the promised faster speeds than what already exists with 4G. **Fiber to and through the premises will always deliver far superior speeds and reliability than anything wireless can ever deliver.**

The wireless industry is also [buying up the entertainment industry](#) as they promote 5G for faster streaming services and content development. This is yet another new revenue stream.

Unless towns have updated their zoning bylaws, the industry is already putting these toxic small cells at close range in many towns. See the [map of Boston installations](#).

As this [two-minute clip](#) from Boston25 News indicates, Verizon has installed small cells up Fenway Park too, where they are radiating thousands of spectators at close range. They’ve gotten into [Gillette Stadium](#) too.

10. Major Breakthroughs in the Medical Community

Many children and adults are suffering from microwave sicknesses and being misdiagnosed because doctors and the public have been kept in the dark by the powerful wireless industry.

When we first introduced MA legislation, we had no way of training health care practitioners to recognize, diagnose, treat and prevent these environmentally-induced illnesses.

Martha's Vineyard environmental medicine practitioner Dr. Lisa Nagy co-chaired the first U.S. Electromagnetic Fields Conference in 2019. In 2021 another expanded international [EMF Medical Conference](#) was held with world leading doctors, scientists and public health experts. I was honored to present state and local policy at both conferences.

Doctors, nurses, first responders and other health care providers can now earn 24.5 continuing medical education credits through affordable self-paced on-line training (note, the CME/CE opportunity expires in May, so if your medical team isn't trained, you might want to strongly encourage them to register for the conference by May 1. Remember, **the damage from this radiation is cumulative in our tissues; those feeling fine today may hit a tipping point tomorrow and if their doctors aren't trained, they will be misdiagnosed and continue to suffer**). The public is also welcome to enroll at a reduced rate to learn directly from the experts.

It was very unsettling to hear from several of the doctors that their patient load increases when utility "smart" meters go in, and when cell towers and small cells are installed at close range. They further indicated that **with the increasing electropollution damaging the gray and white matter of the brain, we can anticipate increases in societal crimes including mass shootings**.

Dr. Lisa Nagy and I worked with the Massachusetts Medical Society for two years, and in December 2021 they converted our **Resolution: [Wireless Communications Public Safety Standards Reevaluation](#)** to a **policy statement**:

That the Massachusetts Medical Society supports continuing research, including quality epidemiologic studies, by appropriate agencies and entities to produce evidence-based data on the effect(s) of radio frequency radiation on human health. If indicated, study findings should be used to revise and update public health standards for safe limits of human exposure to radio frequency radiation.

See also the [1997 Boston Physicians' and Scientists' Petition to Avert Public Exposures to Microwaves](#).

Growing Urgency for All

If we do not stop the industry, they will continue to install close-range cell towers next to our homes, and now directly on our schools too.

Please see this website of the captured Federal Department of Education: [School District Wireless Network Models](#). You will see they are now **targeting school buildings and buses for toxic cell tower/antenna installations, as well as mounting them directly on home rooftops, at the curb at bedroom height, and on water towers inside neighborhoods**.

The industry targeted our children through their 21st Century Classroom campaign with the goal of having a one-to-one device in the hands of every child. They know once you have a child as a consumer, you often get to keep them for life.

The Pittsfield adults and children have had to flee this type of cell tower infrastructure to survive. If the industry succeeds in rolling out the plans on the DOE website, where will anybody go?

The radiation will be unlivable everywhere, plus the children will continue to be radiated every hour of every school day, even on the playgrounds and fields. Again, wireless radiation is a neurotoxin and we are already at epidemic levels of anxiety and depression with the amount of radiation currently in most schools and homes today.

Even pre-pandemic our schools were unable to resolve the escalation of mental health issues, and **now we've given every student in the Commonwealth a toxic wireless tablet to access their education -- with no safety instructions** to hard-wire with an inexpensive adapter to an Ethernet cable, and turn off the multiple radiation antennas.

Please see this [private three-minute video](#) demonstrating the toxic radiation exposure levels from a student's school-issued Chromebook, and how to very easily hard-wire and turn off the radiation. The radiation was at 25,000 microwatts per square meter and the science indicates we should be at 10 or less indoors, and at 0.1 in our sleeping areas.

A Boston resident and I measured the radiation in the North End, on Hanover Street where small cells have been installed. We got readings as high as 600,000. The science indicates we should be at 1,000 or less outdoors, and that is assuming we have a clean home environment where our bodies can do proper cell repair and regeneration while we sleep. With a cell tower outside or utility "smart" meters mounted in or on our homes, there is no escape.

As a recent paper identified, this radiation is **causing Alzheimer's to develop at earlier and earlier ages now too. What will become of our workforce if we continue to do nothing in Massachusetts?**

The Solution

Transitioning to responsible technology is not rocket science:

- **Education** is key to shift the social norm from industry's push for all-wi-fi-all-the-time to responsible, superior hard-wired connections.

We should aim for As Low As Reasonably Achievable levels of wireless radiation for the devices under our control as well as for community infrastructure including utility "smart" meters, cell towers, small cell antennas and satellites. This [ALARA principle](#) is already used by the CDC for ionizing radiation. It's time to instate this as a guiding principle for wireless non-ionizing radiation too.

Dr. Bob Knorr at the MA DPH and I co-wrote [EMF fact sheets](#) which I was told would be released in 2016 and they never were. My non-profit Wireless Education has since

created easy half-hour on-line training courses for [Schools & Families](#), as well as for the [Corporate](#) workplace. Environmental Health Trust has developed a treasure trove of [resources](#) as well. We are poised to quickly train the entire Commonwealth as soon as political will allows. I and others have [presented to the DESE board](#), and former Interim Deputy Commissioner Wulfson told me they are waiting for higher authorities to tell them what to do. We need your leadership, Senator Rodrigues.

- **Bring fiber-optics or high-speed cable to the premises** (which most already have), and [simply connect to the internet indoors via Ethernet cables and adapters to devices](#). Then turn off the radiating antennas in each device. The signal is much faster and more reliable through cables, privacy is better protected, and hard-wiring consumes far less energy than wireless systems. See [Reinventing Wires: The Future of Landlines and Networks](#) for guidance to steer public policy and community development.
- **Funding** may be possible through the ARPA broadband funds. We also already paid the industry to bring fiber to the premises years ago which they failed to fully deliver. They instead took much of that funding and used it to build out their inferior, highly profitable wireless networks. The Irregularators have sued, and paved the way for Massachusetts to recoup that funding. [Click here](#) for further information.

It's time to do what is best for our towns, not what the insatiable wireless industry would deceptively lead us to do. The retired President of Microsoft Canada, Frank Clegg, [presented to the MA State House in 2015](#), and in his [recent NH testimony](#) he indicated **wireless technology is past its prime. The future lies in hard-wired technology to and through the premises** for primary connectivity as other countries are already beginning to do, and it is up to governments to move industry there.

We understand the industry has already set aside billions for their injustices just as big tobacco did. They are expecting to be held accountable as damage to the populace and environment are simply the cost of doing business for them.

Please exercise your lawful duty ASAP to hold them accountable so we can all live safely in our homes and communities. Begin by ensuring [Resolve S. 186](#) passes this session and in the interim take meaningful action to inform and protect the public while public policy catches up to the science.

Please do not hesitate to reach out if Massachusetts for Safe Technology can support your efforts further.

Kind regards,

Cecelia (Cece) Doucette, MTPW
Director, [Massachusetts for Safe Technology](#)
Education Services Director, [Wireless Education](#)
31 Fatima Drive, Ashland, MA 01721
508-881-3878, MA4SafeTech@gmail.com



State of New Hampshire

GENERAL COURT

CONCORD

MEMORANDUM

DATE: November 1, 2020

TO: Honorable Christopher T. Sununu, Governor
Honorable Stephen J. Shurtleff, Speaker of the House
Honorable Donna Soucy, President of the Senate
Honorable Paul C. Smith, House Clerk
Honorable Tammy L. Wright, Senate Clerk
Michael York, State Librarian

FROM: Representative Patrick Abrami, Chair

SUBJECT: Final Report on Commission to Study the
Environmental and Health Effects of Evolving 5G Technology
(RSA 12-K:12-14, HB 522, Ch. 260, Laws of 2019)

Pursuant to RSA 12-K:14, III, enclosed please find the Final Report of the Commission to Study the Environmental and Health Effects of Evolving 5G Technology.

If you have any questions or comments regarding this report, please do not hesitate to contact me.

I would like to thank those members of the commission who were instrumental in this study. I would also like to acknowledge all those who testified before the commission and assisted the commission in our study.

Enclosures

cc: Members of the Commission

Final Report of the
Commission to Study
The Environmental and Health Effects of
Evolving 5G Technology

(HB 522, Chapter 260, Laws of 2019, RSA 12-K:12–14)

Membership

<u>Name</u>	<u>Organization/Representing</u>
Rep. Patrick Abrami (Chair)	NH House of Representatives
Rep. Kenneth Wells	NH House of Representatives
Rep. Gary Woods	NH House of Representatives
Sen. James Gray	NH Senate
Sen. Tom Sherman	NH Senate
Denise Ricciardi	Public
Brandon Garod, Esq.	Attorney General's Office
Carol Miller	Department of Business and Economic Affairs
David Juvet	Business and Industry Association
Kent Chamberlin, PhD	University of New Hampshire
Bethanne Cooley	CTIA – wireless communications industry
Michele Roberge	Department of Health and Human Services
Paul Héroux, PhD	McGill University Medicine

November 1, 2020

Members of the Commission to Study the Environmental and Health Effects of Evolving 5G technology agree to the filing of this final report by the Chairman. This action should not be construed in any way as an adoption of any position by any Commission member or state agency or organization they represent on the underlying issue of the deployment of 5G technology.

Table of Contents

INTRODUCTION	1
Commission Responsibilities and Evolving Role	1
Summary of Commission Meetings	3
Questions Posed in HB 522	4
SUMMARY AND OBSERVATIONS	6
RECOMMENDATIONS	9
MINORITY REPORT	18
APPENDICES	28
Appendix A <i>Electromagnetic Spectrum</i>	29
Appendix B <i>Correspondence with federal agencies</i>	30
Appendix C <i>Answers to the specific questions posed by HB 522</i>	46
Appendix D <i>Sampling of Scientific Studies Pertaining to Cellphone Radiation</i>	75
Appendix E <i>Challenges to the Radiation Exposure Standards Set by U.S. Regulatory Agencies</i>	83
Appendix F <i>Wireless Exposure Limits in Different Countries</i>	91
Appendix G <i>Captured Agencies and Conflicts of Interest</i>	92
Appendix H <i>Example of an RF radiation warning</i>	94
Appendix I <i>Example of a symbol for use on poles and other structures located in public rights-of way that hold 5G antennae</i>	95
Appendix J <i>Deleterious effects of impulsive radiation</i>	96
Appendix K <i>Siting restrictions for wireless antennae</i>	97
Appendix L <i>Measurement of RF intensities within frequency ranges throughout state</i>	106
Appendix M <i>The enabling technology and scientific rationale for automatically stopping cell phones from operating when held against the body</i>	107
Appendix N <i>Research on the effects of wireless radiation on trees, plants, birds, insects, pollinators, and wildlife</i>	111
Appendix O <i>Meeting Minutes</i>	115

INTRODUCTION

Commission Responsibilities and Evolving Role

The Commission to Study the Environmental and Health Effects of Evolving 5G Technology came about from the passage and signing into law of [HB 522](#). The Legislature, after hearing testimony of potential health risks and the political ramifications of small cell antennae being deployed on the public rights-of-way throughout New Hampshire, agreed that a Commission be formed to take a deeper look at this evolving technology. For the record, 5G stands for the 5th Generation of wireless communication. This technology utilizes frequencies in the millimeter wave range of the electromagnetic spectrum. See [Appendix A](#) for a chart showing this spectrum.

What the Commission learned early on in its work is that you cannot talk about 5G without talking about the earlier generations 3G and 4G. Then the Commission embraced the concept of the Internet of Things (IoT) which is a world in which all electronic devices communicate via electromagnetic waves. This led to discussion of routers and other internal technologies. The devices receiving and sending signals via electromagnetic waves also became part of the discussion. So as the presentations and discussions went on, the Commission concluded that all things emitting radio frequency (RF) radiation needed to be considered together because of the interaction of all these waves. We also discovered early on that 5G means something different to each of the major cellular companies ranging from how 5G antennae interact with other generation antennae to whether small cell towers in the public right-of-way will be needed. The conclusion by many experts is that 5G is a marketing concept centered around speed of data transmission using many different engineering strategies.

At the heart of the discussion was the research as to whether non-ionizing radiation causes biological effects on humans as well as other living organisms, either animal or plant. No one argues that ionizing radiation from the high energy and frequency ultraviolet, x-ray, and gamma ray end of the electromagnetic spectrum are a danger to all living things. Of concern to the Commission, and internationally, are the electromagnetic waves in the microwave range of energy and frequency. There is mounting evidence that DNA damage can occur from

radiation outside of the ionizing part of the spectrum.^{1, 2, 3, 4} The Commission heard arguments on both sides of this issue with many now saying there are findings showing biological effects in this range. This argument gets amplified as millimeter waves within the microwave range are beginning to be utilized.

Then the Commission was presented with varying facts about the Federal Communication Commission (FCC) having total say over this issue as granted to it by Congress in the Telecommunication Act of 1996. In brief, this Act says, among many other things, that the siting of any antennae cannot be denied due to health concerns. Many on the Commission are concerned that this Act did not contemplate small cell towers being located on the public rights-of-way in front of people's homes. In addition, the FCC, using the science that they receive from other agencies and scientific/engineering associations, has set the allowable power intensity that can be emitted from these antennae. Testimony shows these limits are set well above many other industrialized nations. There are concerns by many Washington, DC watchers that the FCC is a captive agency whose Commission members come from the industry they are overseeing. These are the realities that can only be altered by Congressional action. As a New Hampshire Commission, as we moved through the Commission process, many of the members concluded we could first encourage our federal delegation to enact changes and second, assuming the federal realities cannot be changed, recommend protective measures that will stay within the current federal framework.

As far as the FCC and federal agencies, we made several attempts to have them testify before the Commission. The Commission was disappointed that they did not reply to these requests, because we thought it important for completeness of our work to hear from these agencies. When the agencies did not reply, we asked several agencies to answer very specific written questions. Instead of answering

¹ Aitken RJ, Bennetts LE, Sawyer D, Wiklendt AM, King BV. "Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline." *Inter J Androl* 28:171-179, 2005, <https://pubmed.ncbi.nlm.nih.gov/15910543/>

² Akdag MZ, Dasdag S, Canturk F, Karabulut D, Caner Y, Adalier N. "Does prolonged radiofrequency radiation emitted from Wi-Fi devices induce in various tissues of rats?" *J Chem Neuroanat*, 75(Pt B):116-122, 2016, <https://pubmed.ncbi.nlm.nih.gov/26775760/>.

³ Akdag M, Dasdag S, Canturk F, Akdag MZ. "Exposure to non-ionizing electromagnetic fields emitted from mobile phones induced DNA damage in human ear canal hair follicle cells." *Electromagn Biol Med*. 37(2):66-75, 2018.

⁴ Al-Serori H, Ferk F, Kundi M, Bileck A, Gerner C, Mišik M, Nersesyan A, Waldherr M, Murbach M, Lah TT, Herold-Mende C, Collins AR, Knasmüller S. "Mobile phone specific electromagnetic fields induce transient DNA damage and nucleotide excision repair in serum-deprived human glioblastoma cells." *PLoS One*. 13(4):e0193677, 2018.

our specific questions, the responses directed Commission members to certain locations on websites for what turned out to be more general information on topics of public interest. The communications with these agencies are contained in [Appendix B](#).

Summary of Commission Meetings

The Commission met a total of 13 times over a period from September 2019 to October 2020. Unfortunately, due to the Covid-19 pandemic, all activity at the NH State House came to a halt from mid-March to mid-June this year. This meant that the Commission missed four meetings and thus heard from fewer experts on this topic than planned. It is important to stress that the Chair was planning to call additional witnesses from the scientific community as well as the telecommunication industry. When we resumed meeting, starting with one on July 1, all remaining meetings were conducted via Zoom. After our July 24th meeting, a work group consisting of seven members was formed to start formulating recommendations for the full Commission to consider. This work group met approximately every other week through the finalization of this report at the end of October. The table below summarizes the full Commission meeting dates and who the main speakers were.

#	Date	Major Topics and/or Guest Speakers
1	9/16/19	Organizational meeting
2	10/10/19	Electromagnetic Spectrum Physics Presentation Dr. Kent Chamberlin, Chair of UNH Electrical and Computer Engineering Department Presentation on Biological Effects of RF radiation Dr. Paul Heroux, Professor of Toxicology, McGill University
3	10/31/19	National Toxicology Program Study on RF-Radiation Michael Wyde, PhD Framing the Issue Video Frank Clegg, Former Microsoft Canada President
4	11/21/19	Non-Existence of RF-Radiation Biological Effects Argument Eric Swanson, PhD, University of Pittsburgh.
5	12/13/19	Reinventing Wires and 5G in Colorado Tim Schoechle, PhD, Colorado State University

6	1/10/20	Studies Showing RF-Radiation Biological Effects Devra Davis, PhD, MPH, Founder/President Environmental Health Trust (EHT) The Landscape Nationally and Internationally Surrounding RF-Radiation, Theodora Scarato, Executive Director EHT
7	2/14/20	What is 5G and What Do We Know About the Health Effects of 5G David Carpenter, MD, Director, Institute for Health and the Environment, University of Albany
<i>COVID-19 NH STATE HOUSE CLOSURE</i>		
8	7/1/20	13 Objections To 5G/4G Herman Kelting, PhD, Retired Las Vegas, NV
9	7/24/20	Around the table discussion of where we are and next steps. Established a work group to formulate recommendations.
10	8/31/20	Presentation of work group recommendations and discussion. Discussed that a minority report would be required.
11	9/22/20	Discussion and voting on first half of recommendations
12	10/8/20	Discussion and voting on second half of recommendations
13	10/27/20	Review and vote on final report.

There are extensive minutes of all of these meetings that are included at the end of this report in [Appendix O](#). In addition, the Commission has maintained a [webpage](#) on which is posted the various documents and links to information that it has collected during the course of its study, including many of the presentations provided during the meetings.

Questions Posed in HB 522

There were eight questions asked in the legislation creating the Commission. Research by the Commission has resulted in lengthy answers with supporting credits. With that we are showing the questions asked in the body of this report only, with the answer to each question shown in [Appendix C](#). The questions are as follows:

1. Why does the insurance industry recognize wireless radiation as a leading risk and has placed exclusions in their policies not covering damages by the pathological properties of electromagnetic radiation?
2. Why do cell phone manufacturers have in the legal section within the device saying keep the phone at least 5mm from the body?
3. Why have 1,000s of peer-reviewed studies, including the recently published U.S Toxicology Program 16-year \$30 million study, that are showing a wide

range of statistically significant DNA damage, brain and heart tumors, infertility, and so many other ailments, been ignored by the Federal Communication Commission (FCC)?

4. Why are the FCC-sanctioned guidelines for public exposure to wireless radiation based only on the thermal effect on the temperature of the skin and do not account for the non-thermal, non-ionizing, biological effects of wireless radiation?
5. Why are the FCC radiofrequency exposure limits set for the United States 100 times higher than countries like Russia, China, Italy, Switzerland, and most of Eastern Europe?
6. Why did the World Health Organization (WHO) signify that wireless radiation is a Group B Possibly Carcinogenic to Humans category, a group that includes lead, thalidomide, and others, and why are some experts who sat on the Who committee in 2011 now calling for it to be placed in the Group 1, which are known carcinogens, and why is such information being ignored by the FCC?
7. Why have more than 220 of the world's leading scientists signed an appeal to the WHO and the United Nations to protect public health from wireless radiation and nothing has been done?
8. Why have the cumulative biological damaging effects of ever-growing numbers of pulse signals riding on the electromagnetic sine waves not been explored, especially as the world embraces the Internet of Things, meaning all devices being connected by electromagnetic waves, and the exploration of the number of such pulse signals that will be created by implementation of 5G technology?

The answers to these questions have been embraced by the majority of the members of the Commission.

SUMMARY AND OBSERVATIONS

House Bill 522 established “a Commission to study the environmental and health effects of evolving 5G technology.” The Commission that was convened as a result of this legislation is comprised of thirteen members with backgrounds that include physics, engineering electromagnetics, epidemiology, biostatistics, occupational health, toxicology, medicine, public health policy, business, and law. The Commission also has representation from the telecommunications industry. The Commission began its work on September 16, 2019 and submitted this report on November 1, 2020.

The Commission recognizes that cellular and wireless communications is very important to the citizens of New Hampshire. The rollout of wireless services and new products in the industry can be key to enhancing public safety, economic opportunity, and healthcare. Regardless of the evidence presented and the risks associated with RF electromagnetic field effects, business and residents alike want 100% coverage and seamless connectivity. The majority of the Commission believes that some balance can be struck to achieve the benefits of technology without jeopardizing the health of our citizens.

To become acquainted with the issues relevant to 5G radiation exposure and health, the Commission heard from ten recognized experts in the fields of physics, epidemiology, toxicology, and public policy. All but the presenter representing the Telecommunications Industry (the transcript of that presentation can be found in the Commission’s minutes of Nov 21st) acknowledged the large body of peer-reviewed research that shows that the type of RF-radiation generated by wireless devices can have a deleterious effect on humans, especially children, as well as animals, insects, and vegetation (see [Appendix D](#)).

The Commission was unable to meet for four months due to the shutdown of the NH State House caused by COVID-19. While this loss of time did limit the number of presenters that could be accommodated, the majority of the Commission did not believe that additional presenters were necessary because the information provided by the ten experts was deemed sufficient.

5G is moving forward because of its potential benefits and because of assurances by federal regulatory agencies that 5G technology is not harmful. However, those

assurances have themselves come into question because of the thousands of peer-reviewed studies documenting deleterious health effects associated with cellphone radiation exposure. Most of the federal regulatory agencies' radiation exposure limits were established in the mid-1990s before the studies were carried out, so they did not take those studies into account when setting exposure limits. In addition, the initial exposure limits were developed at a time before wireless devices, and the radiation associated with them, became ubiquitous. Not only are wireless devices far more prevalent than in the past, but these radiating devices are typically carried in direct, or near direct, contact with peoples' bodies. Further, the total radiation exposure for individuals is compounded by the radiation from nearby sources, including others' devices, cell towers, wireless routers, Bluetooth devices, etc. Because of the large number of radiating devices in today's environments, exposure for people is many times greater than when radiation thresholds were established, and the nature of today's radiation (high-data-rate signals) has been shown to be more harmful than the lower-data-rate signals that were prevalent before.

The significant disconnect between the regulatory agencies' pronouncements that cellphone radiation is safe and the findings of thousands of scientific studies was one of the major issues that the Commission sought to address. The Commission is not alone in wrestling with this issue as many others (see [Appendix E](#)) have challenged the radiation thresholds specified. It is to be noted that the only country with higher radiation thresholds than the U.S. is Japan (see [Appendix F](#)), and a large number of independent scientists have concluded that the thresholds for Japan and the U.S. are unsafe.

A likely explanation as to why regulatory agencies have opted to ignore the body of scientific evidence demonstrating the negative impact of cellphone radiation is that those agencies are "captured" (see Harvard University publication entitled, "Captured Agency: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates" linked in [Appendix G](#)). This report documents how the leadership roles in some agencies (the FCC in particular) are filled by individuals with strong industry ties and hence are more focused on industry interests than the health of citizens. As is shown in other sections of this report, federal legislation uses policy set by the regulatory agencies to wrest control of wireless facility placement from individuals, cities, and states. Consequently, some of the Commission's recommendations call for a

reassessment of the makeup and policies of federal regulatory agencies. Current policies in place by federal regulatory agencies (such as section 704 of the Telecommunications Act of 1996) are tailored to prevent local objections to cell tower siting that are based upon health or environmental concerns, and this leaves citizens with little legal recourse regarding equipment placement.

Industry projects that over 800,000 small cell towers⁵ will be necessary to implement 5G. Many are being erected in the public rights-of-way in New Hampshire neighborhoods and mounted on new poles, streetlights, and utility poles directly in front of homes. However, because of the rules currently in place, individuals and municipalities cannot use health or environmental concerns as a reason to object.

The majority of the Commission has endorsed the 15 recommendations presented in this report. These recommendations are not in prioritized order, and each should be given equal consideration. The objective of those recommendations is to bring about greater awareness of cell phone, wireless and 5G radiation health effects and to provide guidance to officials on steps and policies that can reduce public exposure. We also recommend partnering with our federal delegation to facilitate the reevaluation of radiation exposure guidelines and policies by federal agencies (i.e., the FCC, FDA, NASA, NOAA, FAA, EPA, etc.) to protect people, wildlife, and the environment from harmful levels of radiation.

Since the Commission could not reach full agreement on all that is contained in this report, the minority of the Commission has been given the opportunity to express its opinion as provided in the Minority Report.

⁵ The number of projected cell towers for 5G was taken from the CTIA website: “There are 154,000 cell towers today. To meet growing mobile data demands and win the Race to 5G Accenture projects we will need to install hundreds of thousands of small cells in the next few years. S&P Global Market Intelligence projects more than 800,000 small cells deployed by 2026.”

RECOMMENDATIONS

The Commission has heard from many experts on both sides of the argument concerning the health and environmental effects of 5G and RF-radiation in general; reviewed countless study reports; attempted to get direct answers to our specific questions from the FCC and other federal agencies to no avail; has become aware of a number of lawsuits against the FCC for not accounting for biological effects in the setting of their standards; is still not certain why the standards for acceptable RF-radiation are set so much higher in the United States than other industrialized nations; is concerned that the modulation of frequencies and the combined effect of “the soup” of RF-waves surrounding us today, which will likely increase with time; is aware that there is much research showing potential health risks and understands that much more research is required; is cognizant that our country historically has been beset by examples of products being declared safe only later to be proven unsafe; and is very aware that the World Health Organization and the whole insurance industry are hedging their bets against RF-radiation because of potential harm. Given these considerations, the majority of the Commission yields to the precautionary principle in formulating many of these recommendations. These recommendations cover a broad range of topics. One topic given much consideration had to do with liability from potential harm caused by small cell antennae placed on the public rights-of-way. A majority of the Commission could not agree upon a recommendation surrounding this topic.

RECOMMENDATION 1- Propose a resolution of the House to the US Congress and Executive Branch to require the Federal Communication Commission (FCC) to commission an independent review of the current radiofrequency (RF) standards of the electromagnetic radiation in the 300MHz to 300GHz microwave spectrum as well as a health study to assess and recommend mitigation for the health risks associated with the use of cellular communications and data transmittal. The Telecommunications Act of 1996 was adopted before the health risks and biological effects of RF-radiation to the human body were fully known to the scientific community as well as the public. The majority of the Commission believes that the FCC has not exercised due diligence in its mission to manage the electromagnetic environment by not setting exposure limits that protect against health effects. They have failed to support technical means and investigations aimed at reducing human exposures to electromagnetic radiation (EMR) in

telecommunications systems and optimize wireless modulations to reduce biological and health impacts. Commissioned research should study the health effects and should be conducted by an independent research organization with standards which have been mutually agreed to by all the stakeholders. The FCC shall then ensure that the findings and recommendations are adequately disseminated to the public.

RECOMMENDATION 2- Require that the most appropriate agency (agencies) of the State of New Hampshire include links on its (their) website(s) that contain information and warnings about RF-radiation from all sources, but specifically from 5G small cells deployed on public rights-of-way as well as showing the proper use of cell phones to minimize exposure to RF-radiation, with adequate funding granted by the Legislature. In addition, public service announcements on radio, television, print media, and internet should periodically appear, warning of the health risks associated with radiation exposure. Of significant importance are warnings concerning the newborn and young as well as pregnant women. Even without further study, there is evidence that the public should be warned of the potential dangers of RF-radiation and be told simple steps to lessen the risks of unnecessary exposure. [Appendix H](#) shows an example of a simple RF-radiation warning.

The website must provide an option for visitors to register their opinions about current FCC exposure guidelines. In particular, this registry should provide a convenient and formal mechanism for New Hampshire municipalities and residents to weigh in concerning the 1996 Telecommunications Act Section 704 that disallows using radiation-related health concerns as a reason to challenge cell phone tower siting. The primary use for the data collected on this registry will be to gauge the level of interest about RF-radiation exposure on the part of New Hampshire citizens.

RECOMMENDATION 3- Require every pole or other structure in the public rights-of-way that holds a 5G antenna be labeled indicating RF-radiation being emitted above. This label should be at eye level and legible from nine feet away. In the view of the Commission, the State of New Hampshire has the right to warn the public of potential harm of 5G antennae deployed in the public rights-of-way. Large cell towers all currently have fencing around them at their base to protect the public. This will not be the case with small cell towers or any pole with an

antenna on top in the public right-of-way. These public rights-of-way are the jurisdiction of our municipalities and not of the Federal Government. The Telecommunication Act of 1996 did not contemplate antennae being placed on the public rights-of way of municipalities. Thus, the State of New Hampshire has the right to warn the public by requiring the owners of these antennae to inform the public of potential harm from RF-radiation. See [Appendix I](#) for an example symbol.

RECOMMENDATION 4- Schools and public libraries should migrate from RF wireless connections for computers, laptops, pads, and other devices, to hard-wired or optical connections within a five-year period starting when funding becomes available. There is strong evidence that the younger the child the more susceptible they are to the negative impacts of RF-radiation. Hard-wired connections or optical wireless do not subject children to RF-radiation. The Commission is aware that school districts and public libraries have invested much in wireless infrastructure and that a movement to radiation-less connections would require additional investment of resources.

New optical networking solutions for the classroom and office spaces (such as LiFi) offer faster, healthier, and more secure connections than RF-based WiFi. This technology utilizes visible light, which organisms can withstand without any harm at far higher intensity levels (such as direct sunlight) than is required for data transmission. Such optical data transmission using visible light offers gigabit speed, as well as plug-and-play replacement of current RF WiFi routers. The optical wireless system can be incorporated in an upgrade to cost-efficient LED room lighting which can save schools and public libraries significant energy dollars.

The hard-wiring and/or optical projects should be completed within five years from when the federal funding (e.g., through the FCC's E-Rate program for telecommunications and IT in schools and public libraries) is procured.

RECOMMENDATION 5- Signal strength measurements must be collected at all wireless facilities as part of the commissioning process and as mandated by state or municipal ordinances. Measurements are also to be collected when changes are made to the system that might affect its radiation, such as changes in the software controlling it. Signal strength is to be assessed under worst-case

conditions in regions surrounding the tower that either are occupied or are accessible to the public, and the results of the data collection effort is to be made available to the public via a website. In the event that the measured power for a wireless facility exceeds radiation thresholds, the municipality is empowered to immediately have the facility taken offline. The measurements are to be carried out by an independent contractor and the cost of the measurements will be borne by the site installer. It is recognized that theoretical calculations show that existing FCC guidelines will be met by standard cell tower configurations. However, there are cases where the radiation from towers can be focused by buildings, terrain, and beamforming antennas, causing signal levels to be considerably higher than would be expected in theoretical calculations unless those effects are taken into account. Collecting field measurements provide the only valid approach for determining whether exposure guidelines have been met. It is to be noted that some municipalities (e.g., the town of Burlington, MA [1]) have ordinances requiring measurements at cell towers.

Federal law and NH law grant to municipalities the power to enact zoning rules regulating the placement of personal wireless service facilities within the geographic boundaries of the municipalities. Municipalities should be proactive in this area and, through the exercise of zoning power, establish where, how, and a process for compliance with existing FCC guidelines for signal strength in the surrounding coverage area. Municipalities should establish a hierarchy of siting values and compliance acknowledgements so that the siting most favored by the municipality is the easiest siting for the wireless applicant to obtain and, conversely, the siting which is least desirable should be the most difficult siting for the applicant to obtain. The zoning ordinance should lay out the compliance requirement as part of the zoning approval.

[1] Burlington, MA zoning Bylaw Wireless Facilities section 8.4.6.2 - “Annual RF emissions monitoring is required for all sites by an independent RF engineer to be hired with Planning Board approval and at the applicant’s expense. Test results will be submitted to the Town as soon as available, and not later than the close of the calendar year. Annual testing of electromagnetic emission shall be required to ensure continual compliance with the FCC regulations.”

Recommendation 6- Establish new protocols for performing signal strength measurements in areas around wireless facilities to better evaluate signal characteristics known to be deleterious to human health as has been documented through peer-reviewed research efforts. Those new protocols are to take into account the impulsive nature of high-data-rate radiation that a growing body of evidence shows as having a significantly greater negative impact on human health than does continuous radiation. The protocols will also enable the summative effects of multiple radiation sources to be measured.

Contemporary approaches to performing signal level measurements do not provide a means to evaluate signal impulsiveness or the contribution of multiple radiation sources because of equipment limitations. The measurement protocols proposed will employ wideband equipment that is currently available but is not typically used to measure compliance with radiation safety limits. References that address the deleterious effects of impulsive radiation on organisms are given in [Appendix J](#). The development of the proposed protocols should be funded by the appropriate federal agency (e.g., NSF, NIH, FCC, etc.) and should be facilitated by New Hampshire's federal delegation.

RECOMMENDATION 7- Require that any new wireless antennae located on a state or municipal right-of-way or on private property be set back from residences, businesses, and schools. This should be enforceable by the municipality during the permitting process unless the owners of residences, businesses, or school districts waive this restriction. Local public rights-of-way are under the jurisdiction of municipalities, and the Commission feels that municipalities should uphold the rights of individuals impacted by antennae. The Commission also supports the right of property owners to manage decisions on non-essential devices being placed in front of their property.

The Commission believes that it is important to prioritize citizen safety, particularly as 5G is an upgrade, rather than the provision of wireless service to unserved areas. Additional rationale for this recommendation is shown in [Appendix K](#).

RECOMMENDATION 8- Upgrade the educational offerings by the NH Office of Professional Licensure and Certification (OPLC) for home inspectors to include RF intensity measurements. Home inspectors currently operate as private contractors who may be hired by citizens or enterprises to measure such things as

radon, to collect water quality samples, or search for mold or insect damage. Home inspectors routinely supply test results to both their clients and government entities.

The majority of the Commission believes the public has the right to discover, on a voluntary basis, the RF power intensity related to radio frequencies at a property which they will be purchasing or renting before the transaction is closed. Also, the proprietors of publicly accessible venues may wish to reassure the public about the RF power intensity within their establishments, by posting the data collected by a state-approved inspector. In addition, such testing should be paid for by the party requesting it and the testing itself should be performed by a professional who owns or rents the test equipment and has met the state requirements for training of home inspectors regarding RF measurements.

The majority of the Commission proposes that home inspectors be offered training by NH OPLC on how to measure on-site peak and 24-hour average RF intensities. Measurements of frequencies and intensities will be performed using low-cost equipment (such as GQ-390 meters). [Description of existing home inspector training offered for radon, mold, etc. may be seen at <https://oplcnh.gov/home-inspectors/index.htm>]

RECOMMENDATION 9- The State of New Hampshire should begin an effort to measure RF intensities within frequency ranges throughout the state, with the aim of developing and refining a continually updated map of RF exposure levels across the state using data submitted by state-trained home inspectors. The data should be collected in such a way as to identify geographic areas of notably high RF exposure, places where RF signal for wireless communication is inadequate (dead spots), and places where RF is unusually low (white spots) sought by people who wish to minimize their RF exposure. One possible use of this data will be buyers/renters of property or the public, in general, using benchmark values to make comparisons and make their own decisions based on their comfort level with RF exposure. After a while, an extensive New Hampshire RF database will exist to provide useful maps and data for future public health investigations. [Appendix L](#) outlines in more detail the technical aspects of this recommendation.

RECOMMENDATION 10- Strongly recommend all new cell phones and all other wireless devices sold come equipped with updated software that can stop the phone from radiating when positioned against the body. The Commission has been made aware that cell phones contain proximity sensors that will allow a cell phone to only radiate signals when a certain distance from the body, for example, held in the fingers or placed on a table. This does not change the functionality of the device, only the way it is used, specifically not held against the head or body. Implementation is a software update in the cell phone, as these phones already have a proximity detector to turn off the screen and soft keys when an obstacle is present. With this change, the screen and the RF circuit are automatically turned off. This removes the problems of brain cancers (glioblastomas and acoustic neuromas) and the issue of SAR limits for the industry. See [Appendix M](#) for more detailed references to the science behind this recommendation. Cell phones should come set with this inhibition, with instructions in the manual on how to disable it. There should be a soft button on the unit to easily re-enable the radiation inhibition, for example if the unit is handed to a child. In all cases, it should be easier to enable the restriction than to disable it. Cellular phones marketed specifically for children should stop radiating when positioned against the body under all circumstances. The installation of such proximity sensors is also encouraged in laptops and tablets.

RECOMMENDATION 11- Promote and adopt a statewide position that would strongly encourage moving forward with the deployment of fiber optic cable connectivity, internal wired connections, and optical wireless to serve all commercial and public properties statewide. The majority of the Commission believes that fiber optic transmission is the infrastructure of the future. When compared, RF wireless transmission lacks fiber optic characteristics: speed, security, and signal reliability while avoiding biological effects on humans and the environment.

The State should encourage partnerships between towns to make this happen and encourage our federal delegation to support grant money to assist with such deployments when it comes to funding fiber optic cable deployment, especially in rural locations.

RECOMMENDATION 12- Further basic science studies are needed in conjunction with the medical community outlining the characteristics of expressed clinical symptoms related to radio frequency radiation exposure. Further studies are just beginning to explore the quantum mechanical mechanisms which are the fundamental basis for understanding the biological changes occurring during the interaction of radio frequency radiation and molecules. These mechanisms can affect cells, tissues, and whole organs, as well as accumulate over time.

The majority of the Commission feels the medical community is in the ideal position to clarify the clinical presentation of symptoms precipitated by the exposure to radio frequency radiation consistent with the Americans with Disabilities Act (ADA) which identifies such a disability. The medical community can also help delineate appropriate protections and protocols for affected individuals.

All of these endeavors (basic science, clinical assessment, epidemiological studies) must be completely independent and outside of commercial influence.

RECOMMENDATION 13- Recommend the use of exposure warning signs to be posted in commercial and public buildings. In addition, encourage commercial and public buildings, especially healthcare facilities, to establish RF-radiation free zones where employees and visitors can seek refuge from the effects of wireless RF emissions. Many NH citizens report sensitivity to electromagnetic radiation emitted from devices used in the delivery of in-building cellular and fixed wireless services. A majority of the Commission suggests that owners of commercial and public buildings, especially healthcare facilities, voluntarily place signage at entrances concerning RF-levels and RF-free zones within these structures so those entering the building are aware.

RECOMMENDATION 14- The State of New Hampshire should engage agencies with appropriate scientific expertise, including ecological knowledge, to develop RF-radiation safety limits that will protect the trees, plants, birds, insects, and pollinators. The majority of the Commission understands that current federal safety limits were made with the intention of only protecting humans from short term effects, but not protecting flora or fauna from harm. The State of New Hampshire needs to ensure our natural environment and wildlife are protected by effective safety standards. Tree limbs, birds, and pollinators will be closer than

humans to 5G cell antennae and associated 4G densified infrastructure. In fact, the wireless radiation from cell antennae is very high in a plume surrounding the antennae. It could exceed FCC limits for several feet in this area, yet this is the exact area where leaves of trees, birds, and pollinators live. Thus, they may have higher exposures being in direct line of sight of wireless RF beams. When pollinators are impacted so are all forms of vegetation that depend on them for reproduction. Research on this issue is shown in [Appendix N](#).

RECOMMENDATION 15- The State of New Hampshire should engage our Federal Delegation to legislate that under the National Environmental Policy Act (NEPA) the FCC do an environmental impact statement as to the effect on New Hampshire and the country as a whole from the expansion of RF wireless technologies. Concern comes from the FCC projection that there will be numerous low orbit satellites and 5G small cell antennae, plus many additional macro towers required for these networks to function. The majority of the Commission is concerned that any new large-scale project that will densify antennae networks to this extent truly requires an environmental impact study. The NEPA statute requires that the agency consider environmental concerns in its decision-making process. NH should be provided documentation of such considerations. Until there is Federal action, NH should take the initiative to protect its environment.

MINORITY REPORT

The following members, being unable to agree with the majority of the Commission, endorse this Minority Report:

Senator James Gray, David Juvet, and Bethanne Cooley

Contrary to the position taken in the Recommendations section, the science related to radiofrequencies, wireless devices, and health is well studied and well known: The consensus of the U.S. and international scientific community is that there are no known adverse health risks from the levels of RF energy emitted at the frequencies used by wireless devices (including cellphones) and facilities (including small cells). Some of those who presented to the NH 5G Commission have sought to sow confusion, but the facts demonstrate otherwise.⁶ *First*, when setting limits for the RF emissions of wireless devices, the Federal Communications Commission (“FCC”) intentionally provided a significant safety margin—50 times below the threshold at which adverse effects have been observed in laboratory animals.⁷ And in its 2019 order, the FCC assessed the available science, including studies related to the safety of 5G networks, and based on the relevant scientific research, concluded that wireless devices and small cells are safe when they adhere to the FCC’s current RF exposure limits, as required by law. *Second*, numerous, independent analyses of peer-reviewed studies conducted over several decades by national and international organizations conclude that there are no known health risks to humans from RF

⁶ Commission discussions indicated that the Commission was comprised of many individuals who had preconceived opinions about the safety of RF devices and wireless technology in general. Due to many factors, experts in favor of wireless technology were cut short in participating. For example, an additional expert in favor of wireless technology was offered as a speaker during the summer and the Commission indicated no additional experts would be permitted. However, after that request was denied, an “expert” opposed to RF devices and wireless technology spoke at a subcommittee meeting of the majority. In addition, the Commission heard only a portion of expert Eric Swanson’s testimony and failed to consider in a balanced fashion the well-developed reviews of the science from the U.S. and international health and safety organizations. Thus, in this report we have cited those authorities even though the Commission did not include them as part of the formal record.

⁷ The threshold for adverse effects was set at the level at which heating caused a “disruption of observable behavior” in animals. See *Proposed Changes in the Commission’s Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields*, First Report and Order, Further Notice of Proposed Rulemaking, and Notice of Inquiry, 28 FCC Rcd. 3498, 3582 ¶ 236 (2013) (“FCC NOI”) (“exposure limits are set at a level on the order of 50 times below the level at which adverse biological effects have been observed in laboratory animals as a result of tissue heating resulting from RF exposure”); IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz, IEEE Std C95.1-2019, Annex B Sec. B.5.3.3 and Annex C Sec. C.2.1 (2019) (“Typically, the effect observed has been a decreased rate of responding or decreased reaction time.”).

energy emitted by wireless devices and infrastructure. Thus, the scientific consensus as evaluated by experts, international standard-setting bodies, and federal health and safety agencies is that wireless devices and base stations at the FCC's RF exposure levels is safe.

Given the scientific consensus, it is our opinion that the Recommendations exceed what a reasonable response should be to the evidence on this issue. This Minority Report purposely chose not to highlight each recommendation but instead highlights findings from federal agencies, including the FCC and the Food and Drug Administration (FDA), studies conducted by leading international and national health organizations, the IEEE and the scientific community at-large. It will also note the federal preemption issues associated with the Recommendations. Given the scientific consensus, it is our opinion that the Recommendations have no basis in scientific fact, are irresponsible, and will subject the state and any localities implementing these Recommendations to needless and expensive challenges that will drain time and resources from more important and credible priorities.

THE FCC SAFETY REGULATIONS

FCC limits govern RF energy from antennas used in all wireless devices including cellular transmissions from cellphones, cell towers, and 5G small cells. The FCC based these limits on recommendations from the scientific community and expert non-government organizations; the FCC limits currently cover frequencies from 100 kHz to 100 GHz, including the “millimeter wave” or “mmW” frequencies.⁸ These guidelines—based on internationally-recognized scientific organizations—set limits for the maximum amount of RF exposure from wireless devices and include a significant margin of safety.⁹ Specifically, the FCC has set its limit for a consumer device's Specific Absorption Rate—the measurement for RF emissions for consumer devices such as cellphones—“at a level on the order of *50 times below* the level at which adverse biological effects have been observed in laboratory animals.”¹⁰ The agency explained that this 50-fold factor can well

⁸ NPRM, 34 FCC Rcd at 11742 ¶ 120.

⁹ Testimony of Christopher C. Davis, Professor of Electrical and Computer Engineering, University of Maryland, *Hearing on S.B. 637 and S.B. 894 Before the Mich. H. Comm. on Energy Policy*, 2018 Leg., 99th Sess., at 4:17 (May 29, 2018) ([“Professor Davis Testimony”](http://www.house.mi.gov/SharedVideo/PlayVideoArchive.html?video=ENER-052918-2.mp4)), <http://www.house.mi.gov/SharedVideo/PlayVideoArchive.html?video=ENER-052918-2.mp4>.

¹⁰ FCC NOI at ¶236 (emphasis added).

accommodate a variety of variables such as different physical characteristics and individual sensitivities—and even the potential for exposures to occur in excess of [FCC] limits without posing a health hazard to humans.”¹¹ In reality, wireless devices and antennas typically operate well under FCC thresholds.¹²

Further, all wireless devices sold in the U.S. must go through a rigorous approval process to ensure they meet the science-based guidelines set by the FCC.¹³ The FCC’s testing regime requires cellphones to be tested under “the *most severe, worst-case (and highest power) operating conditions for all the frequency bands used in the USA for that cell phone*” to ensure that they meet the limits under everyday (non-worst-case) conditions.¹⁴ The FDA stands in full support of the adequacy of the FCC’s standards. The Director of the FDA’s Center for Devices and Radiological Health wrote in 2018: “[B]ased on our ongoing evaluation of this issue and taking into account all available scientific evidence we have received, ***we have not found sufficient evidence that there are adverse health effects in humans caused by exposures at or under the current radiofrequency energy exposure limits.***”¹⁵

HEALTH ORGANIZATIONS AND FDA STUDIES

International health organizations have also studied the effects of RF exposure and determined that there is no risk from RF emissions from modern wireless device usage. The World Health Organization (“WHO”) concludes “[c]onsidering the very low exposure levels and research results collected to date, there is no

¹¹ *Id.*; see also *Targeted Changes to the Commission’s Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields*, Resolution of Notice of Inquiry, Second Report and Order, Notice of Proposed Rulemaking, and Memorandum Opinion and Order, 34 FCC Rcd 11687, 11696 ¶14 (2019) (“Order”) (“[O]ur existing exposure limits are set with a large safety margin, well below the threshold for unacceptable rises in human tissue temperature.”).

¹² See Professor Davis Testimony (6:00-7:45) (discussing the 50-fold safety factor and typical emissions from small cells); Christopher C. Davis, Professor of Electrical and Computer Engineering, University of Maryland, *Hearing on S.B. 637 and S.B. 894 Before the Mich. H. Comm. on Energy Policy*, 2018 Leg., 99th Sess., Written Testimony at 2 (May 29, 2018), <http://www.wirelesshealthfacts.com/wp-content/uploads/2019/06/Davis-Testimony.pdf> (observing that “RF exposure levels from wireless base stations are invariably far below the FCC limits”).

¹³ See generally 47 C.F.R. § 1.1307; *id.* part 2 Subpart J; Order, 34 FCC Rcd at 11697-742 ¶¶ 17-118.

¹⁴ FCC, Consumer Guides, Health, Safety and Emergencies, *Specific Absorption Rate (SAR) for Cell Phones: What It Means for You* (emphasis in original), <https://www.fcc.gov/consumers/guides/specific-absorption-rate-sar-cell-phones-what-it-means-you> (last updated Oct. 15, 2019).

¹⁵ News Release, FDA, *Statement from Jeffrey Shuren, M.D., J.D., director of the FDA’s Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure* (Feb. 2, 2018) (“Shuren Statement”), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-recent-national>.

convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects.”¹⁶ The WHO has also concluded that “research has not been able to provide support for a causal relationship between exposure to electromagnetic fields and self-reported symptoms, or ‘electromagnetic hypersensitivity’”.¹⁷ Likewise, both the United Kingdom Health Protection Agency Independent Advisory Group on Non-Ionizing Radiation and Swedish Council for Working Life and Social Research agree that RF exposure below guideline levels consistent with FCC limits do not cause health effects.¹⁸

The majority also justifies its recommendations by referencing “the problems of brain cancers (glioblastomas and acoustic neuromas) and the issue of specific absorption rate (SAR) limits for the industry.” Some have raised questions with respect to cancer and tumors, but experts in cancer have repeatedly found no link between mobile devices and cancer. For example, the National Cancer Institute reported that: “although many studies have examined the potential health effects of non-ionizing radiation from radar, microwave ovens, cell phones, and other sources, there is currently no consistent evidence that non-ionizing radiation increases cancer risk in humans.”¹⁹ Likewise, the American Cancer Society explained that the “RF waves given off by cell phone towers don’t have enough energy to damage DNA directly or to heat body tissues. Because of this, it’s not clear how cell phone towers might be able to cause cancer.”²⁰

Earlier this year, the FDA released a large-scale review of published literature to

¹⁶ WHO, *Electromagnetic fields and public health: Base stations and wireless technologies*, Backgrounder (May 2006), <https://www.who.int/peh-emf/publications/facts/fs304/en/>.

¹⁷ WHO, *Electromagnetic fields and public health: mobile phones*, Backgrounder (Oct. 8, 2014) (“WHO Mobile Phones Fact Sheet”), <https://www.who.int/news-room/fact-sheets/detail/electromagnetic-fields-and-public-health-mobile-phones>.

¹⁸ See Health Protection Agency Independent Advisory Group on Non-Ionizing Radiation, *Health Effects from Radiofrequency Electromagnetic Fields* (RCE-20), at 3 (Apr. 2012), https://webarchive.nationalarchives.gov.uk/20140722075005/http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317133827077 (“The evidence suggests that RF field exposure below guideline levels does not cause acute symptoms in humans, and that people, including those who report being sensitive to RF fields, cannot detect the presence of RF fields.”); Anders Ahlbom, et al., *Radiofrequency Electromagnetic Fields and Risk of Disease and Ill Health: Research during the last ten years*, Swedish Council for Working Life and Social Research, at 6 (2012), <https://forte.se/app/uploads/sites/2/2015/11/10-y-rf-report.pdf> (“Extensive research for more than a decade ... has found no evidence for health risks below current exposure guidelines.”).

¹⁹ National Cancer Institute, *Cell Phones and Cancer Risk*, (Jan. 9, 2019) <https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/cell-phones-fact-sheet>.

²⁰ American Cancer Society, *Cell Phone Towers* (emphasis omitted) (“ACS Cell Phone Towers”), <https://www.cancer.org/cancer/cancer-causes/radiation-exposure/cellular-phone-towers.html> (last visited October 7, 2020).

“assess any possible causal relationship between [RF energy] exposure and the formation of tumors.”²¹ After examining approximately 125 animal studies and 70 epidemiological studies, the FDA stated that “there are no quantifiable adverse health effects in humans caused by exposures at or under the current cell phone exposure limits.”²² As Dr. Jeffrey Shuren, Director of the FDA’s Center for Devices and Radiological Health, observed in 2018: “Even with frequent daily use by the vast majority of adults, we have not seen an increase in events like brain tumors.”²³ Courts too, after hearing extensive testimony, have determined that there is “no sufficiently reliable and relevant scientific evidence in support of either general or specific causation” that cellphone use caused the plaintiff’s brain cancer.²⁴ Dr. Otis Brawley, chief medical officer of the American Cancer Society, explained that “[t]he incidence of brain tumors in human beings has been flat for the last 40 years. ... That is the absolute most important scientific fact.”²⁵

THE SCIENCE AROUND EXPOSURES FROM 5G TECHNOLOGY

The majority has expressed concern with exposures from 5G technology using millimeter wave (“mmW”) bands and on the proliferation of small cell network architecture, and whether there are studies demonstrating that 5G does not create risks to human health.

Although 5G represents a new frontier for wireless communications, mmW frequencies do not. mmW frequencies are well understood by the international scientific community. The Institute of Electrical and Electronics Engineers (“IEEE”) has assembled a list of dozens and dozens of studies on mmW frequencies. The IEEE’s RF exposure standards over the last thirty years have cited 85 different mmW studies, the earliest was published in 1976 and the most recent in 2018.²⁶

²¹ FDA, *Review of Published Literature between 2008 and 2018 of Relevance to Radiofrequency Radiation and Cancer*, at 4 (Feb. 2020), <https://www.fda.gov/media/135043/download>.

²² *Id.* at 5.

²³ Shuren Statement.

²⁴ *Newman v. Motorola, Inc.*, 218 F. Supp. 2d 769 (D. MD 2002), *aff’d per curiam Newman v. Motorola, Inc.*, 78 Fed.Appx. 292 (4th Cir. 2003); *see also Murray v. Motorola, Inc.*, Memorandum Opinion and Order on Expert Witness Admissibility, Case No. 2002 CA 001371 A (Aug. 8, 2014).

²⁵ Luran Neergaard & Seth Borenstein, *Cross talk: Federal agencies clash on cellphone cancer risk*, Associated Press (Nov. 1, 2018), <https://apnews.com/4da5f1cdfd774af29143ff3f5ccffa0b>; *see also* IEEE Std C95.1-2019 at 16 n.8 (“The preponderance of epidemiologic evidence does not provide a sufficient basis for concluding that adult brain cancer is positively associated with mobile telephone use and, by implication, with RF exposures.”).

²⁶ CTIA, Resources, *Millimeter Wave Studies Cited by IEEE*, <http://www.wirelesshealthfacts.com/wp-content/uploads/2020/01/Millimeter-Wave-Studies.pdf> (last visited October 7, 2020).

Common equipment such as “airport scanners, automotive collision avoidance systems and perimeter surveillance radar security systems” all use mmW technology.²⁷

Acting responsibly, scientists and engineers continue to research RF exposure, including RF exposure with 5G technology. IEEE’s Committee on Man and Radiation just completed a comprehensive review of 5G systems concluding that, based on the evidence to date, “the likelihood of yet unknown health hazards at exposure levels within current limits to be very low, if they exist at all.”²⁸ The authors explained that “one can expect that exposures from 5G networks will not differ greatly from those associated with present generation networks” because, like “previous generations of cellular systems: [5G must] provide a signal that is strong enough to be useful within a given cell but not so strong as to cause interference to users in nearby cells.”²⁹ In other words, 5G base stations are limited in their power because of the potential for those emissions to cause interference with other base stations.

The American Cancer Society explained that “[w]hile [5G] RF waves are higher frequency (higher energy) than those used by older generations, they are still forms of non-ionizing radiation, so they still lack the ability to directly damage DNA.”³⁰ Further, “these higher frequency RF waves are less able to penetrate the body than lower frequency waves, so in theory they might be less likely to have any potential health effects.”³¹

5G will also take advantage of small cell network architecture, which results in more base stations operating at *lower* power levels. A recent overview of exposure from small cells determined that such “[f]ixed small cell wireless communication installations ... that operate in compliance with the regulations of the FCC will produce RF exposures well within the recommended exposure limits of the FCC, ICNIRP [International Commission on Non-Ionizing Radiation Protection], and IEEE.”³² Further, “[r]esearch to date does not provide a reliable

²⁷ Joan Conrow, *Three reasons why 5G is unlikely to cause harm*, Cornell Alliance for Science, (June 26, 2020), <https://allianceforscience.cornell.edu/blog/2020/06/three-reasons-why-5g-is-unlikely-to-cause-harm/>.

²⁸ *Id.*

²⁹ *Id.*

³⁰ *ACS Cell Phone Towers*

³¹ *Id.*

³² William H. Bailey, *Wireless 5G Radiofrequency Technology: An Overview of Small Cell Exposures, Standards and*

scientific basis to conclude that the operation of these facilities will cause or contribute to adverse health effects in the population.”³³

In March 2020, ICNIRP released updated, modernized guidelines that expressly cover the new frequencies that 5G will use. Announcing their release, ICNIRP Chairman, Dr. Eric van Rongen, advised that “[t]he most important thing for people to remember is that 5G technologies will not be able to cause harm when these new guidelines are adhered to.”³⁴ The FCC’s rules are also designed to protect health and safety, and prevent harm. Indeed, the FCC notes that “the possibility that a member of the general public could be exposed to RF levels in excess of the FCC guidelines is extremely remote.”³⁵

FEDERAL PREEMPTION

The majority makes several recommendations related to mandated warnings, labeling, compliance regulations, and zoning requirements based on health and safety concerns. These recommendations are not warranted based on the science discussed above, but are also not viable because federal law preempts state and local action that conflicts with the FCC’s determination that compliant devices and equipment are safe. Congress determined that the FCC should be the “central[] authority” for regulating communications in the U.S.³⁶ This charge includes the regulation of “the kind of apparatus to be used” for wireless radio communications and “the emissions” that such equipment may produce.³⁷ The FCC promulgated its RF exposure rules to ensure that they protect human health nationwide as technology evolves, relying on sound scientific research of government and other expert organizations.

The FCC acted in its role as, in the words of the Supreme Court, the “exclusive”

Science, at 7, Exponent (Apr. 2020), <http://www.wirelesshealthfacts.com/wp-content/uploads/2020/04/Bailey-5G-Whitepaper-4-15-20.pdf>.

³³ *Id.*

³⁴ Media Release, International Commission on Non-Ionizing Radiation Protection, *New Guidelines Released by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)*, at 2 (Mar. 11, 2020), https://www.icnirp.org/cms/upload/presentations/ICNIRP_Media_Release_110320.pdf.

³⁵ FCC Consumer Guide, *Human Exposure to Radio Frequency Fields: Guidelines for Cellular Antenna Sites*, at 2 (Oct. 15, 2019), https://www.fcc.gov/sites/default/files/human_exposure_to_radio_frequency_fields_-_guidelines_for_cellular_antenna_sites.pdf.

³⁶ 47 U.S.C. § 151.

³⁷ *Id.* § 303(e).

arbiter in the “technical matters” of radio,³⁸ which includes control for any environmental effects, including, among other things, RF emissions.³⁹ For example, the FCC recognized that “very high levels of RF radiation can be harmful due to the ability of RF energy to heat biological tissue rapidly.”⁴⁰ Accordingly, the FCC’s rules *limit* RF exposure to humans “from *all* transmitting facilities, operations, and devices it regulates.”⁴¹

By way of background, the FCC first adopted RF exposure rules in the 1980s and has updated its rules in response to new scientific evidence.⁴² In 1996, Congress reaffirmed the FCC’s authority to set standards on RF emissions to provide “adequate safeguards of the public health.”⁴³ The FCC updated its RF exposure rules and relied on sound scientific research of government and other expert organizations. In particular, the FCC synthesized “submissions from the Environmental Protection Agency (“EPA”), the Food and Drug Administration (“FDA”), the Occupational Safety and Health Administration (“OSHA”), and the National Institute for Occupational Safety and Health (“NIOSH”).”⁴⁴ Several courts have examined and affirmed the FCC’s process to develop its RF exposure limits.⁴⁵ The Third Circuit observed that “the FCC is well positioned to solicit expert opinions and marshal the scientific data to ensure its standards both protect the public and provide for an efficient wireless network.”⁴⁶ And courts have confirmed that the agency has done so. For example, the D.C. Circuit upheld the

³⁸ *Head v. New Mexico Bd. of Exam’rs in Optometry*, 374 U.S. 424, 430 n.6 (1963) (observing that the “Commission’s jurisdiction over technical matters ... is clearly exclusive”).

³⁹ *Robbins v. New Cingular Wireless LLC*, 854 F.3d 315, 319-20 (6th Cir. 2017) (noting that Congress “delegate[ed] the task of setting RF emission levels to the FCC”). Of course, government entities can and have participated in the notice-and-comment aspect of the FCC’s rulemaking. See, e.g., *City of Boston, Massachusetts*, ET Docket No. 19-226 (filed June 17, 2020).

⁴⁰ FCC, RF Safety FAQ, *What Biological Effects Can Be Caused By RF Energy?*, <https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety#Q5> (last visited October 7, 2020).

⁴¹ Letter from Thomas M. Johnson, Jr., General Counsel, FCC, to Joseph H. Hunt, Assistant Attorney General, DOJ, N.D. Cal. No. C 19-05322 WHA, at 3 (Apr. 13, 2020) (citing 47 C.F.R. §§ 1.1307, 1.1310, 2.1091, 2.1093) (emphasis added), <https://docs.fcc.gov/public/attachments/DOC-363717A1.pdf>.

⁴² Letter from Thomas M. Johnson, Jr. General Counsel, FCC, to Joseph H. Hunt, Assistant Attorney General, DOJ, N.D. Cal. No. 3:15-cv-02529 EMC, at 3-5 (June 22, 2020) (examining the adoption and evolution of the Commission’s RF exposure rules).

⁴³ *Id.* at 4-5 (quoting H.R. Rep. No. 204, 104th Cong., 1st Sess. Pt. 1, at 94 (1995)).

⁴⁴ *Cellular Phone Taskforce v. FCC*, 205 F.3d 82, 88 (2d Cir. 2000).

⁴⁵ See, e.g., *id.* at 89 (rejecting an APA challenge to the FCC’s RF emissions decisions in the 1996 and 1997 proceedings).

⁴⁶ *Farina v. Nokia Inc.*, 625 F.3d 97, 126 (3d Cir. 2010); see also *id.* at 129 (confirming the Commission’s expertise to select an appropriate standard for RF limits).

agency's reliance on the views of expert agencies.⁴⁷

Every court since 2005 that has addressed this issue has held that federal law preempts state action that challenges the safety of wireless devices including zoning decisions based on safety concerns. The Telecommunications Act itself has an express preemption provision that prohibits state or local regulation of cellular equipment based on alleged health effects.⁴⁸ Courts have also struck down state law regulation of RF emissions from cell phones based on alleged health effects as impliedly preempted by the FCC's regulation.⁴⁹ And most recently, a United States District Court in the Ninth Circuit held that federal law preempts the City of Berkeley's Ordinance requiring warnings at the point of sale.⁵⁰ Preemption, therefore, would invalidate many of the Recommendations, which if adopted, would subject the state and localities to expensive challenges and litigation, and almost certain defeat.

The minority does not oppose individuals or communities who want to convert to technology that better suits their needs, so long as those decisions do not conflict with the FCC's goal of the rapid deployment of wireless technology. We also do not oppose communities providing individuals with information about how to reduce their exposure to RF emissions, consistent with what the FCC already does. While individuals should have access to equipment to measure the levels in apartments they are contemplating renting or homes they want to purchase, testing should not be mandated. Access to the testing or the equipment to conduct the test could be provided by various groups such as home inspectors, real estate agents and the county cooperative extension. Similarly, we do not agree to establishing a State funded oversight group or state funding of the measurement equipment. Nor do we believe, as a practical matter, that any of

⁴⁷ *EMR Network v. FCC*, 391 F.3d 269, 272-73 (D.C. Cir. 2004).

⁴⁸ 47 U.S.C. § 332(c)(7)(b)(iv); *See, e.g., Cellular Phone Taskforce*, 205 F.3d at 96 (interpreting the TCA to preempt a state and local government's power to regulate the placement, construction and modification of personal wireless services facilities on the basis of health effects of RF emissions); *Santa Fe Alliance for Public Health and Safety v. City of Santa Fe, N.M.*, 2020 WL 2198120, at *7 (D.N.M. May 6, 2020) (noting the TCA explicitly preempts states and local governments from considering environmental effects of RF emissions in siting decisions).

⁴⁹ *Farina*, 625 F. 3d at 129 ("there is no indication . . . that either Congress or the FCC traditionally viewed state regulation of RF emissions as a necessary complement to federal regulation"); *Murray v. Motorola, Inc.*, 982 A.2d 764, 777-778 (D.C. 2009) ("insofar as Plaintiffs' claims rest on allegations about the inadequacy of the FCC's RF radiation standard or about the safety of their FCC-certified cell phones, the claims are preempted under the doctrine of conflict preemption.").

⁵⁰ *CTIA – The Wireless Association v. City of Berkeley*, No. 15-cv-02529-EMC, 2020 WL 5576135 (N.D. Cal. Sept. 17, 2020) (holding the Berkeley Ordinance "overwarns and stands as an obstacle to the accomplishment of balancing federal objectives by the FCC.").

the Recommendations have any chance of receiving funding.

The minority feels strongly that the full body of literature of the science on wireless technology was ignored. Furthermore, the Commission neglected to carry out its mandate to study “...the advantages and risks associated with 5G technology.”⁵¹ Had this been done, the Commission would have been made aware of the significant economic and societal benefits that 5G is predicted to provide.⁵² The minority has strong concerns that should the majority’s conclusions regarding 5G safety – despite their complete odds with the overwhelmingly majority of verified scientific evidence – lead to the enactment of any of the majority’s recommendations, the citizens of New Hampshire would be deprived of the enormous benefits of wireless innovation in a time when wireless connectivity could not be more important.

⁵¹ See HB 522: http://gencourt.state.nh.us/bill_Status/billText.aspx?sy=2019&id=267&txtFormat=pdf&v=current (last visited October 14, 2020).

⁵² Accenture predicts deploying the next generation of high-speed 5G wireless networks could create up to three million jobs and add approximately \$500 billion to U.S. GDP through direct and indirect potential benefits, https://newsroom.accenture.com/content/1101/files/Accenture_5G-Municipalities-Become-Smart-Cities.pdf (last visited October 14, 2020).

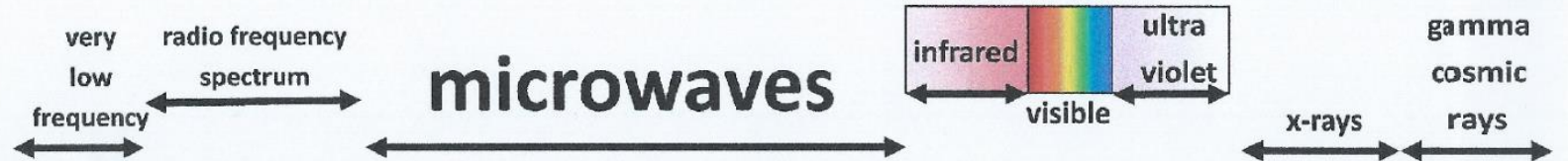
APPENDICES

THE ELECTROMAGNETIC SPECTRUM

SELF ELF VLF LF/ MF/ HF/ VHF/ UHF SHF EHF
 30KHz 3GHz 5GHz 300GHz 430-750THz 30PHz 3EHZ 300EHZ



$$f \text{ (frequency)} = \frac{C \text{ (speed of light)}}{\lambda \text{ (wavelength)}}$$



CRT monitors TV mobile AM/FM cell phones cell towers WiFi wireless smart meters microwave ovens baby monitors cordless phones satellites sunlight medical x-rays radioactive sources

9 Terahertz (THz) 10-12 Petahertz (PHz) 10-15 Exahertz (EHz) 10-18 Zetahertz (ZHz) 10-21 Yotahertz (YHz) 10-24

Appendix B

Correspondence with federal agencies

Correspondence between Councilwoman Denise Ricciardi, a member of the New Hampshire Commission on 5G, and Dr. Barrington and Dr. Hoover of the National Cancer Institute

Begin forwarded message:

From: NCI Information <nciinfo@nih.gov>

Date: July 30, 2020 at 2:51:16 PM EDT

To: New Bedford Councilmember Denise Ricciardi of the New Hampshire 5G Commission

Subject: Important questions that need to be answered.

Reply-To: "NCI Information" <nciinfo@nih.gov>

Subject: Important questions that need to be answered.

Response By Email (NCI Agent) (07/30/2020 11:51 AM)

Dear Ms. Ricciardi:

I received your follow-up inquiry requesting an answer to each question listed in your email. Please see below:

Councilmember Denise Ricciardi - Question 1. What is the National Cancer Institute opinion on the safety of 5G, 4G and cell towers? If you have one, please share your scientific documentation.

Response from the National Cancer Institute:

As a Federal research agency, the NCI is not involved in the regulation of radiofrequency telecommunications infrastructure and devices, nor do we make recommendations for policies related to this technology. The Food and Drug Administration (FDA) and the Federal Communications Commission (FCC) are the responsible federal agencies with authority to issue opinions on the safety of these exposures. Rather, NCI gathers and reviews published findings of well-conducted studies with a focus on cancer in humans in the medical literature and makes summaries available on its website and fact sheets.

[According to the FCC](#) certain agencies in the Federal Government have been involved in monitoring, researching or regulating issues related to human exposure to radiofrequency radiation. These agencies include the FDA, the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safe and Health (NIOSH), the National Telecommunications and Information Administration (NTIA) and the Department of Defense (DOD).

Councilmember Denise Ricciardi - Question 2. Has NCI staff done a systematic research review of the research on wireless radiation?

Response from the National Cancer Institute:

Experts at the NCI review the research on radiofrequency radiation and other types of non-ionizing radiation electromagnetic fields (EMFs) in order to maintain our fact sheets on these topics. Other federal agencies have the responsibility to formally review the research on these exposures, specifically the FDA and FCC.

Councilmember Denise Ricciardi - Question 3. What is the NCI opinion on the safety of cell phones? If you have one, please share your scientific documentation.

Response from the National Cancer Institute:

The FDA and FCC are the responsible federal agencies with authority to issue opinions on the safety of these exposures. As a Federal research agency, the NCI is not involved in the regulation of radiofrequency telecommunications infrastructure and devices, nor do we make recommendations for policies related to this technology.

The NCI gathers and reviews published findings of well-conducted studies in the medical literature on cell phones and cancer risk. The NCI fact sheet "[Cell Phones and Cancer Risk](#)" outlines the available evidence from human and animal studies regarding cancer risk and cell/mobile telephones. It includes references and the citations are at the bottom of the document.

Councilmember Denise Ricciardi - Question 4. Does the NCI recommend that parents teach their children to reduce exposure to cell phone radiation? Does the NCI think it is not necessary to take precautions and that information on reducing exposure is only for "concerned" people? Or does the NCI recommend all parents educate their children to reduce exposure and that they themselves reduce exposure to their children?

Response from the National Cancer Institute:

As noted above, the NCI does not make recommendations or issue guidelines. The fact sheet "Cell Phones and Cancer Risk" does include information from the FDA about ways cell phone users—children, teenagers or adults—can reduce their exposure to radiofrequency radiation. The FDA suggests that cell phone users reserve the use of cell phones for shorter conversations or for times when a landline phone is not available; and use a device with hands-free technology, such as wired headsets, which place more distance between the phone and the head of the user.

Councilmember Denise Ricciardi - Question 5. Did the NCI review in a systematic way the research on impacts of wireless and cell towers to trees and plants? If not, what agency is responsible for ensuring wireless signals are safe for trees and plants?

Response from the National Cancer Institute:

The NCI is not charged with researching the impact of wireless technology and cell towers on trees and plants. NCI is not aware of any Federal agency mandated to

ensure wireless signals are safe for trees and plants.

Councilmember Denise Ricciardi - Question 6. Did the NCI review in a systematic way the research on cell towers and how wireless antennas impact birds. If not, what agency is responsible for ensuring wireless signals are safe for birds?

Response from the National Cancer Institute:

The NCI is not charged with researching the impact of wireless technology and cell towers on birds. The NCI is not aware of any Federal agency mandated to ensure wireless signals are safe birds.

Councilmember Denise Ricciardi - Question 7. Did the NCI review in a systematic way the research on impact to bees and insects. If not, what agency is responsible for ensuring wireless signals are safe for insects and bees?

Response from the National Cancer Institute:

The NCI is not charged with researching the impact of wireless technology on bees and other insects. The NCI is not aware of any Federal agency mandated to ensure wireless signals are safe for bees and other insects.

Councilmember Denise Ricciardi - Question 8. Does the NCI only focus on cancer as a health effect?

Response from the National Cancer Institute:

Yes. In addition, by law, U.S. population-based cancer registries must collect information on benign brain tumors and the NCI fact sheet “Cell Phones and Cancer Risks” describes findings for meningioma, acoustic neuroma and other benign brain and central nervous system tumors.

Councilmember Denise Ricciardi - Question 9. The NCI does not present the findings of the NTP as “clear evidence of cancer” but simply states of the findings that “The primary outcomes observed were a small number of cancers of Schwann cells in the heart and non-cancerous changes (hyperplasia>) in the same tissues for male rats, but not female rats, nor in mice overall.” Why doesn’t the NCI present the findings of DNA damage on their webpage as it is published and was found in rats and mice. In addition cardiomyopathy was found. Why isn’t this presented on the NCI webpage?

Response from the National Cancer Institute:

The focus of the fact sheet “Cell Phones and Cancer Risk” is limited to cancer risk. As you noted, the fact sheet provided an overview of the primary outcomes found in the National Toxicology Program (NTP) study. These findings are reported on the [NTP website](#). A link to this information was included in the fact sheet for those who wish to know more about the NTP study.

Councilmember Denise Ricciardi - Question 10. The FDA disagrees with the National Toxicology Program findings of clear evidence of cancer. What is the NCI position on the determination of “clear evidence”?

Response from the National Cancer Institute:

The NCI does not comment on the cancer evaluation criteria of other organizations or how researchers use these definitions in their analysis. You may find useful [a critical evaluation of the NTP study](#) that was conducted by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Councilmember Denise Ricciardi - Question 11. Is there evidence that heating can cause cancer? That elevated temperatures can induce cancer?

Response from the National Cancer Institute:

There is [no current evidence that elevated temperatures or heating](#) is a risk factor for cancer.

Councilmember Denise Ricciardi - Question 12. Has the NCI reviewed in a systematic way the research on impacts to the nervous system?

Response from the National Cancer Institute:

The NCI fact sheet on “Cell Phones and Cancer Risk” provides a summary review of most epidemiologic studies of cell phone use and brain and other central nervous system tumors. Most of the studies are case-control studies. Details are provided on the three most impactful studies, including the 13-country, case-control Interphone study, the large national Danish cohort study, and the Million Women United Kingdom cohort study.

Councilmember Denise Ricciardi - Question 13. Does the NCI believe the current limits protect the public, children, pregnant women and medically vulnerable from health effects after long term exposure. Please provide documentation for each group, children, pregnant women and medically vulnerable that shows research ensuring safety.

Response from the National Cancer Institute:

The NCI does not regulate issues related to human exposure to radiofrequency radiation.

Councilmember Denise Ricciardi - Question 14. We know that the NCI is aware that cell phones can violate FCC SAR limits at body contact on high power. The FDA has written that because there is a safety factor. What is the safety factor for the SAR the FDA relies on? Do you know?

Response from the National Cancer Institute:

The FDA shares regulatory responsibilities for cell phones with the FCC. The FCC certifies wireless devices, and all phones that are sold in the United States must comply with FCC guidelines on radiofrequency exposure. The FDA also has the authority to take action if cell phones are shown to emit radiofrequency energy at a level that is hazardous to the user.

In addition, the FDA is responsible for protecting the public from harmful radiation

emissions from consumer products such as microwave ovens, televisions, and computer monitors. You may wish to contact the FDA's Center for Devices and Radiological Health's Office of Compliance at 301-594-4654, for information about SAR guidelines used in cell phones.

Councilmember Denise Ricciardi - Question 15. Will the NCI be taking action to inform the public about this? If not, please explain why not.

Response from the National Cancer Institute:

NCI staff are committed to regularly reviewing the published findings of well-conducted studies on cancer and making them available on a timely basis to the public through our online fact sheets. As noted above, the NCI continues to make this information available on its website [Cancer.gov](https://www.cancer.gov), the Institute's primary resource in informing the public about cancer research. The NCI gathers and reviews published findings of well-conducted studies in the medical literature on cell phones and cancer risk. The NCI fact sheet "Cell Phones and Cancer Risk" outlines the available evidence from human and animal studies regarding cancer risk and cell/mobile telephones. As also noted above, the NCI has conducted a review of the research on radiofrequency radiation

and other types of non-ionizing radiation electromagnetic fields (EMFs), available in the fact sheet

"Electromagnetic Fields and Cancer." NCI will continue to update these factsheets as new relevant studies are published in the peer-reviewed literature.

Our sister agencies, the FDA as well as the FCC, retain responsibility for reviewing guidance on safety concerns and informing the public if those circumstances change.

Councilmember Denise Ricciardi - Question 16. What actions specifically is the NCI doing now in regards to 5G and cell phone radiation in terms of research review?

Response from the National Cancer Institute:

As noted above, the NCI regularly reviews the published findings of studies on cancer and makes them available to the public.

Additionally, given the multi-year latency of brain tumors and most other solid tumors and the need to carefully consider the optimal study design, it would be premature to begin development of a protocol for studying the relation between 5G exposures and cancer risk before 5G systems are implemented. We are in close communication with other epidemiologists and dosimetrists working on radiofrequency exposures and cancer risks. We continue to carefully monitor research in this area.

Councilmember Denise Ricciardi - Question 17. Does the NCI evaluate the safety of 5G cell antennas? If so how? If not, what health agency is ensuring that 5G cell antennas are safe for people, wildlife and trees.

Response from the National Cancer Institute:

The FCC is responsible for developing guidelines for human exposure to

radiofrequency electromagnetic fields, which includes antennas.

Councilmember Denise Ricciardi - Question 18. Cell phones and wireless devices emit several types of nonionizing radiation in addition to radiofrequency radiation. For example the devices emit magnetic fields and when a pregnant woman holds a laptop on her lap the measured fields can be high even into the baby. What agency ensures safety related to extremely low frequency (ELF-EMF) electromagnetic fields- also nonionizing? Currently we have no federal limit, no federal guidelines and confirmed associations with cancer and many other health effects. Kaiser Permanente researchers have published several studies linking pregnant women's exposure to magnetic field electromagnetic fields to not only increased miscarriage and but also increased ADHD , obesity and asthma in the woman's prenatally exposed children. A recent large-scale study again found associations with cancer. Where is the NCI presentation of this research for the public?

Response from the National Cancer Institute:

As noted above, the FDA is responsible for protecting the public from radiation emissions from consumer products such as microwave ovens, televisions, and computer monitors. You may wish to contact the FDA's Center for Devices and Radiological Health's Office of Compliance at 301-594-4654, for information about research on this topic.

Our sister institute, [National Institute of Child Health and Human Development \(NICHD\)](#) another part of the NIH, investigates human development throughout the entire life process, with a focus on understanding disabilities and important events that occur during pregnancy. You may wish contact to the NICHD for information about radiofrequency radiation exposure and human development. NICHD can be contacted by email at NICHDInformationResourceCenter@mail.nih.gov <mailto:NICHDInformationResourceCenter@mail.nih.gov>.

NCI staff are committed to regularly reviewing the published findings of well-conducted studies on cancer and making them available on a timely basis to the public through our online fact sheets.

Councilmember Denise Ricciardi - Question 19. Will the NCI be sharing and recommending how to reduce ELF- EMF Exposure? Please clarify which US agency has jurisdiction over ELF-EMF exposures? Please clarify which US agency has authority to set limits for ELF-EMF exposures? As far as we know there is no limit in the USA for this type of exposure.

Response from the National Cancer Institute:

According to the fact sheet [“Electromagnetic Fields and Cancer”](#) sources of ELF-EMFs include power lines, electrical wiring, and electrical appliances such as shavers, hair dryers, and electric blankets.

As noted above, the NCI is not responsible for setting limits for ELF-EMF or any other exposure. Manufacturers of electronic radiation emitting products sold in the United States are responsible for compliance with the [Federal Food, Drug and Cosmetic Act \(FD&C Act\), Chapter V](#)

[Subchapter C - Electronic Product Radiation Control.](#)

The U.S. Congress created the National Institute of Environmental Health Sciences' (NIEHS) EMF Research and Public Information Dissemination (RAPID) Program in 1992 to study whether exposure to EMFs produced by the generation, transmission, or use of electric power posed a risk to human health. Although this program has ended, the NIEHS continues to study EMFs. For more information, please see [the NIEHS website.](#)

Councilmember Denise Ricciardi - Question 20. Who are the NCI staff who have expertise on this issue at the NCI? What NCI staff is in the Interagency workgroup and where can we access the minutes and work of this group?

Response from the National Cancer Institute:

The content on the NCI's website [Cancer.gov](#) related to this topic is authored and maintained by NCI staff. The information on this site is science-based, authoritative, and up to date. Medical experts, cancer researchers, and editors review the content before it is published to the website.

Within the NCI, several research divisions conduct or fund extramural research to discover the genetic and environmental determinants of cancer and new approaches to cancer prevention, including the impacts of ionizing and nonionizing radiation. Epidemiologists also monitor cancer incidence trends for potentially relevant malignancies using U.S.-based cancer registries such as the North American Association of Central Cancer Registries and the Surveillance, Epidemiology, and End Results Program, and periodically review the scientific peer-reviewed literature in this area.

If you are compiling a list of EMF experts to contact, it is important to note that NCI scientists receive many requests for interviews or for advice with projects. All such inquiries should be directed to the NCI Office of Communications and Public Liaison through the NCI contact [page< mailto:https://www.cancer.gov/contact>](mailto:https://www.cancer.gov/contact) ; found on [Cancer.gov.](#)

Councilmember Denise Ricciardi - Question 21. The FCC decided not to update their limits on wireless but the NCI did not submit an opinion to the FCC. Why not?

Response from the National Cancer Institute:

As noted above, the NCI does not make recommendations for policies on wireless technology.

Councilmember Denise Ricciardi - Question 22. Will the NCI be submitting an opinion to the FCC about the higher frequencies to be used in 5G?

Response from the National Cancer Institute:

As noted above, the NCI does not make recommendations for policies on wireless technology.

Councilmember Denise Ricciardi - Question 23. The American Cancer Society funded research by Yale that found cancer after cell phone radiation exposure. See it here [Thyroid Cancer, Genetic Variations, and Cell Phones Linked in New Yale School of Public Health Study](#) What is the NCI opinion?

Response from the National Cancer Institute:

NCI staff are committed to regularly reviewing the published findings of well-conducted studies on cancer and making them available on a timely basis to the public through our online fact sheets.

Councilmember Denise Ricciardi Question 24. Will you be updating your webpage with information on thyroid cancer and on genetic susceptibility as found by the Yale study?

Response from the National Cancer Institute:

Response from the National Cancer Institute: NCI staff are committed to regularly reviewing the published findings of well-conducted studies on cancer and making them available on a timely basis to the public through our online fact sheets.

Sincerely yours,
Bill Robinson
Office of Communications and Public Liaison National Cancer Institute

Customer By CSS Email (Denise Ricciardi) (07/19/2020 06:55 AM)

Hello,

You did not satisfy the commission. We requested you answer each question point by point. Not a paragraph that does NOT properly answer the questions.

Please go back and answer the questions number one provide the answer number two provide the answer and so on. Please expedite this request, it is urgent for commission.

Thank you,

Denise Ricciardi

Subject: Important questions that need to be answered.

Response By Email (NCI Agent) (07/16/2020 11:39 AM)

Dear Ms. Ricciardi:

Your email to Dr. Amy Berrington and Dr. Robert Hoover of the National Cancer Institute (NCI) regarding 5G has been forwarded to this office for reply. In your email, you asked questions about the status of research of the health and environmental effects of 5G (fifth-generation) wireless network technology on people and the natural world and which Federal agencies regulate this technology. We can offer information that you may find useful.

The NCI, part of the National Institutes of Health, is the Federal government's principal agency for cancer research and training. Part of the NCI's mission includes gathering and disseminating information about cancer, including risk factors, to the public and medical community through its website, fact sheets, and the NCI's Cancer Information Service (CIS). The fact sheets "Cell Phones and Cancer Risk" and "Electromagnetic Fields and Cancer" outline the available evidence from human and animal studies regarding cancer risk and cellular/mobile telephones and low- to medium-frequency electromagnetic fields.

The National Toxicology Program (NTP) investigated the health effects in animals exposed to radiofrequency (RF) radiation modulations used in 2G and 3G cell phones. According to the lead toxicologist of the studies, Michael Wyde, Ph.D., "5G is an emerging technology that hasn't really been defined yet. From what we currently understand, it likely differs dramatically from what we studied." This comment can be found in the NIH news release about the NTP final reports.

The NCI is committed to reviewing published findings of well-conducted studies in the medical literature and making them available to the public. Sometimes the results of a research study can yield inconsistent and even unanticipated results. Nonetheless, in this way, hypotheses are thoroughly evaluated.

As a Federal research agency, the NCI does not regulate RF electromagnetic field (EMF) exposure or establish guidelines. Within the Federal government, the U.S. Federal Communications Commission (FCC) authorizes or licenses most RF telecommunications services, facilities, and devices used by the public, industry and state and local governmental organizations. The FCC is required by the National Environmental Policy Act of 1969, among other things, to evaluate the effect of EMF emissions from FCC-regulated transmitters on the quality of the human environment. This includes cell phones and towers. The FCC Policy on Human Exposure web page includes links to several organizations that have recommendations for human exposure to EMF.

In addition, the U.S. Food and Drug Administration (FDA) shares regulatory responsibilities for cell phones with the FCC. Although cell phones can be sold without FDA clearance or approval, the agency monitors the effects the phones have on health. The FDA has the authority to take action if cell phones are shown to emit RF energy at a level that is hazardous to the user. The FDA recently provided an updated assessment of the current limits of RF energy based on the currently available scientific evidence (see Letter from the FDA to the FCC on Radiofrequency Exposure).

Sincerely yours,

Bill Robinson

Office of Communications and Public
Liaison National Cancer Institute

Customer By CSS Email (Denise Ricciardi) (07/10/2020 07:25 AM)

Hello,

I serve in New Hampshire on a health study commission. We need these questions answered each one, one by one.

Questions to Dr. Barrington and Dr. Hoover of the National Cancer Institute

1. What is the National Cancer Institute opinion on the safety of 5G, 4G and cell towers? If you have one please share your scientific documentation.
2. Has NCI staff done a systematic research review of the research on wireless radiation?
3. What is the NCI opinion on the safety of cell phones? If you have one please share your scientific documentation.
4. Does the NCI recommend that parents teach their children to reduce exposure to cell phone radiation? Does the NCI think it is not necessary to take precautions and that information on reducing exposure is only for "concerned" people? Or does the NCI recommend all parents educate their children to reduce exposure and that they themselves reduce exposure to their children?
5. Did the NCI review in a systematic way the research on impacts of wireless and cell towers to trees and plants? If not what agency is responsible for ensuring wireless signals are safe for trees and plants? 6. Did the NCI review in a systematic way the research on cell towers and how wireless antennas impact birds. If not, what agency is responsible for ensuring wireless signals are safe for birds?
7. Did the NCI review in a systematic way the research on impact to bees and insects. If not, what agency is responsible for ensuring wireless signals are safe for insects and bees?
8. Does the NCI only focus on cancer as a health effect?
9. The NCI does not present the findings of the NTP as "clear evidence of cancer" but simply states of the findings that "The primary outcomes observed were a small number of cancers of Schwann cells in the heart and non-cancerous changes (hyperplasia) in the same tissues for male rats, but not female rats, nor in mice overall." Why doesn't the NCI present the findings of DNA damage on their webpage as it is published and was found in rats and mice. In addition cardiomyopathy was found. Why isn't this presented on the NCI webpage?
10. The FDA disagrees with the National Toxicology Program findings of clear evidence of cancer. What is the NCI position on the determination of "clear evidence"?
11. Is there evidence that heating can cause cancer? That elevated temperatures can induce cancer?
12. Has the NCI reviewed in a systematic way the research on impacts to the nervous system?
13. Does the NCI believe the current limits protect the public, children, pregnant women and

medically vulnerable from health effects after long term exposure. Please provide documentation for each group, children, pregnant women and medically vulnerable that shows research ensuring safety.

14. We know that the NCI is aware that cell phones can violate FCC SAR limits at body contact on high power. The FDA has written that because there is a safety factor. What is the safety factor for the SAR the FDA relies on? Do you know?
15. Will the NCI be taking action to inform the public about this? If not, please explain why not.
16. What actions specifically is the NCI doing now in regards to 5G and cell phone radiation in terms of research review?
17. Does the NCI evaluate the safety of 5G cell antennas? If so how? If not, what health agency is ensuring that 5G cell antennas are safe for people, wildlife and trees.
18. Cell phones and wireless devices emit several types of non ionizing radiation in addition to radiofrequency radiation. For example the devices emit magnetic fields and when a pregnant woman holds a laptop on her lap the measured fields can be high even into the baby. What agency ensures safety related to extremely low frequency (ELF-EMF) electromagnetic fields- also non ionizing? Currently we have no federal limit, no federal guidelines and confirmed associations with cancer and many other health effects. Kaiser Permanente researchers have published several studies linking pregnant women's exposure to magnetic field electromagnetic fields to not only increased miscarriage and but also increased ADHD, obesity and asthma in the woman's prenatally exposed children. A recent large scale study again found associations with cancer. Where is the NCI presentation of this research for the public?
19. Will the NCI be sharing and recommending how to reduce ELF- EMF Exposure? Please clarify which US agency has jurisdiction over ELF-EMF exposures? Please clarify which US agency has authority to set limits for ELF-EMF exposures? As far as we know there is no limit in the USA for this type of exposure.
20. Who are the NCI staff who have expertise on this issue at the NCI? What NCI staff is in the Interagency workgroup and where can we access the minutes and work of this group?
21. The FCC decided not to update their limits on wireless but the NCI did not submit an opinion to the FCC. Why not?
22. Will the NCI be submitting an opinion to the FCC about the higher frequencies to be used in 5G.
23. The American Cancer Society funded research by Yale that found thyroid cancer after cell phone radiation exposure. See it here: <https://medicine.yale.edu/news-article/22332/> <https://protect-us.mimecast.com/s/K3TvCmZnOMf1oANt4> What is the NCI opinion?
24. Will you be updating your webpage with information on thyroid cancer and on genetic susceptibility as found by the Yale study?

Thank you for your cooperation.
Denise Ricciardi

Letters between Councilwoman Denise Ricciardi, a member of the New Hampshire Commission on 5G, and Dr. Shuren of the FDA

Note: The FDA did not answer the questions as asked and did not respond to the request to testify to the Commission

- June 23, 2020 Denise Ricciardi writes the FDA a detailed list of questions regarding their statements about cell phone radiation.
- Jul 15, 2020 FDA writes Denise Ricciardi a short two paragraphs that does not answer the questions.
- July 15, 2020 Denise Ricciardi writes back to the FDA stating that her questions are not answered.
- No additional answers have been provided by the FDA.
- March 2, 2020: The FDA also did not respond to the March 2020 request to testify to the 5G Commission.

July 15, 2020 Denise Ricciardi to the FDA

Hello,

This does not answer our specific numbered questions. Please go back and revisit the questions as requested.

Thank you,

Denise Ricciardi

On Jul 15, 2020, at 5:31 PM, Meister, Karen G <Karen.Meister@fda.hhs.gov> wrote:

July 15, 2020 Letter from FDA to Councilwoman Denise Ricciardi of the New Hampshire Commission on 5G

On Jul 15, 2020, at 5:31 PM, Meister, Karen G

Karen.Meister@fda.hhs.gov > wrote:

Dear Ms. Ricciardi,

Thank you for contacting the Food & Drug Administration (FDA) with your concerns regarding exposure to non-ionizing electromagnetic energy. Your inquiry was forwarded to the Intergovernmental Affairs (IGA) team in the Office of the Commissioner. We understand that you are a member of New Hampshire's "Commission to Study the Environmental and Health Effects of Evolving 5G Technology," and that you are gathering information.

As you may know, FDA shares regulatory responsibilities for cell phones with the Federal

Communications Commission (FCC). Under the law, FDA is responsible for, among other things: consulting with other federal agencies on techniques and programs for testing and evaluating electronic product radiation and collecting, analyzing, and making available scientific information on the nature and extent of the hazards and control of electronic product radiation. FDA's website provides information about cell phones, including the Agency's current assessment on the safety of exposure to non-ionizing electromagnetic fields. See <https://www.fda.gov/radiation-emitting-products/home-business-and-entertainment-products/cell-phones> The website includes an update to the scientific evidence evaluated by FDA (see [https:// www.fda.gov/radiation-emitting-products/cell-phones/scientific-evidence-cell-phone-safety](https://www.fda.gov/radiation-emitting-products/cell-phones/scientific-evidence-cell-phone-safety), as well as suggestions for those that may still be concerned about non-ionizing energy exposure (see <https://www.fda.gov/radiation-emitting-products/cell-phones/reducing-radio-frequency-exposure-cell-phones>).

FDA's doctors, scientists and engineers continually monitor the scientific studies and public health data for evidence that radio frequency energy from cell phones could cause adverse health effects. FDA also works with national and international health agencies to ensure the weight of scientific evidence is appropriately evaluated.

We hope this information is helpful to answer your questions. Best regards.

Karen Meister, J.D.
Acting Director, Intergovernmental Affairs
Senior Advisor, Office of Legislation
Office of the Commissioner/OPPLIA
U.S. Food and Drug Administration
(301) 796-8916 office
(240) 494-6228 (work cell)

From: "Shuren, Jeff" <Jeff.Shuren@fda.hhs.gov >
Date: June 24, 2020 at 4:28:49 PM EDT
To: Denise Ricciardi
Cc: OC Ombudsman <Ombuds@OC.FDA.GOV >, Patrick Abrami <abrami.nhrep@gmail.com >
Subject: RE: Important questions NEED to be answered for N.H. 5G health task commission

Thank you for reaching out to me. I have forwarded your questions to the FDA's Intergovernmental Affairs Staff who handles inquiries from State and local governments. I have included Karen Meister, their Acting Director, on this email, as well.

Best regards, Jeff

---Original Message

From: Denise Ricciardi
Sent: Tuesday, June 23, 2020 10:38 PM
To: Shuren, Jeff <Jeff.Shuren@fda.hhs.gov <[mailto: Jeff.Shuren@fda.hhs.gov](mailto:Jeff.Shuren@fda.hhs.gov) >>
Cc: OC Ombudsman <Ombuds@OC.FDA.GOV <[mailto: Ombuds@OC.FDA.GOV](mailto:Ombuds@OC.FDA.GOV) >>;
Patrick Abrami <abrami.nhrep@gmail.com <[mailto: abrami.nhrep@gmail.com](mailto:abrami.nhrep@gmail.com) >>

Subject: Important questions NEED to be answered for N.H. 5G health task commission

Dear Dr. Shuren,

We would appreciate an answer to these questions regarding cell phone radiation. If you could number them one by one it would help with clarity of your response.

Regarding the FDA's report [“Review of Published Literature between 2008 and 2018 of Relevance to Radiofrequency Radiation and Cancer”](#)

1. Why did the FDA only focus on cancer as a health effect?
2. The FDA said of the National Toxicology Program findings that the FDA was unsure if the tumors were a causal effect or if these results were “due to weakening of the immune response due to animal stress from cyclic heating and thermoregulation.” Does the FDA think that cancer could be an effect of whole body heating, that cancer is a thermally induced effect? If so, what other studies show that heating causes cancer?
3. Did the FDA review in a systematic way the research on impacts to the nervous system?
4. At the Commission, a study on how millimeter waves interact with insects was discussed. Did the FDA review in a systematic way the research on impact to bees, insects and pollinators?
5. Did the FDA review in a systematic way the research on impact to trees and plants?
6. Did the FDA review in a systematic way the research on impact to birds.
7. If the FDA did not investigate impacts to insects or trees, what US agencies have done so?
8. The FDA website page [Scientific Evidence for Cell Phone Safety](#) has a section entitled “No New implications for 5G”. Does the FDA believe that 5g is safe or that 5G has the same health issues as 3 and 4G? What is the FDA opinion on the safety of wireless?
9. What is the FDA opinion on FCC limits in terms of long term health effects. Does the FDA believe the current limits protect the public, children, pregnant women and medically vulnerable from health effects after long term exposure.
10. The FDA is aware that cell phone can violate FCC SAR limits at body contact on high power. The FDA has written that because there is a safety factor. What is the safety factor for the SAR the FDA relies on. At what SAR level above FCC limits will the FDA intervene?
11. What actions specifically is the FDA doing now in regards to 5G and cell phone radiation in terms of research review? How often will the FDA be releasing reports?
12. Will the FDA be evaluating the safety of 5G cell antennas? If so how? If not, what health agency is ensuring that 5G cell antennas are safe for people, wildlife and trees.
13. Cell phones and wireless devices emit several types of non ionizing radiation in addition to radiofrequency radiation. For example the devices emit magnetic fields and when a pregnant woman holds a laptop on her lap the measured fields can be high even into the baby. What agency ensures safety related to extremely low frequency (ELF-EMF)

electromagnetic fields- also non ionizing? Currently we have no federal limit, no federal guidelines and confirmed associations with cancer and many other health effects. Kaiser Permanente researchers have published several studies linking pregnant women's exposure to magnetic field electromagnetic fields to not only [increased miscarriage](#) and but also [increased ADHD](#), [obesity](#) and [asthma](#) in the woman's prenatally exposed children. A [recent large-scale study](#) again found associations with cancer. Please clarify which US agency has jurisdiction over ELF-EMF exposures?

14. Will the FDA be initiating any research studies on 5G and health effects?

We as a health study commission on 5G take these duties very seriously. We are unbiased and we are seeking all answers and facts. We are requiring your answers to the above questions.

Thank you,
Denise Ricciardi
Committee Member appointed by Governor Sununu.

Additional Emails related to the questions:
From: "Meister, Karen G" <Karen.Meister@fda.hhs.gov>

Date: July 14, 2020 at 2:12:10 PM EDT To: Denise Ricciardi

Subject: FW: Important [External]

Hi Ms. Ricciardi-

We apologize for not responding sooner. Dr. Shuren forwarded your inquiry to our office because the Intergovernmental Affairs staff in the Office of the Commissioner handles inquiries from state and local governments like yours. We hope to get you a response very shortly. Thank you for your patience.

Karen
Karen Meister, J.D.
Acting Director, Intergovernmental Affairs
Senior Advisor, Office of Legislation
Office of the Commissioner/OPPLIA
U.S. Food and Drug Administration
(301) 796-8916 office
(240) 494-6228 (work cell)
(703) 201-6952 (personal cell- I will call you back on work phone)

Original Message
From: Denise Ricciardi
Sent: Tuesday, July 14, 2020 9:08 AM
To: Shuren, Jeff <Jeff.Shuren@fda.hhs.gov>
Cc: Patrick Abrami
Subject: Important

We have received no answers for our questions for the 5G health study commission in New Hampshire. Please advise!

Original Message

From: Denise Ricciardi

To: CDRHSpeakerLiaison@fda.hhs.gov <CDRHSpeakerLiaison@fda.hhs.gov>;
jeff.shurren@fda.hhs.gov
lyndsay.loud@fda.hhs.gov
<jeff.shurren@fda.hhs.gov>

Cc: Patrick.Abrami@

Subject: Study commission HB522 New Hampshire

Sent: Wed, Mar 4, 2020 2:43 pm

Good afternoon,

Governor Sununu in the State of New Hampshire has tasked a group of us to study the health effects of the 5G rollout.

We are composed of a wide variety of talents. Including Physicians, toxicologists, scientists, epidemiologists, physicists, engineers, the telecom industry and more.

We have been meeting since last October and have had many experts provide testimony.

To complete our findings in an unbiased fashion. It is essential to have a qualified member of the FDA and the FCC present to our commission.

We are making history in New Hampshire. Many other States are watching. Our results will have a profound effect.

When can we count on your participation on such an important issue.

Thank you,
Denise Ricciardi

Appendix C

Answers to the specific questions posed by HB 522

1. Why does the insurance industry recognize wireless radiation as a leading risk and has placed exclusions in their policies not covering damages caused by the pathological properties of electromagnetic radiation?

As [shared](#) with the Commission, insurers rank 5G, wireless, and electromagnetic radiation as high risk based on their white papers which compare the risk to asbestos where it may take decades to know the full extent of health impacts.

Scarato shared a 2019 report by Swiss Re Institute⁵³ which classifies 5G mobile networks as an "off-the-leash" "HIGH" risk, meaning a high-impact emerging risk that will affect property and casualty claims in more than three years' time. The Swiss Re report states on page 29:

To allow for a functional network coverage and increased capacity overall, more antennas will be needed, including acceptance of higher levels of electromagnetic radiation. In some jurisdictions, the rise of threshold values will require legal adaptation. Existing concerns regarding potential negative health effects from electromagnetic fields (EMF) are only likely to increase. An uptick in liability claims could be a potential long-term consequence.

Potential impacts:

- Cyber exposures are significantly increased with 5G, as attacks become faster and higher in volume. This increases the challenge of defense.
- Growing concerns of the health implications of 5G may lead to political friction and delay of implementation, and to liability claims. The introductions of 3G and 4G faced similar challenges.

⁵³ Swiss Re Institute, [New Emerging Risk Insights](#), 2019

- Information security and national sovereignty concerns might delay implementation of 5G further, increasing uncertainty for planning authorities, investors, tech companies and insurers.
- Heated international dispute over 5G contractors and potential for espionage or sabotage could affect international cooperation, and impact financial markets negatively.
- As the biological effects of EMF in general and 5G in particular are still being debated, potential claims for health impairments may come with a long latency.

A Business Insurance analysis⁵⁴ also examined mass tort exposures that may have the potential to cause major difficulties for commercial policyholders and their insurers. It includes workers' overexposure to radio frequency waves from rooftop wireless transmitters as a potential future claim and states that research "has shown biological effects from lower-level 'nonthermal' exposure, and people exposed at lower levels have reported headache, dizziness, nausea, mood disorders, mental slowing, and memory loss." Most insurance plans do not cover electromagnetic fields (EMF) and they have "electromagnetic field exclusions."

For example the [California State University Risk Management Authority \(CSURMA\) Self Insured Program](#) states:

We will not pay for loss or damage caused by or resulting from any of the following:

...

Artificially generated electrical, magnetic or electromagnetic energy that damages, disturbs, disrupts or otherwise interferes with any: (1) Electrical or electronic wire, device, appliance, system or network; or (2) Device, appliance, system or network utilizing cellular or satellite technology. But if fire results, we will pay for the loss or damage caused by that fire if the fire would be covered under this coverage form. For the purpose of this exclusion, electrical, magnetic or electromagnetic energy includes but is not limited to: (1) Electrical current, including arcing; (2) Electrical charge produced or conducted

⁵⁴ BusinessInsurance.com, "[The Next Asbestos: Five emerging risks that could shift the liability landscape](#)," May 13, 2011.

by a magnetic or electromagnetic field; (3) Pulse of electromagnetic energy; or (4) Electromagnetic waves or microwaves.

Even AT&T Mobile Insurance⁵⁵ excludes loss from pollutants. Their policy states, "Pollutants" means: Any solid, liquid, gaseous, or thermal irritant or contaminant including smoke, vapor, soot, fumes, acid, alkalis, chemicals, artificially produced electric fields, magnetic field, electromagnetic field, sound waves, microwaves, and all artificially produced ionizing or non- ionizing radiation and waste."

Crown Castle states in their [2020 Annual Report](#):

If radio frequency emissions from wireless handsets or equipment on our communications infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues.

The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us.

Public perception of possible health risks associated with cellular or other wireless connectivity services may slow or diminish the growth of wireless companies, which may in turn slow or diminish our growth. In particular, negative public perception of, and regulations regarding, these perceived health risks may slow or diminish the market acceptance of wireless services. If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and adversely affected. We currently do not maintain any significant insurance with respect to these matters.

⁵⁵ [AT&T Mobile Insurance Policy](#), 2014, p. 4

Wireless companies from AT&T⁵⁶ to Nokia to T-Mobile to Verizon Wireless have issued similar warnings⁵⁷ to their own shareholders.

Contained in [Vodafone's 2018 Annual Report](#) are the following statements: “What is the risk? Electro-magnetic signals emitted by mobile devices and base stations may be found to pose health risks, with potential impacts including: changes to national legislation, a reduction in mobile phone usage or litigation” and “EMF health related risks - EMF found to pose health risks causing reduction in mobile usage or litigation.” The report also included EMF is a “Principal Risk” rated as high in the graphic on pages 38 – 39.

Additional Insurance Reports that Rank Wireless and Electromagnetic Fields as “High Risk”

- 2016 Austrian Accident Insurance Institute (AUVA) ATHEM Report 2 [“Investigation of athermal effects of electromagnetic fields in mobile communications.”](#)
- 2014 [Swiss Re SONAR Report: New emerging risk insights.](#)
- 2013 AM Best Briefing, [Emerging Technologies Pose Significant Risks with Possible Long-Tail Losses.](#)
- 2011 Business Insurance White Paper, [“The Next Asbestos: Five emerging risks that could shift the liability landscape.”](#)
- 2011 Austrian Accident Insurance Institute (AUVA) ATHEM Report 1, [Investigation of athermal effects of electromagnetic fields in mobile radio areas](#) in German
- [2010 Lloyd’s of London Report on Electromagnetic Fields](#)
- 2009 Austrian Accident Insurance Institute Report on Health Risks from Cell Phone Radiation [“Nonthermal Effects of Electromagnetic Radiation in the Cell Phone Frequency Range.”](#)
- 2011 Business Insurance Article [“Geisel, Roseanne White. “Insurers exclude risks associated with electromagnetic radiation.”](#)

⁵⁶ [AT&T 2016 Annual Report](#)

⁵⁷ EHTrust.org, [“Corporate Company Investor Warnings In Annual Reports 10k Filings Cell Phone Radiation Risks.”](#)

2. Why do cell phone manufacturers have in the legal section within the device saying keep the phone at least 5mm from the body?

5G will have multiple antennas for 5G as well as 4G, Wi-Fi, Bluetooth, and other technology. All of these antennas emit wireless radiation. Even if you are not on the phone, it has continuous emissions.

Phones are premarket tested for cell phone radiation exposures with a separation distance from the phone and the body phantom. This legal section states the exact separation distance the manufacturers used when testing the phone for compliance. As the 2012 GAO Report "[Exposure and Testing Requirements for Mobile Phones Should Be Reassessed](#)" states, "The specific minimum separation distance from the body is determined by the manufacturer. In addition, the U.S. government does not perform independent cell phone compliance testing, allowing each manufacturer to submit their own SAR testing results to the FCC."

If phones are used in positions closer than this manufacturer's stated distance, the cell phone user could potentially receive excessive cell phone radiation SAR levels which violate the FCC regulatory limits. Several reports in the US and internationally have confirmed that when phones are tested at body contact, the measured SAR will exceed FCC limits.^{58, 59, 60, 61} Theodora Scarato presented this information to the Commission including an [analysis](#) by Professor Om Gandhi which examined [data](#) from 450 cell phone models from the French government agency, ANFR, the national radiation assessment bureau, indicating that phones can emit 11 times over the US FCC limit and 3 times over European/ICNIRP limits.

FCC Does Not Require Body Contact Tests for Cell Phone Radiation

As stated in the 2012 [GAO report](#), "Some consumers may use mobile phones against the body, which FCC does not currently test, and could result in RF energy exposure higher than the FCC limit." The GAO report also directed the FCC to review their cell phone testing protocol because they found these protocols could

⁵⁸ Gandhi, O. P. (2019). "[Microwave Emissions From Cell Phones Exceed Safety Limits in Europe and the US When Touching the Body.](#)" *IEEE Access*, 7, 47050-47052. doi:10.1109/access.2019.2906017

⁵⁹ Gandhi, Om P., and Gang Kang. "[Inaccuracies of a plastic pinna SAM for SAR testing of cellular telephones against IEEE and ICNIRP safety guidelines.](#)" *IEEE Transactions on Microwave Theory and Techniques* 52.8 (2004).

⁶⁰ Gandhi, Om P. "[Yes the children are more exposed to radiofrequency energy from mobile telephones than adults.](#)" *IEEE Access* 3 (2015): 985-988.

⁶¹ Kang, Gang, and Om P. Gandhi. "[SARs for pocket-mounted mobile telephones at 835 and 1900 MHz.](#)" *Physics in Medicine and Biology* 47.23 (2002): 4301.

allow for consumers to receive SAR levels that possibly exceed the "on the body" exposure guidelines.

Cell phone manufacturers are not required by the FCC to test cell phones for cell phone radiation compliance in positions which mimic direct contact between the phone and the body. In the USA, manufacturers can set distances of up to 25 mm when they perform SAR radiation testing for their phones and they are still within the law.

In contrast, in Europe the law has changed to ensure phones are tested at least at 5 mm and no more. This happened after France ANFR released radiation measurements for hundreds of cell phones tested independently by the government of France. The ANFR found the radiation levels were so high that most tested phones exceeded European cell phone radiation limits, showing radiation levels up to three times higher than the limits! ANFR has posted the [information](#) on their website.

Several phone models have been taken off the European market or software updated to reduce the radiofrequency radiation. The first withdrawal of cell phones from the market due to cell phone radiation levels dates back to April 2018, with the 100,000 Hapi 30 phones marketed by Orange, followed by the Neffos X1 TP902 (May 2018), the Echo Horizon Lite (Oct 2019), and the [announcement](#) on May 20 of the withdrawal of the Razer Phone 2 devices.

After the release of the ANFR tests that found phones violated limits in body contact positions, a new [European Directive 2014/35/UE called RED](#), applicable from June 2016, changed the regulations so that now all phones in the European Union are SAR tested at a distance no greater than 5 mm.

Furthermore, the French ministries of Health, Ecology and Economy issued a [joint press release](#) on October 25, 2019⁶² announcing France will ask the European Commission to further strengthen the SAR tests requirements to be carried out in a body contact position of 0mm from the body phantom. This would ensure that tests mimic the way people use cell phones today, touching the body.

⁶² Buzyn A. "[The Government is taking action to limit exposure to the emissions of certain mobile phones and to better inform the public.](#)" *Ministère Des Solidarités Et De La Santé*. Published 2019. Accessed July 8, 2020.

FCC SAR Limits


The FCC regulates RF energy emitted from FCC-regulated transmitters and has implemented a certification program to ensure that all mobile phones and wireless devices sold in the United States comply with the agency's limit on RF radiation exposure.

Before a cell phone model is permitted to go on the market for sale, its manufacturer performs Specific Absorption Rate (SAR) tests to evaluate the radiation levels. SAR values are expressed in terms of watts per kilogram (W/kg) and are intended to measure the amount of cell phone radiofrequency radiation absorbed by the body when using a wireless device.

Cell Phone Radiation SAR Limits in the USA

The FCC and Health Canada limit for cell phone radiation exposure to the public from cellular telephones is a SAR level of 1.6 watts per kilogram averaged over 1 gram of tissue. For extremities such as the wrists, ankles, hands, ears, and feet, the allowable SAR limit is much higher and is 4.0 W/kg averaged over 10 grams of tissue.⁶³

Image from FCC Presentation⁶⁴



SAR

Occupational/Controlled Exposure Limits (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

General Population/Uncontrolled Exposure Limits (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body.
Partial-body SAR is averaged over any 1 g of tissue in the shape of a cube.
SAR for hands, wrists, feet and ankles is averaged over any 10 g of tissue in the shape of a cube.

SAR limits are not applicable above 6.0 GHz; MPE limits for field strength and power density should be applied. Categorical exclusion of routine MPE evaluation for mobile transmitters does not apply to portable devices operating above 6.0 GHz.

October 2005 TCB Workshop 8

⁶³ [Radio Frequency Safety](#) | Federal Communications Commission. Accessed July 8, 2020.

⁶⁴ https://transition.fcc.gov/oet/ea/presentations/files/oct05/RF_Exposure_Concepts_Support_KC.pdf

There also is an occupational SAR limit for cell phones, allowing much higher exposures. The US FCC occupational limit is a SAR level of 8 watts per kilogram averaged over 1 gram of tissue. For extremities such as the wrists, ankles, hands, ears, and feet, the allowable SAR limit is much higher and is 10.0 W/kg averaged over 10 grams of tissue.

According to the FCC⁶⁵ the “occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure.”

Thus, the manufacturer's recommended distance for cell phones is a defined number of millimeters. The specific distances for each phone varies and can be found in the cell phone's instruction/user manual. Furthermore, the recommended distance for wireless laptops, Wi-Fi routers, smart security systems, smart speakers and printers is generally 20 centimeters (approximately 8 inches) as stated in the user manual. The FCC states that “mobile devices are transmitters designed to be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.”

The CTIA has argued that “there is no reliable evidence proving that current testing protocols fail to ensure compliance with RF standards.” This is stated in [the CTIA submission to the US Federal Communications Commission](#) regarding the FCC Proceeding on Human Exposures to Radiofrequency Radiation. CTIA also stated, “a zero-measuring requirement would not accurately mimic real usage or increase safety.”

The French data release refutes these CTIA and FCC statements because they found SAR levels were in violation of limits when phones were tested in body contact positions at highest power levels.

⁶⁵ Chan K. [Overview of RF Exposure Overview of RF Exposure Concepts and Requirements Concepts and Requirements](http://grouper.ieee.org/groups/scc34/sc2/wg1/appr_memo.html). http://grouper.ieee.org/groups/scc34/sc2/wg1/appr_memo.html. Accessed July 8, 2020.

Examples of the Manufacturer's Instructions

Here are some examples of the radiofrequency statement for phones as well as other wireless devices people use every day.

Samsung Health and Safety Information	“Body-worn operations are restricted to belt-clips, holsters or similar accessories that have no metallic component in the assembly and must provide at least 1.5cm separation between the device and the user's body.”
iPhone 11 Pro Max	“During testing, iPhone radios are set to their highest transmission levels and placed in positions that simulate uses against the head, with no separation, and when worn or carried against the torso of the body, with 5mm separation.”
Nokia 8110 4G Phone (2019 Manual)	“This device meets RF exposure guidelines when used against the head or when positioned at least 5/8 inch (1.5 centimetres) away from the body. When a carry case, belt clip or other form of device holder is used for body-worn operation, it should not contain metal and should provide at least the above stated separation distance from the body.”
Safety & regulatory information (Pixel & Pixel XL 2016)	“Body worn operation: Pixel complies with radio frequency specifications when used near your ear or at a distance of 0.4 in (1.0 cm) from your body. Pixel XL complies with radio frequency specifications when used near your ear or at a distance of 0.4 in (1.0 cm) from your body. Ensure that the device accessories, such as a device case and device holster, are not composed of metal components. Keep the device away from your body to meet the distance requirement.”
Samsung 3G Laptop Manual	“Usage precautions during 3G connection: Keep safe distance from pregnant women’s stomach or from lower stomach of teenagers. Body worn operation: Important safety information regarding radiofrequency radiation (RF) exposure. To ensure compliance with RF exposure guidelines the Notebook PC must be used with a minimum of 20.8 cm antenna separation from the body.”

Owlcam Manual with RF Instructions	<p>“Caution exposure to radiofrequency radiation, to comply with FCC RF exposure compliance requirements for mobile configurations, a separation distance of at least 20 cm must be maintained between the antenna of this device and all persons.”</p>
PlayStation 3	<p>“This equipment complies with FCC/IC radiation exposure limits set forth for uncontrolled equipment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET65 and RSS-102 of the IC radio frequency (RF) Exposure rules. This equipment should be installed and operated with at least 20 cm (8 in) and more between the radiator and person’s body (excluding extremities: hands, wrists, feet and legs).”</p>
Amazon Echo	<p>“Information Regarding Exposure to Radio Frequency Energy...This device should be installed and operated with a minimum distance of 20cm between the radiator and your body. The remote control meets the RF exposure requirement of low power devices under portable operation. Nevertheless, it is advised to use the Products in such a manner that minimizes the potential for human contact during normal operation.”</p>
Panasonic DECT Home Cordless Phone	<p>“FCC RF Exposure Warning: To comply with FCC RF exposure requirements, the base unit must be installed and operated 20 cm (8 inches) or more between the product and all person’s body.”</p>
HP Printer	<p>“In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20 cm (8 inches) during normal operation.”</p>
Apple Watch	<p>“During testing, Apple Watch radios are set to their highest transmission levels and placed in positions that simulate use against the head, with 10mm separation, and on the wrist, with no separation. When placing Apple Watch near your face, keep at least 10mm of separation to ensure exposure levels remain at or below the as-tested levels.”</p>

Apple iPod Touch	<p>“During testing, iPod radios are set to their highest transmission levels and placed in positions that simulate use near the body, with 5mm separation.</p> <p>To reduce exposure to RF energy, use the supplied headphones or other similar accessories. Carry iPod at least 5mm away from your body to ensure exposure levels remain at or below the as-tested levels.”</p>
Nokia 8110 4G Phone (2019 Manual)	<p>“This device meets RF exposure guidelines when used against the head or when positioned at least 5/8 inch (1.5 centimetres) away from the body. When a carry case, belt clip or other form of device holder is used for body-worn operation, it should not contain metal and should provide at least the above stated separation distance from the body.”</p>

Apple Has Changed Their Text and No Longer Clearly Instructs Users to Keep the Phone at a Distance But Does Share the Test Distance

In 2015 the Apple iPhone 6 manual had the following [statement](#), “Carry iPhone at least 5mm away from your body to ensure exposure levels remain at or below the as-tested levels.” While this sentence was still on their website on [March 2, 2017](#), it was removed by [November 9, 2017](#). Similarly, the iPhone 7 was released in 2016, along with the same online instructions to carry it “5 mm away from your body” which disappeared from the Apple website by [November 9, 2017](#).

Apple’s [website](#) still includes information that cell phones are tested with a separation distance. However, the text is absent of clear instructions to consumers. Years ago, iPhone 3 [filings](#) to the FCC stated “iPhone’s SAR measurement may exceed the FCC exposure guidelines for body-worn operation if positioned less than 15 mm (5/8 inch) from the body (e.g. when carrying iPhone in your pocket).” Apple clearly stated, “When using iPhone near your body for voice calls or for wireless data transmission over a cellular network, keep iPhone at least 15 mm (5/8 inch) away from the body.”

Investigations Find Cell Phones Violate Cell Phone Regulatory Limits When the Phone is Tested at Body Contact

Chicago Tribune Cell Phone Radiation Tests

Tests paid for by the Tribune and conducted according to federal guidelines at an accredited lab, produced a surprising result: Radiofrequency radiation exposure from the iPhone 7 — one of the most popular smartphones ever sold — measured over the legal safety limit and more than double what Apple reported to federal regulators from its own testing. These tests measured radio frequency radiation SAR levels at 2mm from the body. [Chicago Tribune Cell Phone Test Report](#)

During Commission proceedings the CTIA countered that the FCC tested the phones the Chicago Tribune had reported to exceed SAR levels and released a report that found them to not to violate SAR limits. However, if you go to the FCC report on SAR measurements it shows that the FCC used a separation distance (on page 9)⁶⁶. The Chicago Tribune report specifically investigated phones at a distance of 2mm from the body. The FCC Report did not replicate the Chicago Tribune tests at 2mm but instead used the manufacturers separation distances which vary from 5 mm to 15mm.

Canadian Broadcasting Corporation

A 2017 [investigation](#) by the Canadian Broadcasting Corporation found radiation levels higher than government standards after they tested popular cell phones in a US FCC certified laboratory.

French ANFR

Professor Om Gandhi, one of the engineers who developed radiofrequency limits years ago, published an [analysis](#) of the [data](#) from 450 cell phone models from the French government agency, ANFR, the national radiation assessment bureau, indicating that phones can emit 11 times over the US FCC limit and 3 times over European/ICNIRP limits.

3. Why have 1,000s of peer-reviewed studies, including the recently published U.S. Toxicology Program 16-year \$30 million study, that are showing a wide range of statistically significant DNA damage, brain and heart tumors,

⁶⁶ FCC. [Results of Tests on Cell Phone RF Exposure Compliance](#).; 2019. Accessed July 8, 2020.

infertility, and so many other ailments, been ignored by the Federal Communication Commission (FCC)?

There has not been a scientific review of the research by a US agency for more than two decades.

Just recently in December 2019, the FCC determined that there was no need to review the radiofrequency limits. The FCC based this decision largely on a letter by the FDA. In the spring of 2020, the FDA released a research review, but it was not a systematic full evaluation of health effects, but instead only focused on cancer and criticized studies that found effects. FDA has not done experimental research on impacts to humans, birds, bees, trees, and wildlife. The FDA review does not systematically evaluate RF levels and impacts to birds, bees, and trees.

Most importantly, as the FCC states, there are no federally developed safety limits⁶⁷ and there is no US health agency developing such safety limits in the US.

There is not a single health/safety/environmental agency investigating, researching or monitoring impacts to birds, bees, trees, and wildlife. In addition, regulatory limits for exposure to radiofrequency radiation have never been developed for birds, bees, trees, and wildlife. This is why the [US Department of the Interior sent a letter](#) to the National Telecommunications and Information Administration in 2014⁶⁸ reviewing several research studies showing harm to birds and concluding that “the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today.”

A now retired US Fish and Wildlife Service wildlife biologist and former lead on telecommunications impacts, Dr. Albert Manville, has written to the FCC on impacts to birds and higher frequencies to be used in 5G and authored numerous publications detailing research showing harm to birds.^{69, 70, 71} “Now as a private

⁶⁷ [Wireless Devices and Health Concerns](#) | Federal Communications Commission. Accessed July 8, 2020.

⁶⁸ Washington DC, Veenendaal ME. [Department of Interior Letter](#). *United States Department of the Interior OFFICE OF THE SECRETARY*.

⁶⁹ ECFS Filing Detail. <https://www.fcc.gov/ecfs/filing/1060315601199>. Accessed July 8, 2020.

⁷⁰ Albert M. Manville Ph.D. Former U.S. Fish and Wildlife Service Senior Biologist. [“Memorandum on the Bird and Wildlife Impacts of Non-ionizing Radiation.”](#) *Environmental Health Trust*. Accessed July 8, 2020.

⁷¹ Manville AM. “Collisions, Electrocutions, and Next Step : [Bird Strikes And Electrocutions At Power Lines](#),

wildlife consultant and part-time adjunct professor for Johns Hopkins University, I also continue to study the impacts of radiation on human health, welfare and safety, including impacts from millimeter-wide radiation frequencies on humans from 5G. The race to implement 5G and the push by FCC to approve the related 5G license frequencies to industry are very troubling and downright dangerous.”

He has testified⁷² about the impacts of cell towers on birds that “the entire thermal model and all FCC categorical exclusions for all the devices we see today, rests on the incorrect assumption that low-level nonionizing nonthermal radiation cannot cause DNA breaks because it is so low power. The evidence to the contrary is clear and growing laboratory animals and wildlife.”

Most recently Manville wrote the FDA regarding the FDA statements of “safety” in regards to cell phone radiation that, “as a certified wildlife biologist and Ph.D. environmental scientist who has studied the impacts of radiation on migratory birds, other wildlife, and humans since the late 1990s, the statement credited to the FDA is preposterous, without any scientific credibility, and at a minimum deserves a retraction by the FDA. There currently are well over 500 scientific, peer-reviewed papers addressing impacts of non-ionizing, non-thermal radiation on laboratory animals — many of the studies directly applicable to human health and safety.”⁷³

In addition, no “safe” level has been scientifically determined for long term impacts for children or pregnant women. While they are “designed” to address children, the reality is that no such research existed at the time of the limit development that actually considered children’s unique vulnerability which includes their developing brain and immune system. The EPA clarified that current FCC limits do not account for long term exposures⁷⁴ in 2002 stating, “Federal health and safety agencies have not yet developed policies concerning possible risk from long term, nonthermal exposures.” Current FCC human exposure limits “are thermally based, and do not apply to chronic, nonthermal exposure situations” and adequate scientific evaluations of the full impact on sensitive

[Communication Towers, And Wind Turbines: State Of The Art And State Of The Science - Next Steps Toward Mitigation.](#)”; 2002.

⁷² Manville AM. IPCWB. [Declaration of: Albert M. Manville, II, PhD, C.W.B.](#). Published 2018. Accessed July 8, 2020.

⁷³ [Statement From Dr. Albert Manville On The FDA Report On Cell Phone Radiation.](#) *Environmental Health Trust.* Accessed July 8, 2020.

⁷⁴ Washington DC. [United States Environmental Protection Agency.](#) 2002 <http://www.epagov>. Accessed July 8, 2020.

populations such as children, pregnant women, and the elderly has yet to be completed.

Background on US FCC Radiofrequency Human Exposure Limits

The FCC is not a health and safety agency and in fact never developed health based federal safety standards as we have with other environmental exposures.

Although there used to be a robust research effort in the United States in the '60s, '70s, and '80s, it was defunded. In fact, the US EPA was tasked to develop proper safety standards and was in process of developing two tiered guidelines on both thermal and biological effects in the mid-nineties. However, funding was cut and in 1996 the EPA was fully defunded from work on electromagnetic radiation. Then the FCC promulgated limits for human exposure to radiofrequency radiation based on the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE) – ANSI/IEEE C95.1-1992 guidelines and the National Council on Radiation Protection and Measurements (NCRP) NCRP Report 1986. The limits have remained largely unchanged since 1996.

In 2008 the National Academy of Sciences National Research Council Report "[The Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices](#)" documented critical research gaps and called for the need to increase understanding of any adverse effects of long term chronic exposure to RF/microwave energy on children and pregnant women.

In 2008 the Congressional hearing "[Health Effects of Cell Phone Use](#)" of the US House Oversight and Government Reform Subcommittee on Domestic Policy had testimony from several experts including David Carpenter, Ronald B. Herberman M.D., Robert Hoover, Darrell Issa, and Julius P. Knapp II.⁷⁵

In 2009 a Senate Appropriations Subcommittee held a hearing on the "[Health Effects of Cell Phone Use](#)" and had testimony from several experts including John Bucher, Devra L. Davis, Thomas "Tom" Harkin, Dariusz Leszczynski, Olga Naidenko, and Siegal Sadetzki.⁷⁶

⁷⁵ 2008 Congressional Hearing: [Health Effects of Cell Phone Use](#)

⁷⁶ 2009 Hearing [link to transcript](#)

A 2012 report by the Government Accountability Office “[Exposure and Testing Requirements for Mobile Phones Should Be Reassessed](#)” urged the FCC to “formally reassess and, if appropriate, change its current RF energy (microwave) exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body” because without such a reassessment, the “FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure.” The report stated that the FCC RF limits adopted in 1996 did not reflect the way people use their phones, particularly when phones are held against and touching the body. The report led the FCC to launch an official inquiry⁷⁷ in 2013 to explore whether it should modify its radiofrequency exposure standards. The FCC noted, “we specifically seek comment as to whether our current limits are appropriate as they relate to device use by children.” The FCC docket asked these important questions: Are US cell phone and cell tower radiation limits safe for humans? Do children need special protections? Should companies change the way they test the radiation from phones because phones are tested with a separation distance between the phone and the body? The FCC received over a thousand submissions.⁷⁸

In 2019, the FCC issued a report and order⁷⁹ that closed the inquiry. It stated, “First, we resolve a Notice of Inquiry that sought public input on, among other issues, whether the Commission should amend its existing RF emission exposure limits. After reviewing the extensive record submitted in response to that inquiry, we find no appropriate basis for and thus decline to propose amendments to our existing limits at this time. We take to heart the findings of the Food & Drug Administration (FDA), an expert agency regarding the health impacts of consumer products, that “the weight of scientific evidence has not linked cell phones with any health problems.”

Scientists are calling for the FDA to retract their report that is now used as proof of safety. Due to the fact that the FDA later in 2020 released a report criticizing studies that found harm and provided no research demonstrating safety, several expert scientists wrote to the FDA.

⁷⁷ [Review of RF Exposure Policies | Federal Communications Commission](#)

⁷⁸ [ECFS filings results](#). Accessed July 8, 2020.

⁷⁹ FCC. [FCC 19-126](#). <https://www.fda.gov/Radiation>. Accessed July 8, 2020.

“I find it shocking that the FDA would casually dismiss the carcinogenicity findings from the National Toxicology Program (NTP) studies on cell phone radiation in experimental animals, when it was the FDA that requested those studies in the first place ‘to provide the basis to assess the risk to human health,’ and when an expert peer-review panel carefully reviewed the design and conduct of those studies and then concluded that the results provided “clear evidence of carcinogenic activity,” stated [Ronald Melnick PhD](#) who led the design of the \$30M NTP study. Melnick sent [a letter to the FDA](#) documenting the scientific inaccuracies in their review.

“When I worked as a wildlife biologist for the U.S. Fish & Wildlife Service for 17 years, I collaborated with the late Dr. Ted Litovitz in 2000. Dr. Litovitz and his colleagues studied the impacts of low-level, non-thermal radiation from the standard 915 MHz cell phone frequency on chicken embryos. In their laboratory studies, control/non-treated embryos suffered no effects, but some of the treated/irradiated embryos died — at levels as low as 1/10,000 the normal level of cell phone radiation exposure to humans. This was an eye-opener!” stated Albert M. Manville, II, Ph.D.; retired Senior Wildlife Biologist, Division of Migratory Bird Management, U.S. Fish & Wildlife Service, Washington.

“The FDA review omits an evaluation of the science on wireless radiation impacts to trees and wildlife. Electromagnetic radiation is a form of environmental pollution which may hurt wildlife. I have co-published research entitled [“Radiofrequency radiation injures trees around mobile phone base stations”](#) finding harm to trees near base stations (cell antennas) in a long term field monitoring study in two cities, “ stated biologist Alfonso Balmori, BSc who sent a [statement to the FDA](#).

Letters which have been sent to the FDA include:

- [Letter calling for a retraction signed by several scientists.](#)
- [Ronald Melnick PhD’s letter to the FDA on the National Toxicology Program study](#)
- [Albert Manville PhD, retired Senior Wildlife Biologist, Division of Migratory Bird Management, U.S. Fish & Wildlife Service, Wash. DC HQ Office \(17 years\); Senior Lecturer, Johns Hopkins University](#)

- [Prof. Tom Butler of the University College in Cork, Ireland’s letter to the FDA](#)
- [Igor Belyaev, PhD, Dr. Sc. Head, Department of Radiobiology of the Cancer Research Institute, Biomedical Research Center of the Slovak Academy of Science letter to the FDA](#)
- [Paul Heroux PhD, McGill University](#)
- [Alfonso Balmori, BSc statement to the FDA](#)
- [Additional Statements by Experts](#)

The FCC is considered a Captured Agency with Undue Influence by Telecom

Several experts who provided testimony to the Commission detailing how several FCC Commissioners have industry ties. Several cited the Harvard Press Book [“Captured Agency: How the Federal Communications Commission is Dominated by the Industries it Presumably Regulates”](#) by Norm Alster which documents the financial ties between the FCC, Congress and industry and how wireless companies have bought “inordinate access to—and power over—a major US regulatory agency.” The investigation puts forward that there is a “revolving door” between industry and regulators, meaning that persons are moving from positions in the wireless industry to positions in government and vice versa. In addition, the book documents the large financial investment by telecommunications companies into public relations efforts, designing and publishing contradictory science, pushing for minimal regulation, lobbying via “non-profit” associations, and “hyper aggressive legal action and research bullying.”

Examples of the revolving door at the Federal Communications Commission include:

- Tom Wheeler: In 2013, President Obama appointed Tom Wheeler to head the FCC. Wheeler, a fundraiser for Obama in the 2008 election, was a [lobbyist and head of the Cellular Telecommunications and Internet Association](#) (CTIA). As head of the wireless industry, [Wheeler was accused of suppressing science](#). A 2003 inductee into the Wireless Hall of Fame (yes, there is such a thing), Wheeler [laid the groundwork for 5G](#), pushing through regulations to strip local authority.

- Ajit Pai: In 2017, President Trump appointed Ajit Pai, a [former Verizon Lawyer](#) to [head the FCC](#). Pai had already been a member of the commission, having been appointed by President Obama in 2011 — upon the recommendation of Senate Majority Leader Mitch McConnell — to fill a “Republican” seat on the five-member board.
- Brendan Carr: FCC Commissioner Brendan Carr was [appointed by President Trump](#). He too is a former lawyer for Wiley Rein and helped [sue the San Francisco over the city’s cell phone ordinance](#). Carr’s wife is the staff director for the U.S. House Ways and Means Committee’s Oversight Subcommittee.
- Former FCC chairman Julius Genachowski is now [a managing director](#) of the U.S. buyout team at Carlyle Group. The team’s focus is on acquisitions and growth investments in global technology, media, and telecom, including Internet and mobile.
- Meredith Attwell Baker: [Former FCC Commissioner](#) Meredith Attwell Baker is now head of the CTIA - The Wireless Association. She is a former lead lobbyist for Comcast.
- Michael Powell: Former FCC commissioner Michael Powell is [now president & CEO of NCTA](#) - The Internet & Television Association.
- Bruce Romano: Former legal chief in the FCC’s Office of Engineering and Technology. Bruce Romano is [now at the law firm of Wiley Rein, representing the CTIA](#).
- Thomas M. Johnson, Jr.: Thomas M. Johnson, Jr. is general counsel of the FCC appointed by Ajit Pai and previously worked for the law firm Gibson, Dunn & Crutcher LLP which [represented the CTIA - The Wireless Association](#) who sued the City of Berkeley in federal court, seeking to topple the city’s recently enacted cell phone right to know ordinance mandating disclosure of possible radiation hazards associated with use of cellphones.

In addition, published research has documented conflicts of interest in the experts that governments refer to.

- The International Journal of Oncology published “World Health Organization, radiofrequency radiation and health – a hard nut to crack

(Review)”⁸⁰ in 2017 detailing conflicts of interest with ICNIRP and the WHO EMF Project, both started with industry support.

- The American Journal of Industrial Medicine published “Secret ties to industry and conflicting interests in cancer research”⁸¹ in 2006 about industry funding of studies such as the Danish Cohort cell phone studies that are often put forward as showing no harm.
- Molecular and Clinical Oncology published “Appeals that matter or not on a moratorium on the deployment of the fifth generation, 5G, for microwave radiation”⁸² in 2020 details how ICNIRP is referred to as “a private German non-governmental organization. ICNIRP [that] relies on the evaluation only of thermal (heating) effects from RF radiation, thereby excluding a large body of published science demonstrating the detrimental effects caused by non-thermal radiation.”

4. Why are the FCC-sanctioned guidelines for public exposure to wireless radiation based only on the thermal effect on the temperature of the skin and do not account for the non-thermal, non-ionizing, biological effects of wireless radiation?

In 1996, just as the EPA was [set](#) to release their [Phase 1](#) of safety limits, the EPA’s RFR efforts were defunded, halting all EPA research. That year the FCC [adopted RFR exposure limits](#) based largely on limits developed by industry/military connected groups ([ANSI/IEEE C95.1-1992](#) and [NCRP’s 1986 Report](#)).

These FCC limits are only based on protecting against heating (thermal) effects from short-term exposures. They do not account for non-thermal biological effects or the effects of long-term, chronic exposures. Furthermore, adequate scientific data on children's unique vulnerability to RFR was not available at that time. The US still has no federally developed safety limits, and there has been no systematic review of the scientific research to develop safety limits that adequately protect the public from long-term exposures.

⁸⁰ Hardell L. “[World health organization, radiofrequency radiation and health - A hard nut to crack \(Review\)](#).” *Int J Oncol.* 2017;51(2):405-413. doi:10.3892/ijo.2017.4046

⁸¹ Hardell L, Walker MJ, Walhjalt B, Friedman LS, Richter ED. “[Secret Ties to Industry and Conflicting Interests in Cancer Research](#).” *Am J Ind Med.* 2006. doi:10.1002/ajim.20357

⁸² Hardell L, Nyberg R. “[Appeals that matter or not on a moratorium on the deployment of the fifth generation, 5G, for microwave radiation](#).” *Mol Clin Oncol.* 2020;12(3):247-257. doi:10.3892/mco.2020.1984

Due to the lack of evaluation for long term safety and research that linked neurological impacts in firefighters to cell antenna exposure, the International Association of Fire Fighters has long opposed⁸³ cell antennas on fire stations stating that, “fire department facilities, where fire fighters and emergency response personnel live and work are not the proper place for a technology which could endanger their health and safety. The only reasonable and responsible course is to conduct a study of the highest scientific merit and integrity on the RF/MW radiation health effects to our membership and, in the interim, oppose the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions until it is proven that such sitings are not hazardous to the health of our members.” The International Association of Fire Fighters passed a resolution⁸⁴ that they oppose cell towers on fire stations in 2004 and it remains in effect today.

5. Why are the FCC radiofrequency exposure limits set for the United States 100 times higher than countries like Russia, China, Italy, Switzerland, and most of Eastern Europe?

The following countries have cell tower network radiofrequency radiation limits (maximum permissible limits) below ICNIRP and FCC limits: Belarus, Bulgaria, China, Lithuania, Poland, Russia, Belgium, Chile, Greece, India, Israel, Italy, Liechtenstein and Switzerland.^{85 86 87 88 89}

The exposure guidelines developed by the FCC and International Commission on Non-Ionizing Radiation Protection (ICNIRP) were principally designed to protect against adverse thermal effects and were largely based on studies of short-term exposures to animals at high power levels. However, countries such as India,

⁸³ Cell Tower Radiation Health Effects - IAFF. <https://www.iaff.org/cell-tower-radiation/>. Accessed July 8, 2020.

⁸⁴ <https://ecfsapi.fcc.gov/file/109281319517547/20-Attachment%2020-%20Firefighters%20Inter%20Resolution%20Against%20Cell%20Towers.pdf>

⁸⁵ <https://apps.who.int/gho/data/node.main.EMFLIMITSPUBLICRADIOFREQUENCY?lang=en>

⁸⁶ Wu T, Rappaport TS, Collins CM. “[Safe for Generations to Come](#).” *IEEE Microw Mag*. 2015;16(2):65-84. doi:10.1109/MMM.2014.2377587

⁸⁷ Chiang, Huai. “[Rationale for Setting EMF Exposure Standards](#).” Zhejiang University School of Medicine, Microwave Lab, China, as referenced by Wu 2015

⁸⁸ “[Comparison of international policies on electromagnetic fields \(power frequency and radiofrequency fields\)](#).”

Rianne Stam, National Institute for Public Health and the Environment

⁸⁹ Mary Redmayne (2016). “[International policy and advisory response regarding children’s exposure to radio frequency electromagnetic fields \(RF-EMF\)](#).” *Electromagnetic Biology and Medicine*, 35:2, 176-185, DOI: [10.3109/15368378.2015.1038832](https://doi.org/10.3109/15368378.2015.1038832)

China and Russia have much lower limits and are considered “science based.”⁹⁰ They are well below any thermally significant levels to address their own countries research indicating adverse non-thermal health effects.

- USSR and Russian standards were based on many areas of research including impacts to the nervous system and immune system as documented in the [“Scientific basis for the Soviet and Russian radiofrequency standards for the general public.”](#) Their exposure limits are set based on protecting against possible biological consequences which is different than limits by the FCC and ICNIRP, which bases their limits on the lowest RF exposure that causes any “established” adverse health effect. Russia limits consider children to be more sensitive to EMFs and in need of “special consideration when developing exposure limits.” According to the ICNIRP, the following health hazards are likely to be faced in the near future by children who use mobile phones: disruption of memory, decline in attention, diminished learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to stress, and increased epileptic readiness. For these reasons, special recommendations on child safety from mobile phones have been incorporated into the current Russian mobile phone standard.⁹¹
- China’s cell tower limits are based on science showing effects which include behavioral, neurological, reproductive abnormalities, and DNA damage.⁹²
- India dropped their RF limits by 1/10th of ICNIRP after a 2010 Government Report documented the majority of research studies found adverse effects to wildlife, birds and bees.⁹³ An August 2012 Advisory by the Ministry of the Environment and Forests refers to the “negative effects” and makes a series of recommendations to the government.⁹⁴ The findings of the report were later published in the journal *Biology and Medicine* which concludes that, “based on current available literature, it is justified to conclude that RF-EMF radiation exposure can change neurotransmitter functions, blood-brain barrier, morphology, electrophysiology, cellular metabolism, calcium

⁹⁰ Wu T, Rappaport TS, Collins CM. [“Safe for Generations to Come.”](#) *IEEE Microw Mag.* 2015;16(2):65-84. doi:10.1109/MMM.2014.2377587

⁹¹ [“Scientific basis for the Soviet and Russian radiofrequency standards for the general public.”](#)

⁹² Prof. Dr. Huai Chiang. [“Rationale for Setting EMF Exposure Standards.”](#) Accessed July 8, 2020.

⁹³ [“Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees.”](#) Ministry of Environment and Forest, Government of India, 2010.

⁹⁴ Government of India Ministry of Environment and Forests Office. [“Advisory on the use of Mobile Towers to minimize their impact on Wildlife including Birds and Bees.”](#) 2012

efflux, and gene and protein expression in certain types of cells even at lower intensities”.⁹⁵

Many European countries have RF limits much lower than ICNIRP as part of their precautionary approach to decision-making. In 2011 the Parliamentary Assembly of the Council of Europe issued Resolution 1815: “The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment”,⁹⁶ a call to European governments to “take all reasonable measures” to reduce exposure to electromagnetic fields “particularly the exposure to children and young people who seem to be most at risk from head tumors.” The Resolution calls for member states to:

- Implement “information campaigns about the risk of biological effects on the environment and human health, especially targeting children and young people of reproductive age.”
- “For children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises.”

Resolution 1815 specifically states that governments “Reconsider the scientific basis for the present standards on exposure to electromagnetic fields set by the International Commission on Non-Ionizing Radiation Protection, which have serious limitations, and apply ALARA principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation.”

6. Why did the World Health Organization (WHO) signify that wireless radiation is a Group B Possibly Carcinogenic to Humans category, a group that includes lead, thalidomide, and others, and why are some experts who sat on the WHO committee in 2011 now calling for it to be placed in the Group 1, which are known carcinogens, and why is such information being ignored by the FCC?

In 2011 wireless radiofrequency radiation was classified as a “Possible Human Carcinogen” by the International Agency for Research on Cancer (IARC) of the WHO based on research that found an increased risk for glioma, a malignant type

⁹⁵ Sivani S, Sudarsanam D. “[Impacts of Radio-Frequency Electromagnetic Field \(RF-EMF\) from Cell Phone Towers and Wireless Devices on Biosystem and Ecosystem - a Review.](#)” *Biology and Medicine* Vol 4.; 2012. www.biolmedonline.com. Accessed July 8, 2020.

⁹⁶ [Resolution 1815: “The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment.”](#)

of brain cancer, associated with wireless phone use.⁹⁷ The WHO/IARC Class 2B classification includes wireless radiation from any transmitting source including cellphones, baby monitors, tablets, cell towers, radar, other Wi-Fi, etc. The classification applies to RF-EMF in the range of 30 KHz to 300 GHz emitted from any equipment- not just cell phones. This fact is detailed in the [Lancet's published statement](#) and in the related press release in 2011.

Precautions for cell phones were recommended by then IARC Director Christopher Wild in the WHO/IARC [press release](#) for the Class 2B Carcinogen classification with quotes from Wild as stating, "Given the potential consequences for public health of this classification and findings, it is important that additional research be conducted into the long-term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands-free devices or texting."

After the 2011 classification, the WHO/IARC issued a monograph documenting all the research underpinning the 2011 classification.⁹⁸

The 2013 published monograph also references children's higher exposures as compared to adults and states, "the average exposure from use of the same mobile phone is higher by a factor of 2 in a child's brain and higher by a factor of 10 in the bone marrow of the skull."

The reason that scientists are calling for a change to the classification is that since the 2011 classification, the evidence for adverse effects in the published research has increased. Cancer is only one of the issues that have been investigated. Here are some of the studies often mentioned by scientists:

- The National Toxicology Program studies on cell phone radiation in animals found clear evidence of carcinogenic activity, in male rats and [DNA damage](#) in the frontal cortex of the brain in male mice, the blood cells of female mice, and the hippocampus of male rats.
- The multicenter case-control study [Coureau et al. 2014](#) found statistically significant positive association between brain tumors and cell phone use in the heaviest cell phone users when considering life-long cumulative duration.

⁹⁷ [IARC classifies Radiofrequency Electromagnetic Fields as possibly carcinogenic to humans](#)

⁹⁸ [Monograph on Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields.](#)

- An animal study [Lerchl 2015](#) replicated a previous study that found at very low levels, radiofrequency can promote tumors.
- [Falcioni et al. 2018](#) found a statistically significant increase in the incidence of heart Schwannomas in male rats exposed to radiofrequency radiation at levels below FCC limits.
- Yale research funded by the American Cancer Society⁹⁹ found thyroid cancer associated with cell phone use in people with genetic susceptibility.
- Additional Yale research¹⁰⁰ found prenatal radiofrequency radiation exposure led to higher hyperactivity, poorer memory, and altered brain function in mice,¹⁰¹ corroborating prior published [research](#) findings of altered brain development after exposure.
- A 2018 study¹⁰² looking at hundreds of adolescents found memory damage in the brain receiving some of the higher radiofrequency cell phone radiation exposures.
- A 2015 review study¹⁰³ found among 93 of 100 currently available peer-reviewed studies dealing with oxidative effects of low-intensity RFR, confirmation that RFR induces oxidative effects in biological systems.

The evaluation by some scientists that wireless is carcinogenic due to this increased body of published research can be found in [Hardell and Carlberg 2017](#) and [Miller et al. 2018](#).

Several scientists who were members of the WHO IARC 2011 monograph classification have publicly stated that the evidence on the carcinogenicity of RF has increased and that the classification of “possible carcinogen” is outdated and should be upgraded based on increased evidence of adverse effects.

⁹⁹ Jiajun Luo et al. “[Genetic susceptibility may modify the association between cell phone use and thyroid cancer: A population-based case-control study in Connecticut.](#)” *Environmental Research* (2019).

¹⁰⁰ Aldad, T., Gan, G., Gao, X., & Taylor, H. (2012). “[Fetal Radiofrequency Radiation Exposure From 800-1900 Mhz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice.](#)” *Scientific Reports*, 2(1).
<https://doi.org/10.1038/srep00312>

¹⁰¹ [Cell phone use in pregnancy may cause behavioral disorders in offspring](#)

¹⁰² Foerster, M., Thielens, A., Joseph, W., Eeftens, M., & Rössli, M. (2018). “[A Prospective Cohort Study of Adolescents’ Memory Performance and Individual Brain Dose of Microwave Radiation from Wireless Communication.](#)” *Environmental Health Perspectives*, 126(7), 077007. <https://doi.org/10.1289/ehp2427>

¹⁰³ Yakymenko, I., Tsybulin, O., Sidorik, E., Henshel, D., Kyrylenko, O., & Kyrylenko, S. (2015). “[Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation.](#)” *Electromagnetic Biology and Medicine*, 35(2), 186-202.

- Dr. Lennart Hardell in [Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use](#): “This study confirmed previous results of an association between mobile and cordless phone use and malignant brain tumours. These findings provide support for the hypothesis that RF-EMFs play a role both in the initiation and promotion stages of carcinogenesis.”
- Dr. Chris Portier: “A careful review of the scientific literature demonstrates there are potentially dangerous effects from RF,” stated Portier, a recently retired CDC Director, Center for Environmental Health and the Agency for Toxic Substances and Disease Registry [in his official call for invoking the precautionary principle with wireless](#) radiation in a 2015 conference. See also a poster presentation he penned for the conference [here](#).
- Dr. Igor Belyaev: “There are many publications showing health effects of radiofrequency radiations. Approximately half of all published papers show such effects.” ([National Press Club](#), 2012. [He has published findings of adverse effects in several publications.](#))
- [Dariusz Leszczynski](#), WHO IARC expert, former Finnish government researcher [stated in 2015](#) “The IARC-WHO classification of cell phone radiation is misrepresented by the industry. Classification of cell phone radiation as ‘a possible carcinogen to humans’ means that there are enough studies indicating that it might cause cancer and that we urgently need more research to clarify this issue. The strongest evidence that it might be causing cancer comes from three epidemiological studies. In 2011, only two sets of studies were available – EU’s Interphone study and a series of studies from Lennart Hardell’s group in Sweden. Recently, CERENAT study from France published in 2014, similarly indicated that persons using cell phones for more than ten years and for half hour per day are at a higher risk for developing brain cancer. In fact now the evidence is sufficient to consider cell phone radiation as a probable carcinogen – Group 2A in IARC’s scale of carcinogenicity.”
- Ronald Melnick, retired NTP staff scientist has written extensively on this topic and [states in Health Physics 2020](#), “The NTP studies show that the assumption that RF radiation is incapable of causing cancer or other adverse health effects other than by tissue heating is wrong.”

- [Anthony B. Miller, who served as an editorial reviewer of the IARC monograph, has also written](#) that if an IARC panel were to review the science at this point they would conclude that it should be reclassified as category 1, a human carcinogen.

In 2019, an advisory group of the International Agency for Research on Cancer (IARC) of the World Health Organization, consisting of 29 scientists from 18 countries, released new [recommendations](#) to reassess as a “high priority” the cancer risks of radiofrequency radiation between 2020–2024. The recommendations were published in The Lancet Oncology on April 18, 2019.

7. Why have more than 220 of the world’s leading scientists signed an appeal to the WHO and the United Nations to protect public health from wireless radiation and nothing has been done?

Over [393 scientists](#) and doctors from 35 countries have signed on to a declaration called the 5G Appeal,¹⁰⁴ sent to officials of the European Commission, calling for a moratorium on the increase of cell antennas for planned 5G expansion because “5G will substantially increase exposure to radiofrequency electromagnetic fields (RF-EMF) on top of the 2G, 3G, 4G, Wi-Fi, etc. for telecommunications already in place. RF-EMF has been proven to be harmful for humans and the environment.”

In addition, the 5G Appeal references the 2015 Scientific Appeal to the United Nations published in the European Journal of Oncology¹⁰⁵ now signed by 253 scientists who have published research on electromagnetic radiation which states that, “numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.”

¹⁰⁴ The 5G appeal – [5G Appeal 5G Appeal](#). Accessed July 8, 2020.

¹⁰⁵ EMFscientist.org - [International EMF Scientist Appeal](#). Accessed July 8, 2020.

Why has nothing been done?

The Scientific Appeal states that “the various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF.” The International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines do not cover long-term exposure and low-intensity effects, yet they are used by many governments as safety limits. The EMF scientists contend that the ICNIRP guidelines are insufficient to protect public health.

Dr. Lennart Hardell published a paper entitled, “[Appeals that matter or not on a moratorium on the deployment of the fifth generation, 5G, for microwave radiation](#)” explaining how ICNIRP is a private German non-governmental organization of 13 people that “relies on the evaluation only of thermal (heating) effects from RF radiation, thereby excluding a large body of published science demonstrating the detrimental effects caused by non-thermal radiation.” He contends that ICNIRP has disregarded research and that their safety guidelines are obsolete and protect the industry, not health. Hardell describes the communications between decision makers and the scientists and concludes that “the majority of decision makers are scientifically uninformed on health risks from RF radiation.” In addition, they seem to be uninterested in being informed by scientists representing the majority of the scientific community, i.e., those scientists who are concerned about the increasing evidence or even proof of harmful health effects below the ICNIRP guidelines (www.emfscientist.org). Instead, they rely on evaluations with inborn errors of conflicts, such as ICNIRP.

8. Why have the cumulative biological damaging effects of ever-growing numbers of pulse signals riding on the back of the electromagnetic sine waves not been explored, especially as the world embraces the Internet of Things, meaning all devices being connected by electromagnetic waves, and the exploration of the number of such pulse signals that will be created by implementation of 5G technology?

There are extensive data gaps regarding human exposure to wireless devices and the complexity of the waves we are exposed to. Most studies have not adequately explored all of these characteristics but instead only focus on power density.

“Adverse Health Effects of 5G Mobile Networking Technology Under Real Life Conditions”¹⁰⁶ published in Toxicology Letters states “the typical incoming EMF signal for many/most laboratory tests performed in the past consisted of single carrier wave frequency; the lower frequency superimposed signal containing the information was not always included. This omission may be important. As Panagopoulos states: “It is important to note that except for the RF/microwave carrier frequency, Extremely Low Frequencies - ELFs (0–3000 Hz) are always present in all telecommunication EMFs in the form of pulsing and modulation. There is significant evidence indicating that the effects of telecommunication EMFs on living organisms are mainly due to the included ELF’s... While ~50 % of the studies employing simulated exposures do not find any effects, studies employing real-life exposures from commercially available devices display an almost 100% consistency in showing adverse effects” (Panagopoulos, 2019). These effects may be exacerbated further with 5 G: “with every new generation of telecommunication devices.....the amount of information transmitted each moment.....is increased, resulting in higher variability and complexity of the signals with the living cells/ organisms even more unable to adapt” (Panagopoulos, 2019).”

This is an area that requires adequate research before deployment.

¹⁰⁶ Kostoff RN, Heroux P, Aschner M, Tsatsakis A. “[Adverse health effects of 5G mobile networking technology under real-life conditions.](#)” *Toxicol Lett.* 2020;323:35-40. doi:10.1016/j.toxlet.2020.01.020

Appendix D

Sampling of Scientific Studies Pertaining to Cellphone Radiation

CANCER

2018 U.S. National Toxicology Program (NTP) & Italian Study Confirm Cell Phones Cause Cancer

- See the NTP website which indicates radiofrequency radiation is associated with "Clear evidence of tumors" -- the highest warning they can issue:
https://ntp.niehs.nih.gov/whatwestudy/topics/cellphones/index.html?utm_source=direct&utm_medium=prod&utm_campaign=ntpgolinks&utm_term=cellphone
- In the following article, study designer and former NTP Senior Scientist Ronald L. Melnick, PhD., counters with facts the industry spin intended to downplay the NTP study findings:
<https://www.sciencedirect.com/science/article/pii/S0013935118304973?via=ihub>
- In January 2020 the National Institutes of Environmental Health (NIEHS) published the following article from NTP scientist Michael Wyde, Ph.D., confirming brain, heart and adrenal tumors and that more research is underway to understand the impact of adding 5G millimeter waves to the existing exposures from 2G, 3G and 4G radiation:
<https://factor.niehs.nih.gov/2020/1/community-impact/5g-technology/index.htm>
- See study findings by the Ramazzini Institute study in Italy, which corroborates the NTP study findings:
<https://www.sciencedirect.com/science/article/pii/S0013935118300367?via=ihub>
- Longtime World Health Organization advisor [Anthony B. Miller, M.D.](#), and other experts, confirm radiofrequency (RF) radiation from any source now fully meets the World Health Organization criteria to be classified as a "Group 1 carcinogenic to humans" agent:
<https://www.sciencedirect.com/science/article/pii/S0013935118303475?via=ihub>

- BioMed Research International published a peer-reviewed study by Michael Carlberg, MSc, and Lennart Hardell, M.D., Ph.D. concluding "RF radiation should be regarded as a human carcinogen causing glioma."
<https://www.hindawi.com/journals/bmri/2017/9218486/>
- In 2018 IEEE Microwave Magazine published, "Clear Evidence of Cell Phone RF Radiation Cancer Risk" by Dr. James Lin:
<https://ieeexplore.ieee.org/document/8425056/?part=1>

Dr. Lin's article is also available in full here:

http://www.avaate.org/IMG/pdf/lin_2018.pdf

INFERTILITY

- Dr. Martin Pall's 2018 paper, "5G: Great risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field (EMF) Exposures and the Mechanism that Causes Them" indicates much of the damage from wireless radiation is cumulative and some becomes irreversible.

His paper includes 16 scientific reviews (each referencing multiple individual peer-reviewed published studies) which include a wide variety of changes leading to lowered male fertility, lowered female fertility, increased spontaneous abortion, lowered levels of estrogen, progesterone and testosterone, and lowered libido.

The European Academy of Environmental Medicine provides Dr. Pall's paper here:

https://europaem.eu/attachments/article/131/2018-04_EU-EMF2018-5US.pdf

- See the 2018 paper, "Radiations and male fertility":
<https://rbej.biomedcentral.com/articles/10.1186/s12958-018-0431-1>
- See also abstracts for eight review papers and links to 40+ studies as collected by Dr. Joel Moskowitz:
<https://www.saferemr.com/2015/09/effect-of-mobile-phones-on-sperm.html>

- These studies address male fertility issues and wi-fi:
<http://www.ncbi.nlm.nih.gov/pubmed/22112647>
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3778601/>
<https://www.ncbi.nlm.nih.gov/pubmed/28967061>
- A 2017 study, "Temporal trends in sperm count: a systematic review and meta-regression analysis" shows sperm counts dropping dramatically:
<https://academic.oup.com/humupd/article/doi/10.1093/humupd/dmx022/4035689/Temporal-trends-in-sperm-count-a-systematic-review>
- Kaiser Permanente scientists completed a study that concluded non-ionizing radiation more than doubles the risk of miscarriage:
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5727515/>
- The EPA provides an understanding of how DNA mutations from radiation affect what we pass on to our offspring genetically:
http://www.epa.gov/radiation/understand/health_effects.html
- The following link provides an audio track from a 2013 conference led by leading U.S. experts in, "Cell Phones & WiFi – Are Children, Fetuses and Fertility at Risk?"
<http://electromagnetichealth.org/electromagnetic-health-blog/summary-and-audio/>
- Barrie Trower, PhD, "WiFi Report – Humanity At The Brink," September 2013, shows how wi-fi exposure now will affect fertility in the future:
<http://www.geoengineeringwatch.org/barrie-trower-wifi-report-humanity-at-the-brink/>
- A quick search of the National Institutes for Health (NIH) PubMed database on "emf fertility" returns a multitude of other studies from around the world:
<http://www.ncbi.nlm.nih.gov/m/pubmed/?term=emf+fertility>

ELECTROMAGNETIC SENSITIVITY

While adverse effects of long-term exposure to wi-fi radiation, like cancer, infertility and DNA damage may not surface in some for years, there are many who suffer immediate effects when exposed to wireless radiation. Health care providers are now learning to diagnose and treat environmentally induced electromagnetic sensitivity, or ES, also known as microwave sickness. Training for doctors, nurses, first responders and others will be provided in the continuing medical education (CME) accredited EMF Medical Conference 2021, <https://emfconference2021.com/>.

Those who suffer from ES can feel the radiation hitting various biological systems when they encounter cell towers, small cell antennas, routers, access points, cordless phones, smart meters, laptops, iPads, tablets, baby monitors, fluorescent lights or any other devices pulsing signal. Patients experience a myriad of immediate or latent symptoms that may include pain, tightening in the chest or skull, altered heartbeat, tinnitus or ringing in the ears, headaches, nosebleeds, insomnia, fatigue, diminished concentration, cognitive impairment, poor memory, behavioral issues, anxiety, depression, anger, suicidal ideation and more. Symptoms can disappear or diminish over time when exposure to electromagnetic fields (EMFs) is eliminated.

Following is a sampling of the science and actions being taken by the medical community, followed by recognition of ES by the Americans with Disabilities Act:

- Dominique Belpomme and Philippe Irigaray: "[Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It](#)," *Int J Mol Sci*. 2020 Mar; 21(6): 1915.
- "[Electromagnetic Field Sensitivity](#)," *Journal of Bioelectricity*: Vol 10, No 1-2.
- [Replication of heart rate variability provocation study](#)
- McCarty DE *et al*, (December 2011) "Electromagnetic hypersensitivity: evidence for a novel neurological syndrome," *Int J Neurosci*. 2011 Dec;121(12):670-6. Epub 2011 Sep 5 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]
- Nishimura T *et al*, (March 2011) "A 1-uT extremely low-frequency electromagnetic field vs. sham control for mild-to-moderate hypertension:

a double-blind, randomized study,” *Hypertens Res.* 2011 Mar;34(3):372-7. Epub 2011 Jan 20 [[View Author's abstract conclusions](#)] [[View on Pubmed](#)]

- See other EHS papers at [Physicians](#) for Safe Technology: <https://mdsafetech.org/science/es-science/>
- The United States Access Board's IEQ Indoor Environmental Quality Project indicates electromagnetic sensitivities may be considered disabilities under the ADA: <https://www.access-board.gov/research/completed-research/indoor-environmental-quality/introduction>
- The Access Board recommends the following accommodations: <https://www.access-board.gov/research/completed-research/indoor-environmental-quality/recommendations-for-accommodations>
- Job Accommodation Network (JAN) is one of several services provided by the U.S. Department of Labor's [Office of Disability Employment Policy \(ODEP\)](#). JAN offers the following Accommodation Ideas for Electromagnetic Sensitivity: <http://askjan.org/soar/other/electrical.html>

VULNERABILITY OF CHILDREN

- Bioelectromagnetics expert Dr. Om Ghandi published in IEEE Access, "Yes the Children Are More Exposed to Radiofrequency Energy From Mobile Telephones Than Adults": <http://ieeexplore.ieee.org/document/7131429/?reload=true&arnumber=7131429&contentType=Journals%20%26%20Magazines>
- Pall, M. L. (2016). "Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression." *Journal of Chemical Neuroanatomy*, 75(Pt B), 43–51. <https://doi.org/10.1016/j.jchemneu.2015.08.001>
- Warnke, U., & Hensinger, P. (2013). "Increasing incidence of burnout due to magnetic and electromagnetic fields of cell phone networks and other wireless communication technologies." (Original: Steigende „Burn-out"-Inzidenz durch technisch erzeugte magnesche und elektromagnesche Felder des Mobil- und Kommunikaonsfunks, Umwelt·medizin·gesellschaft, 26(1), 31-38. http://avaate.org/IMG/pdf/warnke_hensinger_umg_1_2013_engl_df.pdf

- Martha Herbert, PhD, MD, a leading neuroscientist and autism expert, “Findings in Autism (ASD) Consistent with Electromagnetic Fields (EMF) and Radiofrequency Radiation (RFR)”:
https://bioinitiative.org/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf
- Dr. Toril Jelter, pediatrician and general practitioner, discusses EMF, Autism and Child Behavior in an 8-minute video. She prescribes a two-week trial with limited wi-fi exposure and patients often have remarkable results in just a few days:
<https://www.youtube.com/watch?v=O3iRrVQPDBk>
- Hugh Taylor, MD, Yale University discusses ADHD symptoms seen in mice exposed to cell phone radiation:
<http://vimeo.com/73806192>
- Studies have found adverse effects on offspring from prenatal exposure to wireless radiation:
<http://www.saferemr.com/2014/06/joint-statement-on-pregnancy-and.html>
- Dr. Toril Jelter, pediatrician and general practitioner, discusses EMF, Autism and Child Behavior in an 8-minute video. She prescribes a two-week trial with limited wi-fi exposure and patients often have remarkable results in just a few days:
<https://www.youtube.com/watch?v=O3iRrVQPDBk>
- Barrie Trower, a former physicist with the British Royal Navy and expert in radiation, explains in the following two-part lecture the dangers of using wi-fi radiation. He is particularly concerned for the welfare of children and fetuses:
<http://www.youtube.com/watch?v=5xgJmeQaQmc>
<http://www.youtube.com/watch?v=UhcuSEHVOSM>
- The [American Academy of Environmental Medicine](#) has issued an *Open Letter to the Superintendents* imploring them to protect our children.
- The American Academy of Pediatrics (AAP), representing 60,000 pediatricians, in December 2012 urged Congress to protect children from the dangers of wi-fi. "It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their

lifetimes." The full letter is published here:

<http://www.electrosmogprevention.org/cell-phone-safety-campaign/american-academy-of-pediatrics-supports-rf-protection/>

In addition to the biological effects of radiation on children, science is showing excessive screen time is causing addiction, impairing our children's ability to function and is degrading family and social relationships. Here is a sampling of books that bring forth the science and safe technology solutions:

- Dr. Nicholas Kardaras, addiction expert, has clinically worked with more than a thousand teens. He published the book *Glow Kids* which shows how screen addiction is hijacking our kids and offers strategies to break the trance.
- Dr. Catherine Steiner-Adair offers [*The Big Disconnect*](#), which takes one through technology's impact at each stage of child development. Basically, the left side of the brain where math and science are housed is still developing on point. The right side, however, is not in many children. This is where a child's ability to show empathy, employ coping strategies, make eye contact, and self-soothe are housed. In humans, we need regular human contact and deep meaningful interactions with loved ones and teachers to develop these properly. Children also need unstructured time for imaginative play to develop deep parts of our brains. Although well-intended parents think providing their children with technology will give them a leg up, the research is proving otherwise as we begin to see scores dropping after upping technology time, and behavioral and mental health issues are escalating.
- In [*Reset Your Child's Brain*](#), Dr. Victoria Dunkley explains the myriad ways in which children can be harmed by electronic screen syndrome (ESS). Biologically, electronic screen exposure can cause a chronic fight or flight response, and hit the same opiate receptors in the brain as drugs and alcohol causing addiction. Children with attention issues and those with autism are at higher risk of addiction. If not given appropriate time to rest and regenerate, children begin to suffer chronically. Common symptoms are irritability, depression and mood swings. As ESS progresses, mood dysregulation may combine with aggression causing some to be diagnosed with bi-polar disease. Others may develop obsessive-compulsive behavior, nightmares, panic attacks, tics, seizures, etc., as the effects take hold on the brain. Dr. Dunkley demonstrates how freedom from electronic screens can

change the brain and alleviate or significantly reduce many of these symptoms. She offers a four-week plan to reverse the effects of ESS. See also her article in [Psychology Today](#).

- Paula Healy steps us through the psychological and neurological impact of screentime in this 37 minute talk, *How our Digital Obsession is Dumbing us Down*:
https://www.youtube.com/watch?v=OM_IFijB9rA&feature=youtu.be
- Dr. Marilyn Wedge explains how screens are impairing development in “Virtual Autism” *May Explain Explosive Rise in ASD Diagnoses*:
https://www.madinamerica.com/2017/08/virtual-autism-explain-rising-asd-diagnoses/?fbclid=IwAR0K7A5j36mbGDKdNdafUBPG0TNdHcC9hj4Id_tKJZx6GSf_pcZExVIgJZs

Additionally, Silicon Valley executives limit their own children’s access to technology while promoting it to others’ children:

- Apple's Steve Jobs and other technology executives limited their own children's technology exposure:
http://www.nytimes.com/2014/09/11/fashion/steve-jobs-apple-was-a-low-tech-parent.html?smid=fb-share&_r=1
- The Digital Gap Between Rich and Poor Kids Is Not What We Expected: America’s public schools are still promoting devices with screens — even offering digital-only preschools. The rich are banning screens from class altogether.
<https://www.nytimes.com/2018/10/26/style/digital-divide-screens-schools.html?action=click&module=RelatedLinks&pgtype=Article>
- A Dark Consensus About Screens and Kids Begins to Emerge in Silicon Valley: “I am convinced the devil lives in our phones.”
https://www.nytimes.com/2018/10/26/style/phones-children-silicon-valley.html?action=click&contentCollection=undefined&contentPlacement=4&module=stream_unit&pgtype=collection®ion=stream&rref=collection%2Fbyline%2Fnellie-bowles&version=latest
- Silicon Valley Nannies Are Phone Police for Kids: Child care contracts now demand that nannies hide phones, tablets, computers and TVs from their charges.
<https://www.nytimes.com/2018/10/26/style/silicon-valley-nannies.html>

Appendix E

Challenges to the Radiation Exposure Standards Set by U.S. Regulatory Agencies

Organizations Recommending Reducing Wireless Radiation Thresholds

[5G Appeal to the European Union by Hundreds of Scientists](#)

[American Academy of Pediatrics – Letters Calling for Updating Radiation Standards](#)

[US Doctors and Experts National 5G Resolution](#)

[EMF Scientist Appeal](#)

[International Society of Doctors for Environment – Appeal for a 5G Standstill](#)

[The EMF Call – Protective Limits for Exposure to Electromagnetic Fields](#)

[Vienna Medical Association](#)

[Scientists Join Canadian Doctor Appeal on 5G](#)

[Ontario Doctors Appeal and former Microsoft Canada President](#)

[The European Scientific Committee on Health, Environmental and Emerging Risks](#)

[Worcester School’s Standing Committee consulted with the Massachusetts Department of Epidemiology – Best Practices, Minimizing Exposure to RF](#)

[ANSES, France’s National Agency for Food, Environmental and Occupational Health Safety – Recommends Moderate Use of Wireless Communication Technologies by Children](#)

[ANSES, France’s National Agency for Food, Environmental and Occupational Health Safety – Recommends Limiting The Population’s Exposure to RF](#)

[World Health Organization’s International Agency for Research.](#)

[New Jersey Education Association – Minimize Health Risks from Electronic Devices](#)

[Environment and Human Health, Inc. – Technology, Exposures, Health Effects](#)

[Irish Doctors Environmental Association](#)

[Bioinitiative Working Group – 2012 Report on Biologically Based Exposure Standards](#)

[International Appeal to Stop 5G on Earth and in Space, Scientists \(4,503\), Engineers \(8,036\), Medical Doctors \(2,593\), Nurses \(4,177\), Psychologists, Psychotherapists and Social Workers\(9,663\)](#)

[German Environmental Organisation “Bund” – Petition to Stop 5G in Hamburg](#)

[German Doctors Delegation – Open Letter to Prime Minister Kretschmann](#)

[Hippocrates Electrosmog Appeal of Belgium – Over 550 Health Professional Signatures](#)

[Pancyprian Medical Association & Cyprus National Committee on the Environment and Child Health – Public Health Dangers from the 5G Network](#)

[California Department of Public Health – Reduce Exposure to Radiofrequency From Cell Phones](#)

[The BabySafe Project – Health Professionals Warn of Dangers of Wireless Radiation on Pregnancy](#)

[Turin Medical Association of Italy – Changes in the Law on Electromagnetic Radiation Needed](#)

[Department of Pediatrics at Hadassah Hebrew University Hospital – Statement by Dr. Eitan Kerem](#)

[The American Academy of Environmental Medicine – Recommendations, Letter to the FCC](#)

[Association for Consumer Protection in Romania](#)

[Cleveland Clinic](#)

[Swiss Physicians Association of Doctors for Environmental Protection – Apply The Precautionary Principle for Wireless Devices](#)

[Swiss Physicians Association of Doctors for Environmental Protection – Preliminary Draft for a Federal Law Protecting Against the Dangers of Non-Ionizing Radiation](#)

[African Cancer Organization – Advisory to Keep Children From Mobile Phones](#)

[The Cyprus National Committee on Environment and Child Health – Recommendations to Reduce Exposure to Children](#)

[Austrian Medical Association – Nicosia Declaration on Health Impacts from EMF and RF Radiation](#)

[Austrian Medical Association – Practical Rules to Decrease Wireless EMF Radiation Exposure](#)

[Santa Clara County Medical Association Magazine](#)

[Connecticut Department of Public Health – Cell Phone Safety Bulletin](#)

[Athens Medical Association – Measures to Protect Against Electromagnetic Radiation](#)

[Canadian Parliament Standing Committee on Health of the House of Commons](#)

[Pittsburgh Cancer Institute](#)

LETTERS TO FDA

- [Press releases from scientists challenging radiation limits](#)
- [Letter calling for a retraction signed by several scientists.](#)
- [Ronald Melnick PhD’s letter to the FDA on the National Toxicology Program study](#)
- [Albert Manville PhD, retired Senior Wildlife Biologist, Division of Migratory Bird Management, U.S. Fish & Wildlife Service, Wash. DC HQ Office \(17 years\); Senior Lecturer, Johns Hopkins University](#)
- [Prof. Tom Butler of the University College in Cork, Ireland’s letter to the FDA](#)

- [Igor Belyaev, PhD, Dr. Sc. Head, Department of Radiobiology of the Cancer Research Institute, Biomedical Research Center of the Slovak Academy of Science letter to the FDA](#)
- [Paul Heroux PhD, McGill University](#)
- [Alfonso Balmori, BSc statement to the FDA](#)

LETTERS AND OFFICIAL BRIEFINGS ON 5G

Briefing on 5G Health Impacts by Dr. Martin Pall: [“5G: Great Risk for EU, U.S. and International Health! Compelling Evidence for Eight Distinct Types of Great Harm Caused by Electromagnetic Field \(EMF\) Exposures and the Mechanism that Causes Them”](#)

November 19, 2018 – Magda Havas, BSc, PhD, Trent University, Peterborough, Canada – [Open Letter: Need to Consider Health Effects Associated with Radio Frequency and Microwave Radiation before Deployment of 5G](#)

November 19, 2018 – Paul Héroux, PhD, Professor of Toxicology and Health Effects of Electromagnetism, McGill University Medicine, Montreal – [Open Letter](#)

November 21, 2018 – Yuri Grigoriev, Dr. Sc. Med., Professor, Academician of Russian Academy of Electrotechnical Sciences – [Open Letter: From Electromagnetic Smog to Electromagnetic Chaos Evaluating the Hazards of Mobile Communication for Public Health](#)

December 7, 2018 – David O. Carpenter, MD, Director, Institute for Health and the Environment, University at Albany, State University of New York – [Open Letter to Ministers and Members of Parliament of the Brussels Capital Region](#)

December 13, 2018 – Olle Johansson, PhD, associate professor / retired from the Karolinska Institute, Stockholm, Sweden, and the Royal Institute of Technology, Stockholm, Sweden – [Letter of Concern, addressed to the decision-makers of the City of Brussels](#)

May 15, 2019- Magda Havas, BSc, PhD, Trent University, Peterborough, Canada [Affidavit on 5G to Canadian Parliament with non-profit EMF OFF.](#)

LETTERS FROM ORGANIZATIONS AND OTHERS

[Letter from Frank Clegg, former President of Microsoft, Canada](#)

[Letter from EMF 249 Scientists to Mr. Charles Parkinson/Mrs. Andrea Dudley-Owen President & Vice President of Economic Development, The States of Guernsey, Re: 5G](#)

[Letter from Jerry L. Phillips Ph.D. to Mr. Charles Parkinson & Mrs. A Dudley-Owen President & Vice President Of Economic Development, The States of Guernsey, Re: 5G](#)

[Letter from Paul Héroux, PhD to The States of Guernsey, Re: 5G](#)

[Health Effects of Electromagnetism \(Detailed Report\) submitted to The States of Guernsey by Paul Héroux, PhD](#)

[Letter from Anthony B. Miller, MD, FRCP to Gavin St Pier Esq, Chief Minister, The States of Guernsey, Re: 5G](#)

[Letter from Professor Colin Pritchard to The States of Guernsey, Re: 5G](#)

[Declaration to European Commission by 180 Scientists Calling for a Moratorium on 5G Cell Antennas, September 13, 2017](#)

[National Health Integrated Associates October 29, 2018 Letter to Montgomery County Council](#)

[Letter from Dr. Lennart Hardell To Governor Jerry Brown on SB649](#)

[Beatrice Alexandra Golomb, MD, PhD Lettter in Opposition to SB649](#)

[Letter from Dr. Martin Pall in Opposition to SB649](#)

[Attachment to Dr. Pall Letter – 142 Microwave Radiation Review Studies](#)

[Letter from Dr. Devra Davis to Chair Aguiar-Curry on SB 649, June 28, 2017](#)

[Letter from Dr. Devra Davis to Governor Jerry Brown on SB 649, September 17, 2017](#)

[Letter from Dr. Paul Ben Ishai in Opposition to SB 649, September 08, 2017](#)

[Letter from Dr. Cindy Russell in opposition to SB 649](#)

[Letter from Physicians For Safe Technology in opposition to SB 649](#)

[Article from Dr. Cindy Russell on Impacts of 5G Technology, January 2017](#)

[Santa Clara Bulletin, pg. 20-23, “A 5G Wireless Future: Will It Give Us a Smart Nation or Contribute to An Unhealthy One?” by Cindy Russell, January 2017](#)

[Letter from Dr. Joel Moskowitz To Governor Jerry Brown on SB 649](#)

[Beatrice Alexandra Golomb, MD, PhD Letter in Opposition to SB 649](#)

[Letter from Dr. Sam Milhelm](#)

[Letter from Dr. John West](#)

[Letter from Dr. Hugh Scully to the City of Toronto](#)

[Letter from Dr. Stephen Sinatra to Toronto City Councilors in Opposition to Item 26.21](#)

[Joint letter from 541 health, environment and justice advocates and organizations to US Senators and Representatives in opposition to bills on 5G and wireless radiation expansion – November 13, 2017](#)

[Ellie Marks Letter to Governor Brown SB 649](#)

[Letter from the Alliance of Nurses for Health Environments](#)

[Letter from Environmental Working Group June 26, 2017](#)

[Letter from Environmental Working Group July 26, 2017](#)

[8/20 National Institute for Science, Law & Public Policy Letter to Appropriations Committee](#)

[8/21 National Institute for Science, Law & Public Policy Letter to Assembly](#)

[8/24 National Institute for Science, Law & Public Policy Letter to Governor Brown.](#)

[Letter from the Sierra Club, August 15, 2017](#)

[Letter from Greenlining Institute, June 27, 2017](#)

[Letter from the American Association of Retired Persons \(AARP\), July 19, 2017](#)

[Letter from Law Office of Harry Lehmann “Mass casualties are likely in District 10 from passage of 648”, July 6, 2017](#)

[Letter from Law Office of Harry Lehmann to State of California, “Liability for Damage From Microwave Radiation Exposure Sustained by Senate Bill 649 Will Be Shifted to California State”, July 19, 2017](#)

[Letter from Law Office of Harry Lehmann, “SB 649 will disproportionately effect the poor in California”, August 24, 2017](#)

[Letter from EMF Safety Network and Ecological Options Network, July 06, 2017](#)

[Letter by Susan Foster Assembly Appropriations Letter – Fire Station Exemption from SB 649, August 14, 2017](#)

[Letter from Susan Foster and Radiation Research Trust in of Opposition of SB 649, June 22, 2017](#)

Scientists For Wired Technology, 5/30/17: [front](#) and [back](#)

Scientists For Wired Technology 5/31/17:[front](#) and [back](#)

[American Planning Association Opposes SB 649](#)

[Berkeley City Council Opposition Letter, April 25, 2017](#)

SCIENTIFIC COMMENTS TO THE FCC

[Comments by Ronald M. Powell, PhD, to the FCC on Spectrum Frontiers](#)

[Comments by The Berkshire-Litchfield Environmental Council to the FCC on Spectrum Frontiers, July 12, 2016](#)

[Comments by Dr. Albert Manville to the FCC on Spectrum Frontiers, July 14, 2016](#)

[Comments by Dr. Joel Moskowitz to the FCC on Spectrum Frontiers, July 20, 2016](#)

[Comments by Dr. Yael Stein to the FCC on Spectrum Frontiers, July 09, 2016](#)

[Comments by Dr. Devra Davis to the FCC on Spectrum Frontiers](#)

[Comments by Susan Clarke to the FCC on Spectrum Frontiers, July 14, 2016](#)

[Comments by EMF Scientist Appeal Advisors to the FCC on Spectrum Frontiers, June 09, 2017](#)

[Letters by Scientists and Doctors on Small Cells and 5G](#)

Appendix F

Wireless Exposure Limits in Different Countries

The exposure limits given below are from the [website of Physicians for Safe Technology](#)

Japan	600 microwatts/cm ²
U.S.A.	450 microwatts/cm ²
Canada	450 microwatts/cm ²
Australia	450 microwatts/cm ²
Austria	450 microwatts/cm ²
France	450 microwatts/cm ²
Germany	450 microwatts/cm ²
Hungary	450 microwatts/cm ²
Ireland	450 microwatts/cm ²
Luxembourg	450 microwatts/cm ²
Portugal	450 microwatts/cm ²
Spain	450 microwatts/cm ²
India	45 microwatts/cm ²
China	40 microwatts/cm ²
Russia	10 microwatts/cm ²
Italy	10 microwatts/cm ²
Bulgaria	10 microwatts/cm ²
Poland	10 microwatts/cm ²
Lichtenstein	10 microwatts/cm ²
Switzerland	10 microwatts/cm ²
Belgium	2.4 microwatts/cm ²
Ukraine	2.5 microwatts/cm ²
Cosmic	<0.00000000001 microwatts/cm ²



Appendix G

Captured Agencies and Conflicts of Interest

Alster, Norm, *Captured Agency: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates*, Edmond J. Safra Center for Ethics, Harvard University. The report can be accessed [here](#).

Conflicts of Interest Among Those Who Set Radiation Limits

- In Europe, the public radiation limits are set by the International Committee on Non-Ionizing Radiation Protection (ICNIRP). Investigate Europe, a team of investigative journalists expose that ICNIRP members have extensive conflicts of interest with industry. Dr. Joel Moskowitz chronicles their findings, and additional studies that show ICNIRP scientists are working for industry:
<https://www.saferemr.com/2018/07/icnirps-exposure-guidelines-for-radio.html>
- The 98 page report, "*The International Commission on Non-Ionizing Radiation Protection: Conflicts of interest, corporate capture and the push for 5G*" was commissioned, coordinated and published in 2020 by two Members of the European Parliament – Michèle Rivasi and Klaus Buchner:
<https://www.saferemr.com/2018/07/icnirps-exposure-guidelines-for-radio.html>
- Priyanka Bandara, Ph.D., and others in 2020 published *5G Wireless Deployment and Health Risks: Time for a Medical Discussion in Australia and New Zealand* which cites conflicts of interest with industry and current evidence of harm:
https://www.researchgate.net/publication/343416307_5G_Wireless_Deployment_and_Health_Risks_Time_for_a_Medical_Discussion_in_Australia_and_New_Zealand

Conflicts of Interest at the World Health Organization

- In 2016 the authors of the BioInitiative Report, which summarizes thousands of peer-reviewed scientific studies showing wireless technology is harmful, submitted a No-Confidence letter to the WHO's EMF program manager because the committee no longer includes appropriate representation from non-industry funded EMF scientific experts:

<http://www.bioinitiative.org/bioinitiative-working-group-issues-a-no-confidence-letter-to-the-who-emf-program-manager/>.

- The [Russian National Committee on Non-Ionizing Radiation Protection](#) issued a similar letter in March 2017.
- Over 250 of the world's leading EMF scientists and biologists have signed a formal appeal to the World Health Organization with a clear plan to inform and protect the public from wireless radiation:
<https://www.emfscientist.org/>
- Columbia University's Dr. Martin Blank provides a three-minute introduction to the Appeal that summarizes the issue: <https://vimeo.com/123468632>
- The head of the WHO's "International EMF Project" has heavy ties to the telecom industry. Further, she does not have EMF scientific or medical credentials and is not listening to the scientists proving electromagnetic fields are hazardous. A former UN employee, Olga Sheean of Canada, submitted a petition to get qualified leadership in place:
<http://olgasheean.com/who-emf/>.
- In 2017, the International Journal of Oncology published a report by Dr. Lennart Hardell explaining the WHO has conflicts of interest with industry and does not plan to take action to protect the public from non-thermal electromagnetic radiation, even though the scientific and epidemiological evidence of harm is well documented:
<https://www.spandidos-publications.com/10.3892/ijo.2017.4046>
- In 2020, the WHO's "International EMF Project" reopened its investigation into Electromagnetic Fields:
https://www.who.int/peh-emf/research/rf_ehc_page/en/index1.html

The WHO's "International EMF Project" is composed of those with close ties to industry and is separate from the another WHO group that in 2011 determined EMFs to be Group 2B: Possibly Carcinogenic to Humans. The latter group is the "International Agency for Research on Cancer (IARC)" which has non-industry funded scientific experts in the biological effects of EMFs. It remains to be seen what will come of the investigation launched in 2020:

<https://ehtrust.org/scientists-call-for-transparency-at-the-world-health-organization-emf-project/>

Appendix H

Example of an RF radiation warning

Study:

913 pregnant women;
Greater exposure to magnetic
fields from wireless radiation
increased risk of miscarriage
by 48%.

#knowyourexposure
#babysafeproject



Learn how to reduce your exposure.
Visit: www.BabySafeProject.org

Appendix I

Example of a symbol for use on poles and other structures located in public rights-of way that hold 5G antennae



Appendix J

Deleterious effects of impulsive radiation

While current FCC guidelines for non-ionizing radiation exposure are based upon heating effects, there is a growing body of research showing that the impulsive nature of high-speed data transmission can cause deleterious health effects at considerably lower radiation levels. Three references that document the effect of the impulsive radiation are given below:

[1] Belyaev, I., Dean, A., Eger, H. et al. "EUROPAEM EMF Guideline 2016 for the prevention, diagnosis, and treatment of EMF-related health problems and illnesses." *Rev environ Health*. 2016;31(3):363-397. Doi:10.1515/reveh-2016-0011.

[2] B. W. G. (2012). "Bioinitiative 2012: A Rationale for Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation."

[3] McCarty, D. E., Carrubba, S., Chesson, A. L., Frilot, C., Gonzalez-Toledo, E., & Marino, A. A. (2011). "Electromagnetic hypersensitivity: P Evidence for a novel neurological syndrome." *International Journal of Neuroscience*, 121(12), 670-676.

Appendix K

Siting restrictions for wireless antennae

The siting restrictions for cell phone towers already in force in the world were intended to ensure the safety of vulnerable populations, like children and those with illnesses.

India already prohibits placement of cell phone towers near schools or hospitals, and Canada (Standing Committee on Health), as well as many European countries, are looking into similar restrictions.

CALIFORNIA FIREMEN

California firemen are exempted from the forced placement of towers on or adjacent to their stations, because of radiation health concerns.

“The International Association of Fire Fighters’ position on locating cell towers commercial wireless infrastructure on fire department facilities, as adopted by its membership in August 2004, is that the IAFF oppose the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions until a study with the highest scientific merit and integrity on health effects of exposure to low-intensity RF/MW radiation is conducted and it is proven that such sitings are not hazardous to the health of our members.”

<https://ecfsapi.fcc.gov/file/109281319517547/20-Attachment%2020-%20Firefighters%20Inter%20Resolution%20Against%20Cell%20Towers.pdf>

<https://vimeo.com/122670207>

<https://web.archive.org/web/20150403040308/http://www.stopcellphonetowers.com/index.html%20>

https://www.youtube.com/watch?v=61h_vuBujw0

<http://cbsloc.al/2DNAYA5>

<https://sanfrancisco.cbslocal.com/2018/01/25/consumerwatch-5g-cellphone-towers-signal-renewed-concerns-over-impacts-on-health>

https://ehtrust.org/wp-content/uploads/HARDELL-14-October-2014_1-1.pdf

This was codified in [Government, section 65964.1. \(f\)](#) as enacted by California's legislation AB 57 in 2015:

"Due to the unique duties and infrastructure requirements for the swift and effective deployment of firefighters, this section does not apply to a collocation or siting application for a wireless telecommunications facility where the project is proposed for placement on fire department facilities."

A similar provision was included in California's SB 649 (2018), "Wireless Telecommunications Facilities" under item 65964.2.:

"(a) A small cell shall be a permitted use subject only to a permitting process adopted by a city or county pursuant to subdivision (b) if it satisfies the following requirements: ... (3) The small cell is not located on a fire department facility."

On October 15, 2018, Governor Jerry Brown vetoed SB 649, the so-called small-cell bill, which would have usurped local authority over the siting of telecom equipment.

To the Members of the California State Senate:
I am returning Senate Bill 649 without my signature.

This bill establishes a uniform permitting process for small cell wireless equipment and fixes the rates local governments may charge for placement of that equipment on city or county owned property, such as streetlights and traffic signal poles.

There is something of real value in having a process that results in extending this innovative technology rapidly and efficiently. Nevertheless, I believe that the interest which localities have in managing rights of way requires a more balanced solution than the one achieved in this bill.

Sincerely, Edmund G. Brown Jr.

ESTABLISHING SETBACK

To increase wireless data rates, the 5G industry seeks higher frequencies. These frequencies distribute energy in a smaller fraction of the body and need higher field intensities because of (1) poor penetration into structures, (2) absorption of radiation by oxygen and water, (3) shrinking antenna apertures, as well as (4) noise from an increasing number of extraneous sources.

For human users, this means increased power density exposures. In addition, exposures will become more irregular because of beam-forming, as well as originate from multiple sources (Multiple-Input Multiple-Output architecture).

Since there is no epidemiological or animal data, and very few laboratory results using 5G, cautionary setbacks should be established by the municipalities based upon past 3G and 4G systems.

The verdict on animal studies is expressed in reports by (1) the US National Toxicology Program, (2) the Ramazzini Institute, and by older studies by (3) Chou (1992) and (4) Repacholi (1997).

The verdict on epidemiology is expressed in two reports (ELF and RF) from the *International Agency for Research on Cancer* (“possibly carcinogenic”), which Agency is scheduled to review evidence on RF carcinogenicity between now and 2024.

Senator Blumenthal:

<https://www.radiationresearch.org/articles/us-senator-blumenthal-raises-concerns-on-5g-wireless-technology-health-risks-at-senate-hearing-youtube/>

US National Toxicology Program – Impact of Cell Phones:

<https://ntp.niehs.nih.gov/results/areas/cellphones/index.html>

Ramazzini Institute – Impact of Base Stations:

<https://www.ncbi.nlm.nih.gov/pubmed/29530389>

International Agency for Research on Cancer – ELF:

<https://monographs.iarc.fr/wp-content/uploads/2018/06/mono80.pdf>

https://www.iarc.fr/wp-content/uploads/2018/07/pr208_E.pdf

International Agency for Research on Cancer – RF:

<https://publications.iarc.fr/Book-And-Report-Series/IARC-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Non-ionizing-Radiation-Part-2-Radiofrequency-Electromagnetic-Fields-2013>

https://www.iarc.fr/wp-content/uploads/2018/07/pr208_E.pdf

Chou, 1992: <https://onlinelibrary.wiley.com/doi/abs/10.1002/bem.2250130605>

Repacholi, 1997: <https://www.ncbi.nlm.nih.gov/pubmed/9146709>

As vulnerable individuals are exposed involuntarily every day in society to RF-radiation, caution should be universally used and set according to the Largest Observed Adverse Effect Distance (LOAED), using the experience from past and current 2G, 3G, and 4G networks. A conservative LOAED should include all observed health effects.

Best engineering practice would therefore apply a set-back requirement for new cellular towers, including 5G micro-towers.

From the 17 documents referred to in this appendix, shown below in historical order, this set-back for all new cell towers should be 500 meters which translates to 1,640 feet.

All of these studies have been given support by a recent animal study from the Ramazzini Institute that links to them, as well as to the US National Toxicology Program result on cell phones.

REFERENCES

Paola **Michelozzi**, Alessandra Capon, Ursula Kirchmayer, Francesco Forastiere, Annibale Biggeri, Alessandra Barca, and Carlo A. Perucci.

“Adult and Childhood Leukemia near a High-Power Radio Station in Rome,” Italy. *American Journal of Epidemiology*, Vol. 155, No. 12, (2002) 1096-1103.

Michelozzi et al 2002 describe an increased risk for childhood leukemia at distances up to 6 km from the powerful Vatican Radio transmitters near Cesano, Italy, which led to compensation by decision of Italy’s Supreme Court (relative risk of 7 for lymphomas and myeloma, and 5 for non-Hodgkin’s lymphoma and leukemia).

<https://pubmed.ncbi.nlm.nih.gov/12048223/>

R. **Santini**, P. Santini, P. Le Ruz, J. M. Danze, and M. Seignel. "Survey Study of People Living in the Vicinity of Cellular Phone Basestations." *Electromagnetic Biology and Medicine*. Vol. 22, No. 1, pp. 41-49, 2003.

Santini et al 2003 surveyed by questionnaire 530 people living or not in proximity to cellular phone Base Stations (BSs) in France. Eighteen different symptoms (Non-Specific Health Symptoms-NSHS), described as radiofrequency sickness, were studied. Certain complaints are experienced only in the immediate vicinity of BSs (up to 10 m for nausea, loss of appetite, visual disturbances), and others at greater distances from BSs (up to 100 m for irritability, depressive tendencies, lowering of libido, and up to 200 m for headaches, sleep disturbances, feeling of discomfort). In the 200 m to 300 m zone, only the complaint of fatigue is experienced significantly more often when compared with subjects residing at more than 300 m or not exposed (reference group). For seven of the studied symptoms and for the distance up to 300 m, the frequency of reported complaints is significantly higher ($P < 0.05$) for women in comparison with men. <https://www.tandfonline.com/doi/abs/10.1081/jbc-120020353>

Michael **Kundi**, Hans-Peter Hutter. "Mobile phone base stations—Effects on wellbeing and health." *Pathophysiology* 16 (2009) 123–135.

Kundi and Hutter 2009 comment that studying effects of mobile phone base station signals on health have been discouraged by authoritative bodies like the WHO. As a result, only few investigations of effects of base station exposure on health and wellbeing exist. But two ecological studies of cancer in the vicinity of base stations report both a strong increase of incidence within a radius of 350 and 400 m, respectively. It is suggested that power densities around 500–1000 $\mu\text{W}/\text{m}^2$ must be exceeded in order to observe an effect.

<https://pubmed.ncbi.nlm.nih.gov/19261451/>

Vini G. **Khurana**, Lennart Hardell, Joris Everaert, Alicja Bortkiewicz, Michael Carlberg, Mikko Ahonen. "Epidemiological Evidence for a Health Risk from Mobile Phone Base Stations." *International Journal of Occupational and Environmental Health*. July 2010;16:263–267. DOI: 10.1179/107735210799160192.

Khurana et al 2010 provides a review of 10 BS proximity and neurobehavioral effects, and three investigations of cancer. Eight of the 10 studies reported increased prevalence of adverse neurobehavioral symptoms or cancer in populations living at distances < 500 meters from BSs.

<https://pubmed.ncbi.nlm.nih.gov/20662418/>

Adilza C. **Dode**, Mônica M.D. Leão, Francisco de A.F. Tejo, Antônio C.R. Gomes, Daiana C. Dode, Michael C. Dode, Cristina W. Moreira, Vânia A. Condessa, Cláudia Albinatti, Waleska T. Caiaffa. “Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil.” *Science of the Total Environment* 409 (2011) 3649–3665.

Dode et al 2011 provides the most detailed information. Belo Horizonte is the third largest city in Brazil. It was been selected by the Population Crisis Committee of the United Nations (UN, 2007) as the metropolis with the best quality of life in Latin America. Its health system is considered very good, according to the Atlas of Human Development (2000/United Nations Development Program).

In 2011, a 10-year study on cell phone antennas was released by the Municipal Health Department and several local universities. The study was conducted in a broad environmental context, aiming to verify if there is a spatial correlation between the cellular telephony system BS location and the cases of death by neoplasia during the period between 1996 and 2006. Three data banks were used: 1. death by neoplasia documented by the Municipal Health Department; 2. BS documented in ANATEL (Telecommunications National Agency); and 3. census and demographic city population data obtained from official archives provided by IBGE (Brazilian Institute of Geography and Statistics). The results show that approximately 856 BSs were installed through December 2006.

Between 1996 and 2006, 7191 deaths by neoplasia occurred and, within an area of 500 m from the BS, the mortality rate was 34.76 per 10,000 inhabitants. Outside of this area, a decrease in the number of deaths by neoplasia occurred. The greatest accumulated incidence was 5.83 per 1000 in the Central-Southern region and the lowest incidence was 2.05 per 1000 in the Barreiro region. During the environmental monitoring, the largest electric field measured was 12.4 V/m and the smallest was 0.4 V/m. The largest power density was 407,800 $\mu\text{W}/\text{m}^2$, and the smallest was 400 $\mu\text{W}/\text{m}^2$.

<https://pubmed.ncbi.nlm.nih.gov/21741680/>

Ermanno **Affuso**, J. Reid Cummings, Huubinh Le. “Wireless Towers and Home Values: An Alternative Valuation Approach Using a Spatial Econometric Analysis.” *Journal of Real Estate Finance and Economics* (2018) 56:653–676. DOI 10.1007/s11146-017-9600-9.

Affuso et al 2018 examines the economic impact on home values. For properties located within 0.72 kilometers of the closest tower, results reveal significant declines of 2.46% on average, and up to 9.78% for homes within tower visibility range compared to homes outside tower visibility range.

<https://link.springer.com/article/10.1007/s11146-017-9600-9>

Falcioni L., L. Bua, E. Tibaldi, M. Lauriola, L. De Angelis, F. Gnudi, D. Mandrioli, M. Manservigi, F. Manservigi, I. Manzoli, I. Menghetti, R. Montella, S. Panzacchi, D. Sgargi, V. Stollo, A. Vornoli, F. Belpoggi.

Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission.

Environmental Research 165 (2018) 496–503.

Falcioni et al 2018 conclude: the Ramazzini Institute findings on far field exposure to RFR are consistent with and reinforce the results of the NTP study on near field exposure, as both reported an increase in the incidence of tumors of the brain and heart in RFR-exposed Sprague-Dawley rats. These tumors are of the same histotype of those observed in some epidemiological studies on cell phone users. These experimental studies provide sufficient evidence to call for the reevaluation of IARC conclusions regarding the carcinogenic potential of RFR in humans.

<https://www.avaate.org/IMG/pdf/belpoggi-heart-and-brain-tumors-base-station-2018.pdf>

J.M. **Pearce.** “Limiting liability with positioning to minimize negative health effects of cellular phone towers.” *Environmental Research* 181 (2020) 108845.

Pearce et al 2020 provides the most recent assessment and promotes a 500 m set-back to limit future liabilities of the cell phone industry, based on correlation with headaches, dizziness, depression and other neurobehavioral symptoms, as well as increased cancer risk. It is almost inevitable that such economic impacts will increase in the future.

<https://www.sciencedirect.com/science/article/abs/pii/S0013935119306425>

Other References

Buchner K et al. (2011): [Modification of clinically important neurotransmitters under the influence of modulated high-frequency fields - A long-term study under true-to-life conditions]. In German. Abstract translation below.

This long-term study over one and a half years shows a significant activation of the 60 participants' adrenergic systems after the installation of a regional mobile telephone transmitting station in the village of Rimbach (Bavaria).

The values of the stress hormones adrenaline and noradrenaline grow significantly during the first six months after starting the GSM transmitter; the values of the precursor substance dopamine decreases substantially after the beginning of the radiation (Wilcoxon test, $p < 0,0002$). The initial condition is not restored even after one and a half years. Due to the not regulable chronic difficulties of the stress balance, the phenylethylamine (PEA) values drop until the end of the research period (Wilcoxon test, $p < 0,0001$). The effects show a dose effect relation and are situated far under the valid limits for technical high-frequency stress. Chronic dysregulations of the catecholamine system have substantial health relevance and cause health damages in the long run.

Wolf R, Wolf D. "Increased incidence of cancer near a cell-phone transmitter station." *Int J Canc Prev* 2004; 1 (2): 123-128. Publication unavailable online.

Conclusion according to the authors: Of the 622 people of area A, 8 cases of different kinds of cancer were diagnosed in a period of one year (from July 1997 - June 1998). The cancer incidence rate was 129 cases per 10,000 persons per year in area A compared to 16/10,000 in area B and 31/10,000 in the town of Netanya. Relative cancer rates for females were 10.5 for area A, 0.6 for area B and 1 for Netanya. The authors conclude that the study indicates an association between increased incidence of cancer and living in proximity to a mobile phone base station.

Eger H, Hagen KU, Lucas B, Vogel P, Voit H. [Influence of proximity to mobile telephony transmitters on cancer incidence]. *Umwelt-Medizin-Gesellschaft* 2004; 17 (4): 326-332. In German. Author's conclusion translated below.

320 of 967 residents of Naila have been living in the inner circle at a distance to the next base station of less than 400 m. The results showed an increased risk for malignant tumors for patients living closer than 400 m to the mobile telephony transmitter compared to patients living further away.

In the years 1999 - 2004 the risk for malignant tumors tripled for patients living in the proximity of the mobile telephony transmitter.

Appendix L

Measurement of RF intensities within frequency ranges throughout state

The majority of the Commission suggests this data include location, frequency ranges, peak, and average power intensities of total combined RF emitted by sources such as 3G, 4G, or 5G cellphone networks, Wi-Fi, smart meters, IOT devices, and similar devices. The data should be collected in such a way as to identify possible areas of notably high RF exposure, places where RF signal for wireless communication is inadequate (dead spots), and places where RF is unusually low (white zones) that are sought by people who wish to minimize their exposure.

RF data collected and mapped should be archived and published on a state website, accompanied by state-wide and regional aggregated averages for both peak and 24-hour integrated microwatts/meter squared intensities. The state should also publish benchmarks for comparison: a few readings from low-intensity underdeveloped areas, and nearby some strong high-intensity sources (base of a tower) for min-max comparison. The Bioinitiative 2012 recommends that human peak exposure not exceed an RF intensity of 1,000 microwatts/meter squared.

One use of this data will be buyers/renters of property or the public in general using these benchmark values to make comparisons and form their own decisions based on their comfort level. After a while, an extensive NH RF database will exist to provide useful maps and data for future public health investigations.

Appendix M

The enabling technology and scientific rationale for automatically stopping cell phones from operating when held against the body

The FCC testing procedure for certification of cell phones aims for a power injection into the head below 1.6 Watts per kilogram of tissue. The accuracy of SAR determinations is not very high (variation between laboratories), and some cellular phones have been found to exceed this limit

(<https://www.chicagotribune.com/investigations/ct-cell-phone-radiation-testing-20190821-72qgu4nzlfda5kyuhteieh4da-story.html>).

A major problem is that the FCC testing procedure allows the phone to be tested up to 0.98 inches (2.5cm) from the head, at which distance injection of energy into the head is much reduced compared to when held against the head as is done routinely by users. “Small print” instructions already present in many cell phone manuals instruct users to hold cell phones at a distance from the head, in full knowledge that this is not likely to be done.

In France, measurements by the National Frequency Agency (ANFR) revealed that 9 out of 10 mobile phones tested in 2015 under real use conditions (in contact with the body) exceeded the legal limit, leading to extensive recalls

(<https://www.phonegatealert.org/en/phonegate-scandal-where-are-we-three-years-after-the-alert-was-launched>).

We provide here a simple change expected to reduce the number of glioblastomas and other tumors in cell phone users by mandating that cell phones turn off their radiation when held right against the head or body.

IMPLEMENTATION

A reliable method to reduce head exposure to radiation is to configure the phone itself to automatically shut off, protecting the user’s brain. Cellular phones already contain a small device called a *proximity sensor* (shown at right is the miniature



Sharp GP2AP002S00F), usually located at the top of the phone. The element on the left of the sensor sends out pulsed infrared which is detected by the element on the right, if the phone is near an object. The image sequence at right shows how a finger turns off the screen.



In present Android devices, the proximity sensor triggers as the user's face is close to the screen, switching off the screen and preventing any errant soft-button presses by the skin as well as saving battery power.

Some Android devices can report the distance to another object in centimeters, whereas others will simply report minimum and maximum values to denote *near* and *far*, respectively. These functions are accessed through *SensorManager* and *Sensor* classes from the Android Application Programming Interface (API).

Similarly, the iPhone proximity sensor (also using infrared) is designed to detect any object near the screen and is used to put the display to sleep when the iPhone is against the head, preventing unintentional display triggering.

Assigning to the user the task of keeping the phone away from the head is not practical. The phone itself should disable its RF emissions if proximity is detected. This means that the user could use the phone away from the head, in his hand, or on a table in front of him. At the cost of a small change in personal habits, this measure would instantly remove high SAR exposures from cell phone usage and would remove the need for sophisticated assessment of exact SAR measurements in close body proximity. Note that this phone adjustment does not prevent alerting the user to incoming calls. But it does prevent the unit from autonomously sending out data when held against the body. A number of applications ("apps") have in recent years contributed to user exposures by radiating data even without user intervention. This automatic data traffic tends to increase and should only be permitted if the device is held away from the body. Essentially, this software adjustment is an automated "Airplane Mode", designed to protect users from radiation.

JUSTIFICATION

For cellular phones, commonly held against the head, prolonged use has led to an increase in a lethal form of brain cancer, glioblastoma, as well as with a more benign tumor, acoustic neuroma, in 9 peer-reviewed studies, including one cohort study.

- Brain Tumours: Rise in Glioblastoma Multiforme Incidence in England 1995–2015 Suggests an Adverse Environmental or Lifestyle Factor. Alasdair Philips, Denis L. Henshaw, Graham Lamburn, and Michael J.O’Carroll. Journal of Environmental and Public Health Volume 2018, Article ID 7910754, (<https://doi.org/10.1155/2018/7910754>),
- Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. Lennart Hardell, Michael Carlberg, Kjell Hansson Mild. Pathophysiology 20 (2013) 85–110. <https://www.sciencedirect.com/science/article/abs/pii/S0928468012001101>

Recent studies have also linked cell phone use to cancer.

The US National Toxicology Program,

<https://ntp.niehs.nih.gov/results/areas/cellphones/index.html>,

the International Agency for Research on Cancer,

<https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Non-ionizing-Radiation-Part-2-Radiofrequency-Electromagnetic-Fields-2013>,

as well as individual large studies by Chou,

<https://onlinelibrary.wiley.com/doi/abs/10.1002/bem.2250130605>,

Repacholi,

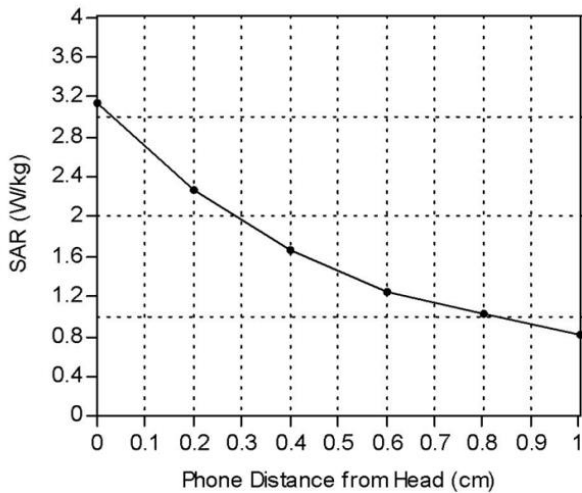
<https://www.ncbi.nlm.nih.gov/pubmed/9146709>,

as well as a collective opinion of scientists,

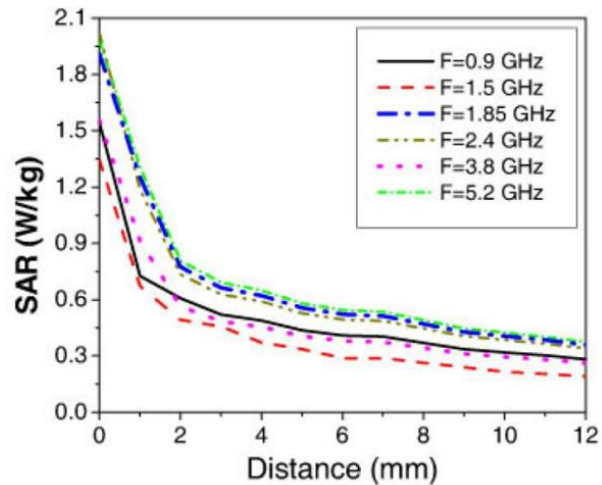
<https://bioinitiative.org/>.

Engineering analysis indicates that the dose delivered to the brain decreases rapidly as distance between cellular phone and head rises. As shown below, it

decreases by as much as 4 to 5 times, according to two separate analyses, as the phone is moved 1 cm (0.4") away.



*A comparative study of the distance effects of human head from mobile phone radiation.
S. Iman Zonoori, S. Vahab Al-Din Makki, Abdorreza Torabi.
International Journal of Microwave and Optical Technology, Vol.10, No.1, January 2015.*



*Design of low sar planar monopole antenna
for mobile wireless communication applications.
Dalia M. E Isheakh and Esmat A. Abdallah.
Progress in Electromagnetics Research M, Vol. 29, 137- 149, 2013.*

While walkie-talkies of the past were used more distantly from the head, the recent trend has been to reduce the size of cellular phones and to promote a style of use identical to that of the telephone which is pressed against the ear. An unfortunate consequence has been to deliver large doses of EMR to tissues of the nervous system which have been shown to be adversely affected, as stated above.

Without altering the function of cellular phones, it is technically possible to seriously reduce exposure to the brain of users by altering how the phones are held when emitting radiation, specifically by holding them away from the body.

Appendix N

Research on the effects of wireless radiation on trees, plants, birds, insects, pollinators, and wildlife

FCC limits were not developed to protect our flora or fauna. Wireless radiation “safety” limits for trees, plants, birds, insects, pollinators, and wildlife simply do not exist. No US agency nor international authority with expertise in science, biology or safety has ever acted to review research and set safety limits on these non-human species.

The [Department of Interior wrote a letter in 2014](#) detailing several published studies showing impacts of wireless radiofrequency radiation (RFR) to birds. It stated the following:

There is a growing level of anecdotal evidence linking effects of non-thermal, non-ionizing electromagnetic radiation from communication towers on nesting and roosting wild birds and other wildlife in the U.S.

However, the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today.

... third-party peer-reviewed studies need to be conducted in the U.S. to begin examining the effects from radiation on migratory birds and other trust species.

Study results have documented nest and site abandonment, plumage deterioration, locomotion problems, reduced survivorship, and death (e.g., Balmori 2005, Balmori and Hallberg 2007, and Everaert and Bauwens 2007). Nesting migratory birds and their offspring have apparently been affected by the radiation from cellular phone towers in the 900 and 1800 MHz frequency ranges- 915 MHz is the standard cellular phone frequency used in the United States.

In laboratory studies, T. Litovitz (personal communication) and DiCarlo et al. (2002) raised concerns about impacts of low-level, non-thermal electromagnetic radiation from the standard 915 MHz cell phone frequency on domestic chicken embryos- with some lethal results (Manville 2009, 2013a). Radiation at extremely low levels (0.0001 the level emitted by the average digital cellular telephone) caused heart attacks and the deaths of some chicken embryos subjected to hypoxic conditions in the laboratory while controls subjected to hypoxia were unaffected (DiCarlo et al. 2002).

Albert Manville, former senior biologist of the US Fish and Wildlife Service wrote [“A BRIEFING MEMORANDUM: What We Know, Can Infer, and Don’t Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife”](#) published in Wildlife and Habitat Conservation Solutions, 2014 on the impacts of RFR to birds and bees. India dropped their RF limits by 1/10th after a [research review](#) documented the majority of research studies found adverse effects to wildlife, birds and bees.

Regarding bees and pollinators, the study [“Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz”](#) published in Scientific Reports found insects (including the Western honeybee) can absorb the higher frequencies that will be used in the 4G/5G rollout, with absorbed power increases up to 370%. The researchers warn, “This could lead to changes in insect behaviour, physiology, and morphology over time...” Research also has found impacts to bees from wireless frequencies including inducing artificial worker piping ([Favre, 2011](#)), disrupting navigation abilities ([Sainudeen, 2011](#); [Kimmel et al., 2007](#)), reducing colony strength ([Harst et al., 2006](#)), and impacts to honey bee physiology ([Kumar et al., 2011](#)).

Research on trees has found that trees are harmed by RFR. A 9 year field study ([Waldmann-Selsam, C., et al 2016](#)) found significant impacts to trees near cell antennas and an investigation of 700 trees found [damage starts on the side of the tree with highest RF](#). A review on impacts to plants entitled, [“Weak radiofrequency radiation exposure from mobile phone radiation on plants”](#) concluded, “a substantial amount of the studies on RF-EMFs from mobile phones show physiological and/or morphological effects.” A study on aspen seedlings found ambient RF in a Colorado setting were high enough to cause necrotic lesions on the leaves, decrease leader length and leaf area, and suppress fall anthocyanin production ([Haggarty, 2010](#)).

[The European Scientific Committee on Health, Environmental and Emerging Risks](#) states, “The lack of clear evidence to inform the development of exposure guidelines to 5G technology leaves open the possibility of unintended biological consequences.” Several literature reviews warn that non-ionizing EMFs are an “emerging threat” to wildlife ([Balmori, 2015](#), [Curachi, 2013](#), [Sivani, 2012](#)).

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Appendix O

Meeting Minutes

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

9/16/19

9:00-10:00 am

LOB 202

Meeting called to order by Rep Abrami at 9:00 am.

In attendance: (9) *(Each member discussed their backgrounds)*

Rep. Patrick Abrami-speaker of the house appointee

Senator Tom Sherman-president of the senate appointee

Rep. Ken Weeks- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Carol Miller-NH Business & Economic Affairs Dept.

Denise Ricciardi-public-appointed by the governor

Michelle Roberge-DHHS- Commissioner of DHHS appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Excused: (1)

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

To be filled: (6)

AG or designee

2 members of the NH High Tech Council

1 member of NH Medical Society, specializing in environmental medicine/electromagnetic radiation

1 member of cell phone/wireless industry

1 member of Business and Industry Association

Agenda: (attached)

- I. Member introductions and background
- II. Election of Chair:
 - Rep. Patrick Abrami was nominated by Senator Tom Sherman, seconded by Rep Gary Woods. Vote was unanimous.
- III. Guiding Principles: (see attached and attached HB522)
 - Senator Sherman: committee decorum protocol, ask permission of chair to speak or rebut.
- IV. Statement of Purpose and Goals: (see attached)
 - Rep. Abrami: Why do we need state level? Fed is not doing much. States are pushing back against the Federal government as small cells are rolled out in front of homes. Because we cannot see it or feel it, except those who are sensitive, doesn't mean it is

not an issue for health and the environment. A sixth goal was added to communicate conclusions to all federal agencies with jurisdiction and the Office of the President.

V. Questions Needing Answers: (see attached)

-Senator Gray: We need to look at all radiation, not just 5G. Is it good or bad? Is it frequency? Intensity? How much is too much? Think broadly, not just 5G.

-Senator Sherman: Applying Precautionary Principle is most important. We are not looking for proof positive, but risk. Lack of knowledge does not equal safety. Is there potential harm here? Public health policy is not black and white. The goal is to protect public health.

-Rep Woods: we need a good understanding of baseline ambient level and levels relative to that.

-Kent Chamberlin: Concerns of cybersecurity and military issues and from sources not under U.S. control, not just biological.

-Denise Ricciardi: Health epidemic avoidance, constitutional privacy issues, data collection. Our job is to get to the truth for public health.

-Rep Abrami: Let it take us where it leads us. Root discussion is RF radiation. We cannot talk about 5G without RF in general.

VI. List of organizations in which testimony will be requested. (see attached)

-Rep Abrami: There will be no problem bringing in people with tremendous science credentials. I am hoping to get someone in to refute that. We need back and forth discussion. The harder problem will be in getting people to testify rebutting findings. Joel is research resource for the commission.

Discussion:

- Rep Abrami: US National Toxicology findings, WHO, FCC. We need to understand FCC standards and why they only test for thermal effects, ignoring biological effects. We may need to skype people in as we do not have a budget for this.
- Senator Sherman: who is making decisions at the FCC? Are they biased? What are their qualifications? Request background on decision makers setting regulations state and fed levels both.
- Kent Chamberlin: limits are set very high compared to other countries who do look at biological effects. What can we, as a state do if fed level decision makers aren't qualified to be making those decisions?
- Carol Miller: We should have an industry report for NH. Where are we at for 5G deployment? How can we help mitigate for our constituents?
- Rep Woods: in hearing testimony, has study been repeated? Look beyond credentials of presenter.
- Rep Abrami: Would like to hear from Industry on this. And insurance?
- Kent Chamberlin: Can we look at where policies are done because of exposure to radiation?

- Senator Gray: Insurance writes exclusions because it's an issue or may exclude on Rumor?

VII. Meeting frequency, time & length.

- every 2-3 weeks, initially.
- two hours typically
- next meeting: Thursday, October 10,2019 8:30-10:30
- Kent Chamberlin will do brief presentation on waves.
- will need projector for slides.
- Dr Heroux may present if he is able to be at the next meeting.

VIII. Public comments:

– Jennifer White (Hancock,NH):

1. Jen and her son are RF sensitive. She manages two businesses out of her home. Agree with Senator Gray it is a greater issue than just 5G. However, the issue with 5G is we can no longer have control over the safety of our home/property environment. If that right is taken away, they will both suffer, as their own home will no longer be a safe place.
2. Response to Senator Gray's statement about some radiation is helpful ie. Killing cancer... Jen's mom had cancer. The radiation did kill that. But she lived 3 years longer but died from Leukemia caused by the radiation to kill the cancer.

-Cherylyn Randolph LeBrun: (Loudon, NH): She has background in public health nursing. Her concern is for children and our future children. Please consider the long term effects on exposure to children who will have a much longer exposure than we have. Autism is a big issue. Please focus on pediatric neurology.

IX. Meeting Adjourned at 10:05 am.

HB 522 - VERSION ADOPTED BY BOTH BODIES

2019 SESSION

19-0261
05/01

HOUSE BILL **522**

AN ACT establishing a commission to study the environmental and health effects of evolving 5G technology.

SPONSORS: Rep. Abrami, Rock. 19; Sen. Sherman, Dist 24

COMMITTEE: Science, Technology and Energy

ANALYSIS

This bill establishes a commission to study the environmental and health effects of evolving 5G technology.

Explanation: Matter added to current law appears in ***bold italics***.
Matter removed from current law appears ~~[in brackets and struck through]~~.
Matter which is either (a) all new or (b) repealed and reenacted appears in regular type.
19-0261
05/01

STATE OF NEW HAMPSHIRE

In the Year of Our Lord Two Thousand Nineteen

AN ACT establishing a commission to study the environmental and health effects of evolving 5G technology.

Be it Enacted by the Senate and House of Representatives in General Court convened:

1 New Subdivision; Commission to Study the Environmental and Health Effects of Evolving 5G Technology. Amend RSA 12-K by inserting after section 11 the following new subdivision:

Commission to Study the Environmental and Health Effects of Evolving 5G Technology
12-K:12 Commission Established. There is established a commission to study the environmental and health effects of evolving 5G technology, which includes the use of earlier generation technologies. Fifth generation, or 5G, wireless technology is intended to greatly increase device capability and connectivity but also may pose significant risks to humans, animals, and the environment due to increased radiofrequency radiation exposure. The purpose of the study is to examine the advantages and risks associated with 5G technology, with a focus on its environmental impact and potential health effects, particularly on children, fetuses, the elderly, and those with existing health compromises.

12-K:13 Membership.

I. The members of the commission shall be as follows:

- (a) Three members of the house of representatives, including one member from the house science, technology, and energy committee, and one member from the health, human services and elderly affairs committee, appointed by the speaker of the house of representatives.
- (b) Two members of the senate, appointed by the president of the senate.
- (c) A member of the public, appointed by the governor.
- (d) The attorney general, or designee.
- (e) Two members of the New Hampshire High Technology Council, appointed by the council.
- (f) One member representing the Business and Industry Association, appointed by the association.
- (g) One member of the New Hampshire Medical Society who specializes in environmental medicine and is familiar with electromagnetic radiation, appointed by the society.
- (h) One member representing the university system of New Hampshire knowledgeable in radiofrequency radiation, appointed by the chancellor.
- (i) One member of the cell phone/wireless technology industry, appointed by the president of the senate.
- (j) The commissioner of the department of health and human services, or designee.
- (k) One public member with expertise in the biological effects of radiofrequency radiation, appointed by the speaker of the house of representatives.

II. Legislative members of the commission shall receive mileage at the legislative rate when attending to the duties of the commission.

III. The members of the commission shall elect a chairperson from among the members. The first meeting of the commission shall be called by the first-named house member. The first meeting of the commission shall be held within 45 days of the effective date of this section. Seven members of the commission shall constitute a quorum.

12-K:14 Duties and Reporting Requirement.

I. The commission shall:

- (a) Examine the health and environmental impacts from radiofrequency (RF) radiation emitted from the waves in the 30-300 gigahertz(GHZ) range of the electromagnetic spectrum, which falls somewhere between microwaves and infrared waves, and which are required with the rollout of 5G technology.
- (b) Assess the health and environmental impacts of 5G technology, which requires small cell towers to be placed at a distance of 250 meters from each other at telephone pole height from the ground and will operate in conjunction with the 3G and 4G technology infrastructure.
- (c) Receive testimony from the scientific community including but not limited to physicists and electrical engineers, the medical community including but not limited to cellular experts and oncologists, the wireless technology industry including but not limited to cell phone businesses and businesses working on the development autonomous vehicles which will rely on 5G technology, as well as other organizations and members of the public with an interest in 5G technology.
- (d) Consider the following questions and the impact on New Hampshire citizens, municipalities, and state government of:
 - (1) Why the insurance industry recognizes wireless radiation as a leading risk and has placed exclusions in their policies not covering damages caused by the pathological properties of electromagnetic radiation?
 - (2) Why do cell phone manufacturers have in the legal section within the devise saying keep the phone at least 5mm from the body?
 - (3) Why have 1,000s of peer-reviewed studies, including the recently published U.S. Toxicology Program 16-year \$30 million study, that are showing a wide-range of statistically significant DNA damage, brain and heart tumors, infertility, and so many other ailments, being ignored by the Federal Communication Commission (FCC)?
 - (4) Why are the FCC-sanctioned guidelines for public exposure to wireless radiation based only on the thermal effect on the temperature of the skin and do not account for the non-thermal, non-ionizing, biological effects of wireless radiation?
 - (5) Why are the FCC radiofrequency exposure limits set for the United States 100 times higher than countries like Russia, China, Italy, Switzerland, and most of Eastern Europe?

(6) Why did the World Health Organization (WHO) signify that wireless radiation is a Group B Possibly Carcinogenic to Humans category, a group that includes lead, thalidomide, and others, and why are some experts who sat on the WHO committee in 2011 now calling for it to be placed in the Group 1, which are known carcinogens, and why is such information being ignored by the FCC?

(7) Why have more than 220 of the worlds leading scientists signed an appeal to the WHO and the United Nations to protect public health from wireless radiation and nothing has been done?

(8) Why have the cumulative biological damaging effects of ever-growing numbers of pulse signals riding on the back of the electromagnetic sine waves not been explored, especially as the world embraces the Internet of Things, meaning all devices being connected by electromagnetic waves, and the exploration of the number of such pulse signals that will be created by implementation of 5G technology?

II. The commission shall prepare and publish an interim and final report of its findings and recommendations. The reports shall:

(a) Outline the advantages of, and risks associated with, 5G technology running in conjunction with the 3G and 4G technology infrastructure.

(b) Develop a strategy, if deemed necessary, to limit RF radiation exposure from 5G or lesser generation technology relying upon electromagnetic waves.

(c) Include a public policy statement on 5G wireless systems, which either declares the technology safe or outlines actions required to protect the health of its citizens and environment.

(d) Consider alternatives to 5G technology that will accelerate information flow speeds and volumes without the use of electromagnetic waves that emit high levels of radiation.

(e) Provide any recommendations for proposed legislation developed by the commission.

III. The commission shall submit the interim report required under paragraph II to the speaker of the house of representatives, the president of the senate, the house clerk, the senate clerk, the governor, and the state library on or before November 1, 2019, and shall submit the final report on or before November 1, 2020.

2 Repeal. RSA 12-K:12 - 12-K:14 and the subdivision heading preceeding RSA 12-K:12, relative to commission to study the environmental and health effects of the evolving 5G technology, are repealed.

3 Effective Date.

I. Section 2 of this act shall take effect November 1, 2020.

II. The remainder of this act shall take effect upon its passage.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

10/10/19

8:30-10:30am

LOB 202

Meeting called to order by Rep Abrami at 8:30am.

In attendance: (13) (Each member discussed their backgrounds)

Rep. Patrick Abrami-speaker of the house appointee

Senator Tom Sherman-president of the senate appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Carol Miller-NH Business & Economic Affairs Dept.

Denise Ricciardi-public-appointed by the governor

David Juvet-Business and Industry Association

Brandon Garod-AG designee, Asst. AG Consumer Protection

Bethann Cooley-CTIA , trade association for wireless industry and manufacturers

Michelle Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Not present: (1)

Frank MacMillan ,Jr. MD-NH Medical Society Environmental Medicine

Agenda: *(attached)*

I. Approval of minutes from 9-16-19:

-minutes were approved with changes to be made for Rep. Wells name to be corrected and to correct quote attributed to Kent Chamberlin in error.

II. Commission in agreement to broaden out to RF effects beyond just 5G.

III. Dr. Kent Chamberlin Presentation: Electromagnetic Spectrum Physics: (see attached 6 pages)

- All information/data is transmitted merely as 1s and 0s.
- Everything is electrical in the data transmission system.
- Data rate= how fast you can send information= bandwidth, etc.
- The higher the data rate, the higher the frequency.

- Frequency is inverse relationship to wavelength. Increase frequency, the shorter the wavelength.
- The data rate can be no faster than half the speed of the oscillator for acoustic transmission. Therefore, data cannot be sent very quickly at low frequencies.
- Two fields are generated: Electric and Magnetic fields in electromagnetic transmission.
- Antenna converts voltage to E/M waves or the reverse.
- Wavelength is distance from peak to peak of the wave. The lower the frequency, the greater the wave length, the larger the antenna needed. Need high frequency, shorten wavelength to have smaller antenna.
- We need high frequency for high data rate for small antenna for mobile devices.
- 2.45 Ghz Industrial scientific Medical band.
- 800 Mhz-2.7 Ghz currently for cell phones same as microwave oven frequency.
- 5G is proposed to be 86 Ghz, significantly higher, close to the invisible spectrum.
- Photon Energy =frequency x Planck's constant= to find energy in photons of the frequency.
- Wave particle duality which is part of quantum physics is important to look at for health effects.

Sherman: why doesn't my cell phone fry my hand like a microwave oven if I put my hand in it?

Chamberlin: 1.5 Kw for a microwave is more watts of power than your cell phone. Power drives the heating. Increased power increases photons but energy remains constant. We need to look at Quantum Physics and photons.

Rep Abrami: non ionizing vs ionizing?

Chamberlin: We need to look at photons for that. EMR can be represented as discrete packets of energy called photons. If photon energy is great enough to detach electrons from molecules, you have ionizing radiation or heating, if power is great enough. It is a fuzzy line between ionizing vs non ionizing radiation. You will have heating if thermal radiation from microwaves is strong enough.

Sherman: if visible light is that far along the spectrum, why isn't it damaging?

Chamberlin: We know that it is. You are also exposed to UV rays in light like sun or tanning beds.

Woods: Can it be damaging but non-ionizing?

Wells: yes...an example of an egg frying.

Woods: Proton tunneling- protons go from one side to other of DNA which creates a misread or error. Non-ionizing is in that category because hydrogen bonding can be flipped during proton tunneling. Quantum physics. There is a probability it can go through the energy barrier. Be aware, because there are other mechanisms by which energy levels can be damaging but non-ionizing.

Chamberlin: EMF simulation- if we increased the wavelength and it strikes something like wet wood, some of the energy reflects back like radar. Some of it gets transferred into the wood or object. The wave is getting smaller as it enters because it gives up heat and warms the wood. You get heating from within and you do get heating from the outside.

Sherman: Does impact of reflected wave change the amplitude of the incoming wave?

Chamberlin: Yes. It causes a partial standing wave.

-High frequency supports higher data rates and allows for designs of convenient sized devices.

-Relatively (600 mw to 3 watts) low power of cell devices, supposedly won't cause heating.

- Signal loss increases with increasing frequencies which is why they need to be so close to towers.

-Cell phones adjust power output as needed. Cell works harder if signal is weak or antenna is covered. It will pump more EM energy into the user. (22-45 miles) typical cell power distance ranges.

The closer your cell phone is to your body, the power is significantly greater. What goes through someone's head while talking on cell phone? It uses your head as a ground plane before radiating outside, standing waves and resonances within cavities like sinuses. This isn't good. We need to ask. If it's harmful, what can we do about that?

Sherman: Are you saying that human tissue becomes part of antenna or diffuses power into tissue?

Chamberlin: Yes. Your head acts as antenna or ground plane. It excites current inside your skull and causes heating. Is it significant heating? I don't know.

Abrami: original studies in 1990s studied thermal effects. Studies say potential biological effects. As a Commission, we will be about science, not speculation.

Wells: Besides ionizing or non-ionizing radiation, other photo chemical reactions are at play. For example, vitamin D or Plastic beach balls out in the sun. The red ones fade from photo chemical reactions. It is consequential.

Sherman: Seacoast terrible cell service. Does that mean cellphones work at higher level than Manchester? If that's the case, are we getting more of one kind of EMR from cell tower? Or cell phone?

Chamberlin: If cell tower is far away, will not get constant radiation. However, your cell phone will give off higher radiation because it works harder to find the signal. But, we can choose to have a cell phone off or not radiation constantly.

Cooley: with small cells, your phone battery is not working as hard to find signal and works at lower power.

Sherman: what are you getting in exposure from that closer infrastructure?

Chamberlin: which is worse? Short high bursts? Or constant low level doses?

Roberge: On your slide, the higher the red in the brain, the higher the intensity?

Chamberlin: yes.

Denise: Does that explain the rise in brain cancer?

Chamberlin: It's a correlation but is that causation? I don't know that answer. We need to look at epidemiology.

Wells: Brain Cancer and reproductive organs don't require big voltage to affect.

Woods: much of our tissue is ionized and that is a natural state. Your bones don't grow or heal unless you have an ionized state. Biological tissue can operate in an ionized state.

Abrami: Some say it's safe because it's non-ionizing. But is that a true statement? That's why I bring that up.

IV. Dr. Paul Heroux Presentation: Biological Effects of RF Radiation: *(see attached 6 pages)*

- Occasionally, we make mistakes in public health with uncertainty. Because we did not recognize accurately the danger, In 2007, we changed chromium 6 from 100 to 5 which is a factor of 20 that we misjudged safety. Workers under the old limits have 35% chance of cancer from exposure. The new limits reduced to 4.5%.

-Risk is a part of life. We cannot have zero risk. Important to realize that legal exposure limits are what is known at the time, for the exposed population, and if there are the alternatives should be part of risk assessment for an agent.

-EMR standard came about after second WW. U.S. was the only country to produce a standard because they were the only ones who had that capability. The military was the source of deciding that heat would be the criteria.

- Navy, Air Force, Army: EMR enormous importance in time of war... would need radar to survive. Applications involving military were given high priority at that time. Colonel George Knauf of USAF and Dr. Herman Schwann, bio-physicist, were those making decisions. At that time, it was perceived as non- patriotic to suggest any ban of use of Emfs because of Cold War with what was considered a nefarious power. People gave green light to military which was understandable at that time.

-Debating the danger of microwave: 1960-1990. There was a rift in science at that time.

-Biophysicist, Dr. Herman Schwann, using physics thermal guidelines for heating experiments with short 30 minute exposures. His understanding was limited at that time.
-Biologist Allan Frey used biology based guidelines, microwave hearing, blood-brain barrier leakage and chronic 24x7 exposure. Some research was fabricated to discredit his work.

Military point of view: yes there is doubt to risk but people in service get hurt all the time. So we err on side of keeping armed forces with best technology available. Lots of things are acceptable in times of war.

USAF standard from 1960 survived more or less in this form as standard today in the US. Interestingly, USAF was 10mW/cm²; General Electric was 1mW/cm²; Bell labs was .1mW/cm² and the Soviets .01mW/cm².

Soviets based their standard on nervous system disturbances, not heating. They provided two standards; a higher standard for their military and much lower standard for domestic applications.

The US did not accept this difference. USAF, ANSI, IEEE, FCC...standards still based on heating... as being the only dangerous agent. It's not easy to measure real exposure in high frequency. This limited capabilities for biologists to be part of this process.

1966 Health Standards were ultimately developed by 15 people: 10 from military, 1 oil, 1 space, 1 General Dynamic, 1 US Treasury and only 1 from Public Health.

Very heavily biased to applications vs biological affects... are exposures for fighter pilot in F16 appropriate for children in classrooms today?

In commerce and engineering, people are highly motivated to promote product. If someone says, maybe there is a subtle affect related to your product that you have not investigated, most companies will not have the desire nor resources to do so. This is not a recent story. Adam Smith...warned if merchants have their way, they will act in such a way to promote their product... beware. This has lead in the past to public health issues:

-Air pollution is one of these. Air pollution is visible. However, no one realized it until 1952 when 12,000 people died in four days...and that was what finally motivated people because it was obvious.

-Lead: 1930s. They knew at the time it was toxic and GM could have decided to use ethanol in fuel but they knew it could not be patented and you could not make more money. The company decided to use lead instead. You may not die immediately, but your civilization will be inferior as a result... 15 million US children lost 10 IQ points as a result of that decision.

-We should use alternatives, if they exist for public health.

-Today an average of three hours a day are spent on mobile phones, texting and internet access. The cell phone has been an incredible success. Schwann or the Colonel did not anticipate the situation we are in right now. This explosion in constant exposure should have changed the risk assessment today.

-We are being exposed to chronic man made waves in a very short span of time. The reason we adapted to the radiation of light is we have had millions of years to adapt. What is less certain is if we are resistant to other forms of radiation like man made technological radiation.

-RF exposure and Low Frequency exposure: all signals that carry data, function in bursts. Many biological effects we detect, refer to modulation at LOW FREQUENCY (non thermal and non ionizing). This is important.

What evidence do we have that this radiation is biologically active?

*Altered enzyme activity, biochemical changes, Oxidative Stress (ROS), pathological cell changes, neuro-behavioral effects, DNA damage, Altered Gene Expression, Brain wave changes. (hundreds of research papers)

- Currently, 44% of the world is living under much lower standards vs. US and much of the western world which have the highest standards allowed.

-How did IEEE react to these facts?

Engineers had the notion that public health people are trying to get grants based on the success on the telecom industry. There was a great deal of suspicion as they used research unfamiliar to them. Public health people, doctors and biologists realized they could not bridge the gap between engineering and health.

Dr. Carpenter designed the Bioinitiative Report to establish a better standard. But this group is lightweight compared to interests of industry. Academics are a loose group with very limited means and the results had very little influence. The situation is starting to change in Europe in particular in allowing the exposure to humans.

What is 5g? What does it mean?

-Slice spectrum into tiny bands changing 12.5 times per second your cell phone can change frequency.

- Time domain multiple access in bursts.

-Space segmentation...instead of broadcasting in every direction use narrow beams, 3-10 degrees in width. Tom Wheeler of FCC said it's a wonderful new idea ...but Russians had in 1981 most sophisticated radar... already in military long time ago but what is new is beam steering and beam focusing. This results in a lot more radiation and information being broadcast for the Internet of Things. (IOT)

- Noise is important. IOT seems like a great idea but it will be a self-fulfilling prophecy. It will be difficult to extract information from all the noise from all the waves constantly radiating.

-Some people think less penetration in the body will result from 5G...but UV causes skin cancer at penetration of .1mm which is less penetration than 5g.

Abrami: pulsing?

-Amplitude modulation... allowed us to send voice over large areas... modulated with voice of person. When FM came along, this allowed us large amount of stations but you had to allow more power. Then, we changed from analog to digital or data as it can be compressed. Now, it is sent as pulses. Are pulses more negative affect than waves? All indications are that they are more biologically active. The irregularity of the pulse creates a challenge to the organism. The organism is hit vs being pushed. Irregularity of the challenge to organism is important.

-3G/4G cell phones... we had a lot of exposure to these pulses. These bursts are so useful that this was not taken into account. You do not want your phone to use high frequency all the time so you can save power.

Sherman: The difference between 10Ghz and 50Ghz is less penetration but is there increase in intensity of penetration?

Heroux: Yes.You will have more concentration of energy.

-Caution: Phone industry wants to get rid of SAR because they won't be able to sell them because that concentration will raise the SAR above the limits. They will be illegal. They will say power density should be the new standard. All that will do is change the location of the cancer in the body as it will be more concentrated. Regulators are coming from the industry to set standards for their products.

- RF in cars is a public health threat. They will become radiation intensive. Companies are more concerned about "features" in car vs the biological effects.

-IOT is dream of engineers to put RF in anything that you can get information from. But they are also taking information from people without authorization.

-We want the capacity but should a company be able to put that in a product without my authorization or knowledge? It has to be controlled.

Abrami: Can you touch on autonomous vehicles? Colleges have grant money to look at it.

- It is NOT TRUE you need 5g for autonomous vehicles.

-Vision and laser scanning are being done at MIT. You need very rapid scanning but it is being developed.

-Engineers are smart. If we tell them to do it safely, they will.

-You don't need 5g for remote medicine although they will say you do because of low latency.

-In terms of humans, low latency does not mean much. It means a lot in a process in a plant or with robots, but not humans.

-Is it possible to non thermally affect cancer cells? Yes. Dr. Heroux's research.

- ALL cancer cells react to artificial EMFs.

-Low level radiation, similar to cell phone at low frequency have same or higher power of oxygen that can affect the body. O2 is fuel for body that generates ROS but we need O2. However, fields that produce larger effects like cell phones, we can CHOOSE not to have.

-Organs that need the most oxygen are most affected. Cells die more by necrosis than apoptosis.

- In 1900s rates of disease and chronic disease very different than what we have now.

Abrami: has your research been replicated? Yes... there are hundreds of research papers to support this.

Cell necrosis vs fibrosis:

Sherman: necrosis (cell death) to fibrosis (scarring)

Tissues most at risk...are brain, pancreas which has high levels of ROS already, diabetes.

-Non thermal effects... RF changes behavior of cells..... which is why we talk about children and digital RF exposure in their lifetime. There are places now eliminating wifi from schools.

-Pregnant women, infants, children: cells replicate quickly, developing tissues are vulnerable, microwaves penetrate young brains more deeply.

- Reproduction and sperm counts are very serious subject but I do not have time to cover all effects.

-You don't need energy to affect biology, they are already ionized.

- According to Prof Martin Blank: DNA becomes unstable from EMR.

Our bodies are electrical machines...the movement of protons tunneling and effect on ATP synthase, which is one of the most sensitive places in the body result from EMR.

-Importance of cell phones are so great people are not willing to act on risk. We need to find a way to maintain function and minimize the risk.

-If you expose brain to EMR: penetration of albumin in brain= egg white which carries toxins so now you have toxins carried into the brain. Alan Frey detected permeation of blood brain barrier. The lesions were occurring have pattern have no connection to simulation by a physicist. It means there is penetration of albumin into the brain. 50% of protein in blood is albumin. It is used to capture toxicants of all sorts so your body is not affected too rapidly. It captures it and releases slowly so you aren't shocked. When albumin goes into brain, it carries all toxins that you carry in body into your brain. It is not a good thing and happens in a very short time.

Ramazzini & NTP studies.... Yes... DNA damage & cancer particularly, in nervous system.

Wells: EMR studies with plants? Yes...There is a lot of literature even with visible light. The visible light is not a grave problem because we have evolved over millions of years... tissues can adapt over time...rapid changes we cannot adapt to.

Abrami: We ran out of time. Dr. Heroux, you may finish your presentation at our next meeting.

Next meeting will be Thursday, Oct 31st at 9 am.

Nov 1st, first draft report due

V. Meeting Adjourned at 10:30 am.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

10/31/19

9:00-11:15am

LOB 202

Meeting called to order by Rep Abrami at 9:00 am.

In attendance: (12)

Rep. Patrick Abrami-speaker of the house appointee

Senator Tom Sherman-president of the senate appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

David Juvet-Business and Industry Association

Brandon Garod-AG designee, Asst. AG Consumer Protection

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Not present: (2)

Frank MacMillan, Jr. MD-NH Medical Society Environmental Medicine

Carol Miller-NH Business & Economic Affairs Dept.

Agenda: (attached)

I. Approval of minutes from 10-10-19:

-minutes were approved with changes to be made for proper spelling of Bethanne Cooley and Michele Roberge.

II. Webex (NIEHS) National Toxicology Program Study Presentation

Presented by Dr. Michael Wyde, toxicologist and Dr. John Bucher senior scientist and former Director of NTP Division, in the Division of the National Toxicology Program at the National Institute of Environmental Health Sciences (NIEHS), which is a part of the National Institute of Health.

- Interagency program (NTP) was established in 1978 with the: National Institute of Environmental Health Sciences, National Institute of Occupational Safety and Health, FDA (National Center for Toxicology Research).

- The NTP's mission is to evaluate agents of public health concern by developing and applying tools of modern toxicology and molecular biology.
- Their scope of work includes: research and testing agents of public concern; conduct literature-analysis activities to identify cancer and non-cancer human health hazards; develop new approaches to better predict how agents affect biological responses and communicate results to multiple stakeholder groups through technical report series, journal publication and the NTP website. (<https://ntp.niehs.nih.gov>)
- In 1999, the USFDA nominated radiofrequency radiation (RFR) of wireless communication devices to NTP for study.
- At that time, there were 100 million users. Today there are over 310 million Americans and 5 Billion worldwide, exceeding the number of people.
- Biological effects have been reported in cell-based tests and in laboratory animal studies. However, animal studies have not consistently demonstrated increased incidence of tumors at any site associated with exposure to cell phone RFR in lab animals.
- There are challenges and logistical issues associated with RFR study.
- According to FCC, RFR limit is 1.6W/kg. Needed to design a new way to expose to RFR for research. Study focused on 2G and emerging 3G technology at the time.
- Used reverberation chambers as recommended by National Institute of Standards and Technology (NIST): shielded room with RF antenna distributing frequency into the room with uniform exposure. The benefit is that they could control and monitor the exposure.
- Three phase study: 5 day, 28 day and 2 year, alternating on/off for ten minutes at a time and exposed to GSM and CDMA signals for both mice and rats.

NTP Findings:

- NTP's study on cell phone RFR is the most comprehensive assessment of health effects in rats and mice from exposure to 2G and 3G cell phone RFR.
- There was **CLEAR EVIDENCE** that exposure to cell phone RFR caused malignant schwannomas (heart tumors) in male rats.
- There was **SOME EVIDENCE** that exposure to cell phone RFR caused malignant gliomas (brain tumors) and pheochromocytomas (adrenal gland tumors) in male rats in addition to positive findings of DNA damage to hippocampus and equivocal findings in frontal cortex.
- In mice, equivocal evidence of carcinogenic activity in both male and female and positive findings for DNA damage in the brain in males and blood cells in females.
- Positive findings for lower weight babies exposed in utero for rats and at five weeks for mice.
- NTP uses a 4 level scale: no evidence, equivocal evidence, some evidence, clear evidence.

- Final conclusions represent the consensus of NTP and a panel of external scientific experts who peer reviewed the studies at a public meeting on March 26-28, 2018. Two technical reports: TR 595 (2018) and TR 596(2018) Note: these findings should not be directly extrapolated to human cell phone usage because they were done at higher exposure and to the whole body during research.
- NTP Publications published in journals: 2017 in IEEE and in Bioelectromagnetics in 2018.

Goals for further study:

- Address issues raised in peer review and do follow up studies.
- Smaller scale exposure facility and quicker time frame to get data out.
- Use newer technology: 3G and 4G
- 5G uses different modulation schemes and frequencies above 60Ghz which behave differently.
- Evaluate DNA damage, establish biomarkers of exposure and probe biological mechanisms for RFR induced effects.
- What role does DNA damage and repair play?

Questions:

Abrami: Was the level 1.6W/kg in 1999? Is it the same today?

Wyde: Yes. It is based on acute exposure based on tissue heating. NO changes have been made in twenty years to the standard.

Abrami: If current standard is 1.6W/kg, where did damage start at the three levels you tested?

Wyde: Heart tumors were significant at 6W/kg showing clear evidence with some at lower exposures.

Abrami: That is well above the standard of 1.6W/kg and I am assuming phones are lower.

Wyde: Theoretically, 1.6 W/kg is the limit for phone which is what device is allowed not the exposure to people. New evidence is that SAR from phones is actually higher than 1.6W/kg. Part of that is because phones are not supposed to be next to your head.

Chamberlin: Reverberation chamber to have homogeneous 1.6 W/kg exposure, but how does that correlate to holding phone next to your head for a human?

Wyde: You have pin point exposure to the head but we don't have data on what that exposure is to all areas of the body at the same time. This is why we can't directly apply results to humans.

Chamberlin: Frequencies for 5G. You mention 60Ghz but I heard 87-100Ghz which is much higher. That is significant. We also have Beth here from industry.

Wyde: I defer to the expert. I am not aware of any intention to move above 60Ghz.

Cooley: I am not allowed to be privy to future deployment plans as a rep for CTIA. I only have information that the public has because of antitrust laws.

Sherman: When we are in a network of wifi/phones like we are right now, is there a certain level of radiation we are exposed to without even using our cell phone?

Wyde: Yes. That is one of our concerns in an increasingly wireless world. What is our background level of exposure when we are sitting in a room surrounded by people with cell phones or a school with wifi? The way we use devices has changed. It's not just a cell phone. Actual exposures is important, not just what a device emits.

Sherman: So to get to 6W/kg in a human holding a cell phone to their ear, could they get to that level or exceed it? Or is it well beyond any potential exposure a human would have?

Wyde: That exceeds what a device is capable of. But independent studies have looked at that showing it exceeding 1.6W/kg.

Sherman: Does exposure increase with increasing 2G, 3G,4G and 5G capable phones?

Wyde: no. the G means generation. (Woods, Heroux shaking heads...YES it does)

Gray: Does the energy emitted by antenna that is absorbed fall off as a cubed function?

Wyde: No, not cubed but squared.

Gray: Area is two planes, three dimensional is cubed. I would think it would fall between those two planes. I will explain later why I asked the question.

Wyde: That is not our area of expertise.

Chamberlin: I am not sure it's relevant.

Wells: Talking about intensity of field as opposed to photon energy. Photon energy definitely goes up as frequency increases.

Ricciardi: DNA damage was found without a degree of body temperature change which means non thermal effect. The FCC limits say that one degree of body heat is considered thermal heating. So what does that say about the FCC limit? Does that mean that this is harmful?

Bucher: That's one of the things we need to look at in the future. One idea is that there is an inhibition of the repair process. DNA damage happens all the time and is RFR slowing rate of DNA repair? We need to look at that.

Ricciardi: I am still not clear. Your study was designed to test non heating damage. You found damage so doesn't that mean that FCC assumption that only heating can cause damage is incorrect and no longer accurate? Would you agree?

Wyde: A lot of people believe unless you heat tissues, you won't see health effects with RF. This study disproves that as we did not have over heating but we did see damage.

Abrami: Dr. Chamberlin hopefully will bring in someone from IEEE to help us understand how they developed those standards.

Sherman: Was there any way to determine cumulative exposure rather than dose related? Or did you not look at that?

Wyde: We did not look at that when we designed studies.

Woods: Question on the structure of cages? What was it made of? Were they metal? They look like a faraday cage. Where was RF measured?

Wyde: That's a very good question. The chamber is stainless steel. Anything in the chamber was non metal so it did not affect the signal. We did not want to heat anything or cause problems for the animals. NIST took measurements to make sure there was uniformity in the whole space.

Abrami: what is a faraday cage?

Woods: Faraday cage is a metal mesh network that prevents RFR exposure to what is inside.

Woods: Why did you use rats and mice? Why were rats started in utero and mice at five weeks? Any animal is much more sensitive in utero to damage. How much of result was attributed to in utero?

Bucher: Traditionally, all cancer studies use both rats and mice. We only use in utero exposure with rats because it's harder to use hybrid mice in utero. By using both, we get more information than we would normally.

Wyde: Part of the reason for in utero, is it mimics human exposure in utero.

Roberge: Were you able to see the difference where health effects occurred, with regard to various levels, knowing your exposure was above the 1.6W/kg that a device is permitted to emit?

Bucher: We need to backup and understand what we were trying to do. We needed to make sure we did not use thermal limits more than one degree of body temperature that animals could tolerate. Different sized animals absorb different amounts. Rats because they are larger, could only be exposed to lower levels because we saw the largest response on the largest animals. They were affected more with strongest responses to RFR.

Roberge: Are you looking at synergistic effects of multiple frequencies in your future studies? Does that influence exposure?

Wyde: yes that is part of what we are looking at. How are people's exposures going to change with 5G? That's very important as we move forward.

Chamberlin: Are the signals realistic by alternating regular modulation, since it's not realistic compared to the pulsed or bursts we are exposed to now. Cell phones don't radiate continuously. Did you look at that?

Wyde: We tried to create scenarios with spikes and ten minute on and off exposures. We had modulating patterns that would mimic conversation on cell phones. We tried to create relevant exposure scenarios.

Bucher: We used actual GSM and CDMA signals that spike. GSM modulation when signals are sent only 1/8 is the spike. That is what we used.

Abrami: Legislators are being faced with push back on small cell towers with 5G at street level and every 250 meters apart with millimeter waves.

Bucher: We are keeping close eye as 5G emerges.

Heroux: NTP study was designed quite a long time ago. Our situation is that we deploy things and the time to assess health impacts is much larger than rapidly evolving technology.

Sherman: Can you recreate background daily exposure to what we might anticipate by increased number of 5G towers in a neighborhood using this model? I would like to know BEFORE deployment.

Wyde: The technology is not capable of doing that with 5G frequency.

Bucher: Our exposure depends upon how we are positioned with respect to antenna. To study 5G and combine with lower level exposure, is an enormously difficult scenario to recreate.

Wells: For base station towers 250 feet apart, the energy density is 5x higher than a cell tower. The depth of penetration in tissue, the higher the frequency have higher photon energy, the amount of energy being absorbed in a thin layer is significantly higher. Would you agree?

Bucher/Wyde: yes. We would agree. But power levels are lower.

Ricciardi: power levels are lower but it's in close proximity 24 hours a day, which is microwave radiation. Would that not heat tissues over time? If so, would we assume 5G would not be safe?

Wyde: No. Our exposure is a function of distance and power levels and other factors. At this point, we don't know.

Chamberlin: Your category, Clear Evidence. Can you compare that to relative risk?

Wyde: No. clear evidence is a descriptor we use in our cancer studies. It does not relate to relative risk in the human population.

Chamberlin: Are you using P value of .05 as statistically significant value?

Wyde: We look at .05 as cutoff as statistical significance but often the clear evidence findings have a lower P value.

Sherman: We should get their peer reviewed articles. They may have more data in them.

Chamberlin: It would be nice if they could compare it to smoking or something.

Ricciardi: There is an online library at: <https://onlinelibrary.wiley.com> They just published new findings in October.

Woods: We need to be cautious because we cannot make one to one correlations with humans when we look at these studies. For example: if aspirin (dioxin) was tested today, it would be banned because it causes cancer in mice and rats. So we need to be careful when looking at these studies. Is there a significant difference between a rat and a mouse?

Sherman: We have to be cautious before we extrapolate to humans but we can't test humans without a long period knowing their cumulative exposure. You can't recreate it because it takes 20 years for people to die before we know anything. Hopefully, we will take as much evidence as we have. Because what we have seen in other industry settings with contaminants, we don't know until a lot of people die. They cannot recreate this in a lab. It's a warning on both sides.

Woods: We have to be able to say, we don't know. Some of the other literature, they were criticized for poor standards.

Ricciardi: Ramazzini Institute studies duplicated that study, using very low standards.

Wells: These are very difficult studies to do. The human body is an antenna. Larger animals are more exposed. Humans are much larger than mice or rats. They are studying critters smaller than the wavelength. When we talk about base stations for 4G transmitting at 100watts but KM away, that is much less than the magnitude of intensity from 10's of meters away of 5G antenna, even if it's only 7 watts. A flaw in this study is that they are treating them as chemical exposures. The room has a uniform feel but when it hits the skin, it's no longer uniform. Penetration depth is important. With 5G that's a very thin piece of tissue getting a lot of penetration. It's difficult to study.

Heroux: Mice and rats are only superficially similar. They are used because they are cheap, easy to handle. We know they are different and provide different information. Toxicologists know about these things. That is why they design a model on how to use animals in these experiments, which is extremely complex.

Cooley: What is on the towers is not line of sight technology. Small cells are. They are not beam forming. We will talk about this at future meetings as well.

Sherman: I have a comment on autonomous vehicles. People claim you need 5G for those. My nephew is one of the lead engineers for the Google vehicle, Waymo and he said the very definition of “autonomous” is autonomous. It does not or should not need wireless or power networks to depend upon. I don’t think the ongoing claim that autonomous vehicles need 5G, is true.

Heroux: I agree MIT as well has a car that does not rely on 5G. There are many ways autonomous vehicles can operate using: vision, laser scanning, ultrasound. EMR is not required.

III. General Discussion:

We will hear from Prof. Eric Swanson, U. Pittsburgh provided from Bethanne Cooley at the next meeting: Thursday, November 21st at 8:30am.

Interim report: Agreed upon with correction for non-ionizing statement to reflect properly Ken Chamberlin’s opinion from his presentation.

IV. Frank Clegg Video: Framing the Issue:

- Former CEO of Microsoft Canada, 40 years in technology sector.
- Current implementation of wireless is not safe.
- 5G is not tested.
- Millimeter waves are used by the military for crowd control.
- We are advocates for safe technology, not, no technology.
- FCC is made up of previous telecom, lawyers and engineers not doctors.
- No oversight provided by FCC. Telecom industry is self-policing.
- 1996 Telecom act prevents anyone from suing Telecom for health injury.
- Countries like China, Russia, Italy and Switzerland have safety limits 100x safer for citizens.
- Today we have significant exposure in our homes, schools, work and public spaces.
- Many states and cities are questioning safety, while the Federal Govt and some other states are fast tracking 5G.
- Many health and mental health effects, including permanent DNA damage.
- Individual, state and local rights are being passed over to telecom industry. That is a significant and historic power shift in rights. Telecom has over 500 lobbyists.
- Swiss RE has designated 5G as a significant insurance risk.
- Convinced there are safer alternatives available so we can have technology safely.
- We need to advocate for change to allow industry to become more responsible.
- Most important thing you can do is to get educated and educate your family, friends, co-workers, state, local and school officials. Knowledge is power and your power is in your hands.

Abrami: If anyone has any questions for Frank Clegg, we can contact him to talk with us.

That video encapsulates a lot of the issues we are dealing with here.

V. Dr. Heroux Completion of Presentation of Biological Effect:

-Human evidence: two documents that are very detailed human evidence: ELF (power systems) and RFR(communication). Both classified both high and low as possibly carcinogenic Class 2B. IARC repeats old notion that there is no mechanism that supports this. They are great epidemiologist but not cognizant of other things. Anthony Miller is worried about rollout of 5G because he is seeing an increase in student 15-19 increase 1%/year in lethal brain tumors. He would like IARC to go back to reclassify because IARC said there was a lack of animal studies but there are many studies which was the reason for the Class 2B. How many will they ignore? He would like it classified as a class I carcinogen.

-Another study shows with a cell phone one and off, that glucose metabolism is increased in the brain when cell phone is on. This is not thermal or heat related but it is an effect.

- Also troubling evidence on increasing gray matter changes.

-Hypersensitive: those who feel its impacts. In Finland, there is software to plot a path from where they live to where they want to go to minimize exposure to radiation. This software has been downloaded 200,000 times. These people are very real. Contrary to what a lot of the medical community is telling them, it's not in their mind. They are physical reactions and not everyone has same effect, nor should they. That is typical of medicine. One of the reasons is that many of them have variants in Glutathione enzyme which is a major detoxifier. EHS people have variations in this enzyme 10x higher than non EHS. Genes will not allow them to produce effective versions of glutathione transferase. The next generation will likely be more sensitive if both parents have this variant. You see a lot of people with EHS, who also have multiple chemical sensitivities because they share the same detoxification mechanisms.

- Proton tunneling: basic mechanism of action of EMR on tissues. Ionizing argument is beside the point. Biological systems are ionized. This is relevant. Stability of materials is an illusion. Every molecule of water decomposes and recomposes. PH of pure water is 7. This is based on the mobility of protons. In every living system, mobility of protons is very important.
- - Oxidative phosphorylation is arguably the most important process in the body. Science did its work on this very quickly after concerns of EMFs on this process. Essential mechanisms of action were discovered of EMFs but ignored. A group of enzymes from 1-5 synthesize ATP. Protons and electrons have to move through our body. EMFs affect the movement of these affects function of enzymes. When protons and electrons are free, they are vulnerable to EMR especially ELF components. Within Mitochondria, you have a PH of 1. You have the highest electric field. If you apply EMF to this system, you disrupt the flow of electrons and mainly protons. Entry channel is completely hydrophilic. It has the same structure as ice and the way enzymes work is proton tunneling. Through this, the proton is vulnerable to fields as small as 20 nano-tesla as

confirmed in experiments. This is very vulnerable to EMR. The semiconductor industry has devices that work on the same principle. If you reduce ATP activity, electrons have to jump across distances and are vulnerable. There are 400 publications that talk about these effects on enzymes from EMF. These electrons form ROS (reactive oxygen species) and have a hard time functioning. The jumping of charges from one place to another creates a lot of room to interfere with propagation of electrons that support metabolism of cells. The science behind tunneling mechanism is... If you have a quantum of energy of any frequency, you are going to have a change in probability to jump from one place to another. This happens at levels way below thermal levels of FCC.

At Duke University in 1985, research showed changes the function of mitochondria but he was ignored. Nobody reads science or a paper unless someone needs them. The mechanisms and science are there but they are unknown.

I agree with Frank Clegg. We can get everything we want. You don't to fear you will lose your cellphone or go back to the dark ages. We can do this very well. We know engineers can do this.

Woods: Buran zones are happening at mitochondria level.

Sherman: Can we get the digital link to the slideshow?

Abrami: We have a website now where all info is posted.

Sherman: When you talk about impacts at exposure much less than our limit, does is increase cell death in terms of end organ damage?

Heroux: Biology is an electrical motor. We are electrical. Any field is possibly going to interfere with this.

Heroux: I exposed cells to radiation and see how cells died. It's not to kill them but does it change how they die by being exposed to EMF. If you compare the power of fields in everyday life, their ability to kill cells is higher than oxygen, creating ROS. ELF component of Telecommunication signals is a significant component.

It increases cell death and diverts cells toward necrosis vs apoptosis. The cell doesn't have enough (energy) ATP and it gives up and goes into necrosis. EMF has power to increase ROS leading to chronic diseases with inflammation like Alzheimer's and Diabetes. So why add on to the load we already have with ROS? We can control electric and magnetic exposure. If you ask at a hospital how many Parkinson's, are related to EMF exposure? They say none and claim EHS people don't exist at all. It is a part of chronic illness. I am not saying it's all of it but it is a part. We have just gotten used to these illnesses. If you can decrease diabetes 20% by reducing this effect, you will save a lot of money in medical care if you address this issue.

V. Meeting Adjourned at 11:15 am.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

11/21/19

8:30-10:35am

LOB 202

Meeting called to order by Rep Abrami at 8:30 am.

In attendance: (11)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Brandon Garod-AG designee, Asst. AG Consumer Protection

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Carol Miller-NH Business & Economic Affairs Dept.

Not present: (3)

Frank MacMillan, Jr. MD-NH Medical Society Environmental Medicine

David Juvet-Business and Industry Association

Senator Tom Sherman-president of the senate appointee

Agenda: (attached)

- I. Approval of minutes from 10-31-19:
-minutes were approved with comment from Rep Woods.

- II. Dr. Eric Swanson: University of Pittsburgh, Professor of Physics Presentation
(Here at the request of CTIA but the opinions are his own)
 - There is a lot of misinformation and misunderstanding out there + fear of the unknown= trouble.
 - Fear of the unknown is what links past worries like power lines and radio waves causing cancer cellphones killing honey bees to the current ones about 5G and cellphones.
 - Millimeter waves (similar to 5G) are used in Russia therapeutically for over 50 diseases.
 - It is not plausible that the same radiation can both cause and cure 50 diseases. It does neither. It does nothing.
 - It does not affect living things: and I have two main points.

Ricciardi: Experiments with 5G on bees show that bees are affected. Bees absorbed more with higher frequencies.(Scientific Reports: 2Ghz-120Ghz). This could lead to changes to insect behavior over time. Can you confirm based on scientific evidence that these frequencies are safe for pollinators? What credentials do you have to speak to this?

- Swanson: It's scientifically not plausible that these waves have any effect on ANY living thing. Biochemical response of a bee cell to EMR is the same as a rat cell and a human cell. That is my scientific opinion. It's true that EMR does not do nothing.
- As far as credentials... There are two aspects:
- 1. The radiation itself: we understand perfectly since 1875. There are no questions and no ambiguity. This is where I come from.
- 2. The biological response: it's difficult to measure. It's complex and messy. We can explain it all with general physics terms, not fancy biological terms.

Heroux: The IEEE standard is based on resonance between dimensions of humans and for example (70MHz) frequency of radiation. Frequencies that match the size of the bees, the transfer of power will be increased by a large factor. These parameters have been recognized by engineers, physicists, etc. not just biologists. They fly everywhere, not walk on the sidewalks and are likely to go to areas where power densities are very high. In my opinion, you are not showing much concern for the small pollinators that we need to survive.

Swanson: I disagree with everything you said. If you want I can go into details of why. Resonance is in fact related to size of important bio mechanical mechanisms inside of cells. There is a famous paper by Robert Gadera (sp?) from twenty years ago showing these resonance effects just cannot occur. These are not relevant to biology and cannot occur inside of cells. You said bees are attracted to these things. I would love to see the study saying bees are attracted to radio transmitters. Bees are actually attracted to flowers. It's true they don't walk on sidewalks. Transmitters are built where people live, not bees. That means they are even more removed, not closer.

Woods: I want to clarify your idea that the Bees are like rats and humans. We know if we test djoxin/aspirin today, rats get cancer but people do not. Can you please clarify what you mean that they are the same? That seems to break down there.

Swanson: This is a good point. You have to be careful about comparison and I was talking about the cellular level.

Woods: But chemicals are processed at the cellular level.

Swanson: If you are feeding aspirin to a rat vs to a human and if they normalize for the size, I would expect the response of test subjects to be very similar. But it's not what we are talking about here. Chemical reaction is far more energetic than reactions that are relevant to cellphones. Chemicals are like taking a hammer versus a gently tweaking it, like a cellphone does.

Chamberlin: On the previous slide, you mention exposure in some cases provides positive therapy. You are saying that it can't be both helpful and harmful. I disagree. For example, sunshine is a form of radiation. It is both beneficial like Vitamin D, etc. and harmful like skin cancer, depending upon exposure. I disagree with the premise stated there.

Swanson: You are right. There is room for something like this to happen. Like I said, I don't find this plausible and I have a reason why I don't find it plausible but I will get to that.

Abrami: On your electric towers slide, you said were definitive studies disproving health effects . We are trying to get at is, are there definitive studies RF in general whether it's 3G, 4G or 5G. Right now I don't know of any definitive studies saying whether 5G is good or bad. As a legislative body, we are trying to understand. We are blessed with having people in the room who understand these things. We have to be responsible to our public. If a small cell tower appears in front of their house, they will want to know, where is the definitive study showing its safe?

Swanson: Valid question. But those studies were specific to those towers. I completely respect that as a question.

Electromagnetic Basics:

- Electromagnetic radiation is the best understood phenomenon in the universe.
- It is not nuclear radiation.
- It is completely described by three numbers (intensity, frequency, and polarization) which makes it so well understood and so simple.
- Electromagnetic spectrum is a continuum from zero to infinity.

Ricciardi: Are you saying that you do not believe a potential mechanism exists for non-ionizing radiation to harm us?

Swanson: I will get to that in a minute. Do you mind?

Abrami: Let him cover non ionizing radiation and then ask your question.

Health Effects:

- You are well aware that there are health effects on this spectrum.
- UV radiation is dangerous. It's not good to get too many x rays. There are two scanners at the airport and you should go through the mm wave scanner not the x ray scanner because x rays are dangerous if you expose yourself to too many.
- Gamma rays are very dangerous. They will outright kill you.

- Ionizing radiation is damaging because of how it damages things. Your body responds by producing more melanin. DNA regulates reproduction of cells. You could mess with the reproduction of your cell and you get cancer. You don't want to damage your DNA.
- Shorter wavelength waves carry more energy.
- Visible light is just below UV light. Threshold effect between UV light and visible light. We can be in visible light all day and never get cancer because visible light is lower in energy. It is only a bit lower. There is no gradual tailing off. There is a threshold. This threshold effect between UV light and visible light was explained by Einstein in 1905. He won the Nobel Prize for this. That's called non ionizing radiation.
- There is a threshold 1.77ev and 2.25ev or minimal energy needed.
- The important thing: is that there is a photo electric effect.
- You need ionizing energy to remove an electron off its atom.
- When we talk about non ionizing radiation, there is no cumulative effect and there is no intensity effect and no effect on cancer.
- Ionizing is above the threshold effect. Non- ionizing is below on the spectrum.
- It doesn't matter how far below the threshold. Something could be just below threshold or far below threshold. It doesn't matter. The threshold is only thing that matters.
- Non Ionizing radiation has no known effect on the human body other than heat.
- Heat is just heat and motion of molecules.

Abrami: I understand water vibrates to heat in microwave but you wouldn't put your head in a microwave would you?

Swanson: I actually intend to put my head in a microwave next week.

Abrami: You are pulling my leg now, right?

Swanson: no. I am not going to have it at full power and will probably put my hand in. My point is, it's regular heating and what I will feel is my hand getting warm and then I will take it out. It's just like putting your hand on a radiator.

Wells: If radio frequencies that are non-ionizing have no effect, can you explain how radios work?

Swanson: they have no known health effects on tissue except for heating. EMR is absorbed by your skin. About half of it is reflected by the body. Metals are special because the electrons are mobile. Our electrons are attached to a molecule. They are hard to move except the salty water part of the cell. The signal in the radio just turns into heat.

Ricciardi: Thank you for explaining that. Before I ask my question, I want to understand what you said. It sounds like what you were saying is due to oxidative stress not heating. Did I understand that correctly?

Swanson: No. I didn't say any of those things.

Ricciardi: Well then. Are you saying there is no real potential harm for non-ionizing radiation?

Swanson: To the degree that you don't cook yourself, yes.

Ricciardi: There are several studies and if you can debunk them. I have a copy for you.

Abrami: Dr Swanson, can you address these later for time sake during your section on studies?

Swanson: Yes. I will address generic, not these particular studies later.

Chamberlin: I just want to say it's quite a statement and in preparation for service on this commission, I did a lot of work reading published peer reviewed journals and a lot of them DO say there are biological effects. So I am assuming you will address those.

FCC Regulations:

- I want to clarify misconceptions about the FCC.
- The FCC does not conduct experiments. It sets regulatory limits based on the evaluation of relevant literature made by many nation and international agencies.
- One of these agencies is: IEEE which has a rigorous policy creation process.
- I was very impressed with their methodology for how they come to their decisions.
- They are very thorough. They have various working groups where reports go into a committee called sub- committee four.
- Sub-committee four has 125 members in it. They have a broad swath of expertise.
- They looked at 2,200 papers.
- 5G is just part of the spectrum. It's the 30Ghz part of the spectrum. 5G is new. The physics and biology of 5G is not.
- You don't have to do studies at 5Ghz. Where do you draw the line? The difference between 4G and 5G is essentially meaningless when it comes to the response of humans to this radiation.
- FCC has two primary measures: Thermal behavior. IEEE determines thresholds of watts/kg.
- FCC sets its limit 50x lower than the limit detected on animal studies. Based on that they get the SAR (Specific Absorption Rate which should be less than 1.6w/kg) That is an extremely conservative number. I mentioned a heating pad earlier that is roughly 100w/kg.
- Another method is the MPE (maximum permissible exposure) Effects on humans start at 100x higher than the limit.
- Why are there two standards? BC at higher frequencies like 5G that does not penetrate as far in the body so it's hard to measure so they use MPE.
- 5G is called small cell because they are low power and closer together and about 30 feet high.
- Your exposure is about .4% of the extremely conservative limit if you stand at the base.
- It occurred to me that light is EMR and what would happen if the FCC regulated light? Or the sun? They don't for obvious reasons. We can see light. They expect us to react responsibly.
- For a 100W light bulb six feet away, you are at a quarter of the FCC allowable limit in terms of thermal exposure. Three feet away, you are at the FCC limit.
- If you stand outside in the sun, you are at 1600% of the FCC standard for exposure limit.

- The sun would be outlawed if the FCC regulated it.
- Should we worry about standing under a 5G tower? I would say no.
- Another example is the brain. It is a radio transmitter transmitting at the thermal end of the spectrum far higher in energy than 5G. Your body is 85W machine. The brain is 15W. It uses a lot of energy. The brain weighs about 1 kg. So I estimate an SAR of 15w/kg. So thinking would also be outlawed by the FCC whose limit is 1.6w/kg.
- Let's get to what it does to you. It heats the skin up. The higher the frequency, the less it penetrates the skin and 5G is at the very surface.
- 10W/m² is the FCC limit. Temperature rise at the surface of the skin. According to this model (The Human Body and MM Wave Wireless Communication Systems accepted 2015 IEEE International Conference) which shows a rise in temperature for different energy densities. The SAR limit of 10W/m² results in about .1 degree temperature rise.
- You would have to climb the 5g pole and hug and wait for your skin to rise .1 degrees.
- It would create more heat just in the energy to climb the pole. It's not magical stuff. It's just heat energy.
- Stepping outside or drinking a cup of coffee, you get a larger rise in temperature than irresponsible behavior of climbing and hugging a 5G pole.

Cooley: When you showed the heights of the various towers and small cells, because there will be 5G on towers as well. Can you speak to the difference of towers at 100-200 ft vs the small cells at 20-50 ft. Can you talk about the exposure based on the higher it is, the exposure decreases? I am making an assumption. If you use an average 150ft tower vs a 40ft small cell.

Swanson: If you are asking what would happen if the tower was 40ft instead of 20, then all of those numbers would go down. If you double the height, you go down by a factor of 4 if you are standing right under it. It's not that clean cut. With a higher tower, you have more powerful equipment. It's the same thing with 5G. If it's a 40ft tower, there will be more powerful equipment on that small cell. You have to take that into account. I am speculating that when engineers design the towers, they figure how to get down to 1/1000th of the FCC limit. According to research I just read, there are countries that measured levels at 1/1000th of the FCC limit. It wouldn't surprise me if it ends up being a wash if you double the height.

Cooley: Please clarify a term you used, lens opacity. What is that?

Swanson: It's the beginnings of cataracts.

Roberge: When was the FCC limit set?

Swanson: This is an ongoing thing. I can partially answer this. I know that the IEEE did this in 1996 and did it again in 2005. I believe the FCC monitors these new standards as they come out. But I don't know that they had an official meeting to incorporate all of that. I believe there is something in the news about reinstating a meeting.

Abrami: Yes. We have a paper on this.

Swanson: I believe you know more than I do about this.

Roberge: When they set this, they were only looking at heat effects on the body. Do you know when they look at this again and will that include other biological effects?

Swanson: I wouldn't quite put it that way. They looked at 2,200 papers. They don't just go, oh this one deals with other effects and throw it into the garbage. They take all of it into account. Of course, the things that you focus on are thermal effects because those are easily measurable. Other effects are random.

Heroux: You describe the review process of the IEEE in glowing terms.

Swanson: Yes. It was glowing. I was very impressed.

Heroux: Were you there?

Swanson: Was I there? No.

Heroux: Are you a member of SC3 or SC4?

Swanson: No.

Heroux: You don't go to IEEE meetings?

Swanson: Nope

Heroux: So in other words, your description of this review process is based on what you were told.

Swanson: That's correct and from what I read. Yes.

Heroux: Ok. I was there. I can tell you that this process is far from impartial. I have personal experienced it and if you want, I can tell you how it happened. At the time, I had designed an instrument that measured pulsed EMF. I was part of an epidemiological study at McGill. It was found that all the underground workers exposed to these fields and smoked, systematically died of lung cancer. ...All of them. This was done by Armstrong a biostatistician who is now in London. I was charged with informing IEEE of this. I was a member of SC4. I went when Eleanor Adair was presiding and I unfolded what had happened. Eleanor Adair said we will form a committee and we will look at this. There was a separate meeting. They wanted three members to join the president to study this. I was the one who designed the instrument and the only one at the time who knew of the epidemiological study determining this. At that meeting when they asked for volunteers, I raised my hand. Since only two other people did, I thought I am going to be able to discuss this openly in an IEEE committee. I was never called. This reflects the fact that your selection of the people controlling these committees and the literature that you review is very partial. It's not for some conspiracy but because of the fact that there is a natural tendency to assemble similar opinions in a given location. Are you aware that Eleanor Adair, who was president of SC4 for years and yea, at the time that she was supposed to be a judge on whether non

thermal effects occur, simultaneously published a paper in the open literature promoting the idea that we should heat the people rather than houses.

Abrami: Dr. Heroux, is there a question you want to ask?

Heroux: Yes. The review process is very difficult to control and hard to be impartial. I have lived through these difficulties. When you haven't lived through the process, it's very difficult isn't it? to be entirely certain that it's entirely impartial? Would you agree?

Swanson: That is way too generic for me to agree.

Abrami: We are hoping to hear from IEEE, so we can form our opinion on that.

Swanson: Personally, if I formed a subcommittee I would not want one of the paper's authors on the subcommittee. It would be biased.

Wells: can you give us an idea of the wattage of a 5G transmitter and handset?

Swanson: The handsets will be similar to current handsets that operate around a watt. The 5G transmitters are much smaller than 4G. I ask this question many times and I always get the run around. The reason is because different sites and different manufacturers have different specs. Roughly speaking, it's 10-20 watts for the transmitter.

Wells: The function of 5G is communications so how would you relate data rate to intensity and frequency?

Swanson: Those are good questions. One of the major goals of 5G is to increase data rates. Apparently, everyone wants to watch their videos on their cellphones. That's why this higher frequency is needed. The reason these need to be closer together is higher frequencies have trouble penetrating wet air. The more humid it is, the harder it is to penetrate. So they tend to be closer together, low power, high frequency.

Wells: The power density in w/ square meter. Is that a parameter that affects data rate?

Swanson: Yes. Actually it is. The stronger the signal, the more data you can push through. Dr. Chamberlin can probably address this better.

Chamberlin: I wanted to get clarification on the setting of limits. You mention two ways. One is the IEEE going through publications to find out what other people have established as safe limits. You also mention there was an animal study where you expose some sort of animal to increasing amounts of radiation until you saw a change in their behavior. Then, you use a factor of 50 below. Which is it? Do they use both together?

Swanson: I didn't see a conflict there. Part of what IEEE is doing is looking at animal studies. That's one of the things they look at. That's what the IARC looked at as well, animal studies. So they are looking for any effect.

Abrami: But, isn't it just thermal effects they are looking at?

Swanson: No. they look at everything under the sun. These guys review what scientists look at and the only thing that actually sees something definitive is the thermal effects.

Chamberlin: But these are short term studies and that's my concern.

Swanson: They vary.

Swanson: I touched on it before and I will talk about this again on a famous NTP study later.

Ricciardi: I just wanted to clarify something on the FCC. I have a couple of documents stamped from the federal government in 1985. A letter written from the EPA to the FCC and it says they have done the studies on the heating of tissues and explained to the FCC that they needed to do studies on non thermal effects because it can heat chronically low over time. Heating of tissues vs non heating of tissues and only heating was studied when the EPA wanted to go further. The FCC responded by saying they were taking this out of the hands of the EPA and putting it into the FCC's hands. So we no longer have a health agency representing us doing those studies. The FCC is not a health agency.

Swanson: That's right. They are not. They have a committee and listen to what they tell them. They know what they are talking about.

Ricciardi: I think these scientists that have done peer reviewed studies know what they are talking about. How many peer reviewed studies have you done?

Abrami: we are going to get to the next topic.

Studies:

-Everything I have been telling you is consensus, mainstream science.

-There is no fringe aspect, controversy or conspiracy theories.

-In the internet age, it is possible to find a "respectable" source that says anything, from silly to ludicrous to dangerous. There is the flat earth society, pizzagate, and we all know of black helicopters coming in the night to take us all away. It is important to search out consensus views.

-Statements from National Bodies: FCC, FDA, Cancer Institute, Cancer Society (see slide)

-Statements from International Bodies: European Commission, WHO, Health Canada, UK Health Protection Agency, Swedish Council for Working Life and Social Research, Norwegian Institute for Public Health, Australian Radiation Protection and Nuclear Safety. (see slide)

- The Swedes and Norwegians say this is safe. They are most sensible people in the world.

-Here is the upshot. The rate of glioma, which is a rare brain tumor, has gone down in the US. The rate of cellphone use has increased. There is no correlation at all. That is a very powerful statement.

-There is a difference between doing physics and chemical studies and health and nutritional studies. Health studies are very difficult to do and have them be reliable. There are conflicting claims. I can't tell you how many times I have heard eggs are good for you, then they are bad for you then they are good for you. I don't want to give you the idea that science is useless or these people are dumb. Neither of these is true. It's just difficult to do studies on humans. Humans are not great subjects.

- Amgen tried to reproduce 53 landmark studies on cancer. They were only able to reproduce six of them. Bayer Health was only able to reproduce 25% of 67 studies. It's just really difficult to do this stuff.

- Most cited paper of all time in medicine: Dr. John Ioannidis studying studies. He found that 80% of non-randomized studies turn out to be wrong. There are many reasons for this: study biases (to make splashy result), lack of blinding, difficulty working with human or animal subjects, the rarity of effects being sought (trying to tease up very subtle stuff), the expense of dealing with many test subjects.

Example: NTP study

- One important aspect is the problem of Multiple Comparisons:

- For example, I am going to examine a lot of outcomes from smoking. I have to conduct my experiment at a certain level of acuity. That's called a P-value. Industry standard for P-value is 5%. The P-value is the probability of observing the effect seen, or greater, given that the null hypothesis is true. Let's say you decide that cigarette smoke is not dangerous. That is the null hypothesis. Then you find your rats are getting lung cancer. Then you would say the probability of rats not getting lung cancer is very low. That implies that you are seeing something. I am going to assume a much tougher standard in my experiment with a P-value of 1%. That means that if I have 100 subjects, one of them has to have the outcome.

What happens in the real world with P-values much higher than 1% is that you could have three studies and they all have outcomes. You could have several different outcomes, not just the one you are testing. What is then reported, are all of the outcomes when in fact it should be none. For example...news clip about powerlines causing brain cancer, leukemia, breast cancer, birth defects, reproductive problems, fatigue, depression, and many others. It's implausible that a single thing causes many things.

- A single exposure causing many outcomes is a sure sign of the multiple comparisons problem! All of these studies find different things. If they don't start replicating each other, you shouldn't pay attention to them.

NTP Study-the claim:

- There is clear evidence that RFR causes heart tumors in male rats
- There is some evidence that RFR causes brain tumors in male rats
- There are problems with the NTP Study: (see slides for detail)
- The problem with the NTP study is the Multiple Comparison Effects.

Heroux theory:

He claims that electric fields from cellphones disrupt proton transfer in water, thereby “influencing the properties of water and the stability of DNA”

- This is a valid scientific question. We should delve into it.
- So what is going on here is something called the acid-base reaction which creates H_3O molecules. There is about 1 H_3O molecule per 10 million H_2O molecules. The extra proton can hop along chains of water molecules. This is called the Grotthuss mechanism. This is normal and is a chemical reaction. What is the effect of an electric field on chemical reactions?
- There is a study by Boxer at Stanford using fields from 2,000,000 V/cm to 100,000,000 V/cm to see a reaction. Cellphones max out at 1V/cm!
- So the physics of it and the chemistry of it say its fine but the magnitude of it says it's not something to worry about. A cellphone is not sufficient to cause any chemical reactions.
-

Chamberlin Presentation: I need to correct or point out what he said.

Chamberlin claim: power per unit area becomes alarmingly large.

- Significance of $1/r^2$ Power relationship. The implication that having a cellphone in your sports bra (per slide) is definitely not a good idea, I have a problem with. This is misleading.
- There is something called the Fraunhofer distance. The near field and the far field have different laws.
- You need to compare to IEEE localized MPE at 30 Ghz. It's well below that.
- I have to say this is not what is actually going to happen. What is actually going to happen is very complicated. You have to simulate these on computers.

Abrami: We are running out of time. We need time for questions and responses from Dr. Heroux and Dr. Chamberlin on your remarks. We may take you up on your offer to dial in at a future date. You mentioned the WHO but the WHO categorized RF as a group 2B carcinogen. Can you tell me how that works? You said the WHO said there is no problem but they have graded it like lead and thalidomide.

Swanson: Sure I can address. First a technical point. The reason there seem to be these conflicting statements is it is actually the IARC which is a sub portion of the WHO that made that statement.

Abrami: There are many articles saying WHO.

Swanson: Just because they ascribe it to WHO, it's really IARC a sub portion. They do categorize it like lead like you said but also things like coffee, sawdust are in that group.

Abrami: Ok . You made your point on that.

Swanson: This committee (IARC) like IEEE only smaller looked at literature and concluded Group 2B. The standard for that is a very low bar. They made this on two things. The first is a data point on the interphone study in Europe and a collection of studies from Swedish researcher Hardell. The other

studies find no effect. I actually wrote to them and asked them, what are you doing??? What they said was, we are applying the Precautionary Principle.

Abrami: Dr. Sherman would bring that up, the Precautionary Principle.

Swanson: I have written about this. I am fine with the principle. But you can go overboard. It would be prudent not to go outside, not to get on a plane but I do it and accept the risks associated. One thing about the data points on the phone study. They self-reported that the numbers are unreliable.

Abrami: So why then is there a legal notice on RF in your cellphone telling you to keep it away from your body?

Swanson: It's not science. It's precautionary with a flavoring of legalese is what that is.

Abrami: So you are saying there is no science behind that legal notice?

Swanson: Correct. Yes.

Abrami: Let's talk about insurance industry. They recognize wireless radiation as a leading risk and place exclusions not to cover it. What does the insurance industry know that we don't know?

Swanson: I am not qualified. I don't work in industry and don't talk to them.

Heroux: You make a great point of giving a lot of influence to the concept of ionization vs non ionization. So if I take a copper atom in space and I want to extract an electron from it, it will take me a fair amount of energy. Is that right?

Swanson: Yes.

Heroux: We call this the extraction energy from the atom. But if I take a group of copper atoms together, how much field do I need to move the electrons in them?

Swanson: You don't need much. It's easy.

Heroux: It's called the degenerate fermi gas. The fact that you bring these atoms together changes considerably the electrical properties of the material. So you agree with me that if you have a material that has closely packed atoms and the electrons or protons move through the material then a small electric field can influence the motion of charges.

Swanson: Yes. But so we are not confused. We are talking about metal and of course people are not metal. There is an analogous effect on people though that I rarely ever mention where cooperative effects can cause something below the ionization. However, it's extremely rare and I don't feel like I was lying to you.

Chamberlin: I feel epidemiology is going to play an important part in the decisions of this commission. Your slide on gliomas vs cellphone usage is pretty convincing and that may not be the issue. But something that does concern me in the same time frame (1989-2005) is a 32% decline in male sperm

count. That is major and significant. If you look at the studies that have been done, they are pretty convincing even exposing people at low levels below .1W/kg. They are getting statistically significant effects. I am not talking about P-values of .05 but of .001. I am wondering if you are aware of these and it correlates very strongly to wireless networks and cellphones.

Swanson: There are a lot of studies who are going to see an effect and some are going to be statistically significant. The real question is, are they reproducible? I don't look through all of these but every time I do look at one, I see problems and I don't see reproduction every single time. It's just amazing. I thought the NTP study...wow, this is a going to be a good study. Oh my god...they had problems. This always happens. The existence of these studies doesn't surprise me and would concern me if they could be reproduced but they can't. So I have to look at the consensus.

Chamberlin: There were 16 studies where statistics looked good and they all say the same thing. It's global epidemiology 32% sperm count decrease.

Swanson: Let me address sperm count. I use this in my class. There is a problem with studies. They are not based on same criteria or same subjects. About four years ago, the Danish Army did a study and they completely debunked this. There was no effect.

Wells: The Boxer lab slide is that a static field not an RF?

Swanson: Yes. I believe it's a static field.

Ricciardi: You just made a comment that you don't buy into these studies because they aren't reproduced. Many of these have been including the NTP study which was reproduced twice. What peer reviewed studies have you done?

Swanson: I have not done animal studies. I do theoretical studies.

Ricciardi: I find it difficult that you can dismiss all these studies showing biological health effects from cellphone radiation. The international EMF scientist appeal. That's 2,000 reproduced papers of studies over and over again with 240 scientists studying the fields on biology and health. How do you argue that health and regulatory agencies state that there is a scientific consensus that cellphones are safe when so many experts disagree?

Swanson: That's a good question. This thing is called the 5G appeal. These are scientists and doctors in Europe and North America saying let's slow down on 5G. So how many scientists and doctors are there in Europe and North America? They have 260 people out of 26,000,000 that have signed. That's not consensus.

Ricciardi: You misunderstood me. I wasn't talking about a petition. I was talking about 260 scientists doing studies.

Abrami: I think he stated his position already. We are short on time. If you could spend some time later on the phone or webex maybe in a few months. We may have more questions for you and you can finish. (He ended his presentation just before Nasim and Kim).

Next meeting: Friday, December 13th . 8:30 was agreed upon. We will have one speaker and then talk through where we want to go next.

V. Meeting Adjourned at 10:35 am.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

12/13/19

8:30-10:35am

LOB 202

Meeting called to order by Rep Abrami at 8:30 am.

In attendance: (10)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Carol Miller-NH Business & Economic Affairs Dept.

Senator Tom Sherman-president of the senate appointee

Not present: (4)

Frank MacMillan, Jr. MD-NH Medical Society Environmental Medicine

David Juvet-Business and Industry Association

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Brandon Garod-AG designee, Asst. AG Consumer Protection

Agenda:

I. Approval of minutes from 11-21-19:

Minutes were approved.

II. General Discussion:

Abrami: Recommendations will be based on general consensus.

Minority reports can be written by anyone if there is disagreement.

Focus: things that we can do as a state: from as simple as warnings...to ordinances.

There are things going on in our state right now. Dr. Sherman and I are cosponsors in smart meter bill allowing opt out without having to pay a fee to do so.

- A. The electromagnetic spectrum discussion on terms such as: frequency, wave length, photon, electron volts, etc. and comparison from radio to Gamma. Frequency is the inverse of wave length.
- B. Energy. Radio waves are the lowest electron volts. Gamma Rays are highest at 1.24MeV. Where is the break point? None of this is linear. Science says ionizing radiation which expels electrons from atoms or molecules, doesn't happen until UV rays. However, we have learned that it's actually doing damage below that. The question is: Is the science still out on damage beyond "heat", which is the FCC's standard? It seemed from one presentation that they looked at papers beyond heat so we still want the FCC to talk with us. I will see what we can do.

Sherman: We may be able to inspire them with a nudge from one of our Senators. I would be happy to do that.

Abrami: Kent, I took this from your presentation!

B. Photons: EMR can be represented by discrete packets of energy called Photons.

1. Increasing transmission power will increase the number of photons (although the energy in each photon remains constant).
2. The energy in each photon is proportional to the frequency of the transmission.
3. If the photon energy is great enough to detach electrons from atoms and molecules, it is referred to as ionizing radiation.
4. All the charts that I look at say that happens at UV level.

Wells: When you are ionizing radiation and you remove an electron, you are breaking a chemical bond but you can break a chemical bond at much lower energies. That's why we can see. This is also why humans can photo-synthesize vitamin D. They do it at energies much lower than UV.

Woods: Along those lines, we have to remember, and this is important. This is isolated episodes. However, biological systems work collectively. They diffuse their base energy around parts of a molecule. There is thermal activity already and sometimes can cause a disruption of a bond without anything occurring from anything external. We have to remember that these are terms that we are learning but they are for isolated singular entities. Some electrons are shared by biological systems and are a very different process. We have to go from a single item to a collective and that's a big jump. These are some of the experiments that Dr. Heroux is working with that tries to address that biologic collective entity.

Sherman: One factor.....Transmission power: If I remember correctly, people in industry were saying that each tower would be lower in power because there would be so many, is that correct? My question is: if you increase power, there are more photons but the energy in the photon is proportional to the frequency. So when you increase frequency to 5G but decrease transmission

power, you will have fewer photons but they will each be higher energy. What does that mean to us on the receiving end?

Wells: And the antenna is closer. As 5G single transmitter power density goes down but the number of them is much larger and they are much closer. It's like little Christmas tree lights around the room instead of just one bright one.

Sherman: Does that mean that the total amount of exposure will go up?

Wells: Yes.

Sherman: Because of the proximity of the antenna?

Wells: Yes.

Sherman: even though the power is down?

Wells: Yes.

Sherman: The photons will have more potency and you are closer to them.

Wells: They will have larger numbers. The total power of a 5G system has five orders of magnitude which is 100,000 times more intense than a 4G system!

Abrami: This is something we have to focus on. Kent, do you have something to add to that?

Chamberlin: No. I agree with what's being said.

Heroux: Basically with the beam forming you tend increase the directionality. It's more focused. With the old systems, they broadcast to a very wide area. So it's true that the new system 5G will be less power input into the antenna. But the beams will be much more focused and the cellphone will also have the ability. You are talking about very narrow beams that will be directed to you when you use the system so that means increased levels of radiation because of this concentration. The antenna is spending less power because it is not broadcasting everywhere.

Sherman: You just said something that I don't think I put this together until now. When the cellphone is 5G capable, is the antenna putting out the same level of radiation?

Heroux: It's going to put out the same type of radiation. They are miniaturized antenna in a chip that is implanted inside the phone which you will hold so you will direct the beam to wherever it wants. You will have a more concentrated energy coming from your phone. The radiation pattern will be fundamentally different.

Sherman: So will it be 5G level radiation be coming out of your phone?

Heroux: Yes.

Abrami: Ken wants to talk about antennas after we get through this.

- C. Specific Absorption Rate: power absorbed by mass of tissue=energy is absorbed by the human body when exposed to RF/EM field=Watts/kilogram. US cell phone standard is: 1.6Watts/kilogram or less.
- D. IEEE/ICNIRP 209 standards are still the same basically what the FCC uses.

Dr. Swanson said that the FCC reviews biological standards as well, not just heat. We really need to speak with FCC on this.

Chamberlin: I thought my question to Dr. Swanson was pretty direct. I asked him which of the two approaches setting standards, did they use. One he described was on animal studies exposed to increasing radiation until their behavior changed, divide that by fifty and you come up with a standard. That was one way. He also said they relied on publications written but he didn't say which did they use? He said both but I don't feel like I got my question answered. If it's the behavior in animals, then that is a short term phenomena and does not address the concerns that we are looking at in this commission where people are going to be bathed in electromagnetic radiation 24x7. I am really unhappy with where we are, with finding out that piece of information.

Abrami: Dr. Heroux, I know you went back and forth with him on this and you were involved.

Heroux: Yes. The FCC cannot try to implement a national standard for radiation without claiming it is taking everything into account. Yet, they don't have biologists on their staff. They have a tradition of being a spectrum allocating agency which is very important for coordination in the country but they are not biologists. A better body to ask is the IEEE. Again, the IEEE is heavily influenced by engineering tradition and I would reinforce the argument of Dr. Woods. All of these things about physics are entirely true and entirely valid. What what we cannot forget are that biological systems, the fact that we think and we act are processes. These processes involve manipulations of electrical charges in our body. These processes fundamentally move electricity around in our body. Those are unstable processes that can be influenced by vanishingly small amounts of energy. Energy is an immensely valuable concept. But the complexities of biology have been underestimated by engineers eager to serve the public with applications and by the FCC eager to serve commerce.

Roberge: I asked Dr. Swanson a question related to the FCC standard as well. I thought I remembered a conversation about the standard being focused strictly on heating rather than other biological effects. That was my question with him, to understand are they strictly looking at effects of heat or are they looking at other biological effects? I am not clear on his answer. I am not clear if the standard evaluated other studies or just heat. I also thought it has been awhile since they set the standard.

Chamberlin: I would like to interpret what I heard him say. As long as you are below UV Ionizing radiation, the only factor is heating. There is a question about how much heating you can tolerate. That has been the industry mantra on radiation exposure for as long as I have been in the field. I believe that is what they are using as the criteria.

Abrami: That standard hasn't changed much over time, is my understanding.

Sherman: I apologize. I could not be here for that meeting. We are talking about human health effects. This bathing 24x7 is not just on the human environment. It's on the entire environment. Do any of you know if there are any studies on plants or animals and others exposed to this?

Chamberlin: Yes. There is a study that shows that tree and plant health near cell towers is degraded considerably. I have a paper that says that.

Ricciardi: There are many studies and a big study on the damage to bees. I did ask Dr. Swanson because he dismissed the fact that it harms bees. So I handed him the study. It has a huge impact on the environment.

Abrami: Let's pause on that one. There was a study done on bees using twelve hives. Half of the hives, they put cellphones in and in all six, they did not come back to the hive. They got confused and you wonder ...why is that? It must have to do with their navigational system. I always thought they had sensors that pick up the Earth's magnetic field. All of a sudden we are going to cloud the Earth's natural magnetic field with man-made different frequencies.

Ricciardi: This one is the exposure of insects to radiofrequency electromagnetic fields from (2-120Ghz), published in Scientific Reports which is the first study to investigate into how insects including the Western Honey bee absorb the higher frequencies to be used in 4 and 5G. The simulation showed increases in absorbed power from 3% to 370% when insects were exposed. This could lead to changes in insect's behavior, physiology and morphology, over time. I did ask Dr. Swanson, can you confirm that these frequencies are safe for pollinators and what credentials he had to speak to this? I don't feel my question was answered at all.

Abrami: This is one I feel we need to follow up on. I found studies on bees at low levels that impacted the number of queen bees produced by 40% something like that, which is significant. Bees are our health, food, etc. It's navigation, which can also be biological. I don't want any of us to sound like alarmists. We want the facts to come out and we want to understand this. But on my list, I think bees and probably migrating birds as well are important.

Wells: there has been a lot of work on homing pigeons, migrating birds and bees. They also use iron to determine which orientation the EM field is. The effect is if you hit the frequency that will make that move, you will make that sense blurry or obliterate the usefulness. There haven't been a lot of studies determining what those frequencies are. However, if you confound the major pollinators, that puts all of plant life in jeopardy.

Abrami: yes...that's oxygen and food.

Woods: It's important for us to ferret out in these studies which include 5G because our charge is 5G. We know that that the photon energy is different. The comment that I heard him say was, how many G's do you need to study? We need to study 5G. As we go through this, we need to make sure studies include 5G. The energy is definitely different and we talked about that. Some of the studies do not include 5G.

Ricciardi: There is a recent study this year on 5G in France and Netherlands. They measured the RF from small cells increased radio emissions from the base stations while decreasing the radio emission from the user. They found that in the area human sickness is well documented and has increased since it's been installed. This is all involuntary exposure hanging in front of people's homes. With your phones, you have the choice to turn off or not own. I have issues about choice and it's a privacy thing, too.

Abrami: The 1/R² rule. Meaning the further away you are is a physics principle we need to talk about too.

Issues:

- Biological effects of non-ionizing radiation.
- We need to make sure these studies are not flawed.
- We need to find studies that are replicated.
- We need to understand the FCC approach to standard setting. Are biological effects included or not?
- Impact on navigation of bees, birds and other living things such as interference with Earth's magnetic field used for guidance (non-biological).
- Energy level from cell towers and small cells based upon distance. What other factors?
- Legislative activity, ordinances and the courts around the country and the world.
- RF Communication security. It's scary what's going on in China. Facial recognition, etc. Pretty soon you won't need any devices.
- Insurance Issues: why is it insurance companies won't insure this stuff?
- Smart meters on homes.
- Precautionary Principle. Dr. Sherman, I know you think this should apply here.
- Final report will have recommendations for future legislation or public health warnings based upon solid facts. We will come to a consensus. Anybody can write a minority report on any part they disagree with.

Sherman: One thing to consider is looking at all this frequency and power. Are we already beyond the safe level? Is 4G not safe? Is what's out there now unsafe even before 5G?

Abrami: well, we are not going to take people's cell phones. That's not going to happen. To industry, it means money. There are not definitive studies on 5G that there are not health effects. I asked Swanson that. Where are the studies that say 5G is going to be safe? Show us the definitive studies.

Ricciardi: I asked him, are you saying that 4 and 5G are not harmful? He said yes. To Dr. Sherman's comment about already being dangerous, your cell phones already have warnings buried in your phone to not put them close to your head or ear. People really don't know that. It is dangerous. We aren't going to get rid of phones. One solution we may want to consider a right to know law at the point of sale because people will still buy them but they may use them more carefully, just like cigarettes are still sold with a warning.

Sherman: That's my point. If this commission finds out that maybe we have crossed that threshold into what may be dangerous, I think transparency in sharing that knowledge is important. Also with 5G, one of the concerns is everyone will be exposed whether you own a phone or not. Are we already at that point with 4g whether you own a phone or not and is that exposure potentially toxic? That is something where we can at least raise the question.

Ricciardi: Very good.

Heroux: I have a number of comments. I have been in this business for a long time and I want to emphasize the importance of what has happening here and the influence that you are going to have. You are not the FCC. You are not the IEEE. You are not the Chinese government. But, you are a public body that has NO conflict of interest. You can claim that engineers have a conflict of interest because they are pushing products. You can claim that the FCC has a conflict of interest. This body apparently has none. It is looking at data and reality. The discussions that we are having today are incredibly rare. They are usually held in private between individuals. Although New Hampshire has limited power implementing laws and regulation, what you will recommend, will be heard. That can have tremendous influence on the future. I see that responsibility on the shoulders of this committee, as huge.... planet wide, in my opinion. First point!

The frequency range of 5G can be very wide because industry is very flexible in what it does. Some frequencies used in 5G are lower than some used in current systems. Some that have been allocated are much higher. As Tom Wheeler would say, if someone tells you that they know what 5G is, run the other way because not even industry, itself knows. So, we are forced to evaluate electromagnetic radiation as a whole.

About scientific studies: All scientific studies are flawed. You would have to have unlimited money and time to produce one that is not. The weakness of the overall process is that because you can criticize ANY study, a committee that has a philosophy, can get rid of studies it doesn't like. This is a reality that is inescapable. The philosophical attitude of the people assessing science is absolutely tantamount.

Another problem is that the reproducibility of experiments that you are familiar with in engineering or in science is higher than what you have in biology. This is because biological objects are inherently extremely variable. So when you impose the same standards of reproducibility on biology to those of engineering or science, it's extremely unproductive, in my opinion.

The physicists have to bear the guilt of the atomic bomb. I am sorry to say this but electrical engineering will have to bear the responsibility of 5G. In a sense, it's electrical engineering's atomic bomb. Probably the people who can attenuate and manage this are here.

III.Ken Wells: Presentation on 5G malign applications:

Culture of Safety:

It has been said in this room, that little research has been published on the hazard or the safety of these frequencies. I have been involved in hobby auto racing as a driver, pit crew and safety corner worker. I am used to cooperative safety culture that asks, what is the worst thing that could happen? Then you work together to make sure that is very unlikely or impossible. I don't see that 5g is progressing that way. I think we would be wise to take that same approach with high frequency radio frequency.

Is it possible for radio frequency to cause harm?

There is an RF weapon that's called "active denial system: that uses 3.25mm or 95 Ghz band of 5G. In testing, it was able to create a burning sensation in the people it was aimed at in a tenth of a second. It was able to create 1st and 2nd degree burns in less than a second. In one case a subject was hospitalized for two days. So, yes RF radiation can cause harm. From this military experiment, we have evidence that RF can cause pain and injury. I would like to explore what could happen if instead of a cooperative safety culture that I spoke about, that a maligned player either foreign or domestic wanted to pursue a nefarious use of this RF against a civilian population. In theory, could a 5G network of small cells, IOT and devices be weaponized? I think so. This is the worst thing that can happen scenario that we must render impossible.

Physical descriptors of RF. There are three major ones are used universally.

1. Photonic Energy that you can categorize in terms of frequency or wavelength.
2. The intensity of radiation: The brightness if you will. It expresses how much energy strikes an area in a given time.
3. Duration of exposure. The IEEE standard 95.12019 is substantial and you should look in to that document. The research in that describes a quantity called fluence which describes field strength times the time you are exposed to it. It implies that pulses of RF should be separated by a few tens of seconds to avoid damage. That is not currently incorporated in the standard but something I think we need to pay attention to.

Absorption: waves transmit energy from place to place. EMR interaction with matter is frequency dependent. It has three ways it shows that dependency. The first one is heating. Second, is quantum effects with sharp bands particular frequencies that are strongly absorbed by particular atoms and molecules. That is not so well studied.

Third, you have anisotropic effects. Those are not uniform in all directions. Those include things like polarized emission and absorption, tunneling, and we don't really understand the biological role very well. We know they are very important. We know that we can point to these in chlorophyll and DNA.

Membrane bound biological processes like photosynthesis, oxidative phosphorylation (respiration), reproductive fertilization and neurological processes are all things where we think these electronic reactions are happening. There is even some theory by Roger Penrose and others doing research that the human brain might even enlist what is not well understood called quantum entanglement. There could be a role of chaos theory. As Dr. Herox said, very small electrical fields are involved in these biological effects.

On page three, I took measurements from a cell tower. I happened to be hiking and got some readings of a 4G Verizon tower. Dr. Swanson told us that the amount of power was hard to pin down. The manufacturer said it was only about ten or twenty watts. I am not sure what we should believe. Since there is so much variation on it, we need to be able to put a large error safety bar on these values. I am most concerned about the layout of these small cell antennas which resemble a phased array.

A phased array is the way that modern radar picks its direction. Remember that old ones had oscillating antennas. A phased array nothing moves but you change the characteristics of the antenna in order to steer the beam. The hardware layout for small cell 5g antenna areas meets the requirements for a phased array about a hundred meters apart over an entire city. Once this antenna is built, a maligned operator using software could upload to the array to alter its function from the benign communications function to a high powered steerable array either to disrupt communications or to actually be used like this military device. Foster et al say in IEEE 95.1 "The use of multiple steerable beams from 5G base stations will introduce new issues for compliance assessment for future RF exposure risk" which I think is quite an understatement.

I don't think that we or the FCC, can effectively regulate either operating frequencies or power levels of such an array because today's equipment hardware characteristics are completely transformed by software. You need only to consider the VW "Dieselgate" cheat to see how software can be used to hide or reveal deeply embedded nefarious capabilities of hardware. Since regulation of wave parameters can't be done with this array, the phased array deployment has to be blocked by controlling what kind of physical antenna can be built.

We could continue on our current path of allowing maligned foreign entities to sell us 5G equipment or even components that go inside these things. How hard would it be for a remote operator over the internet, to toggle the equipment from its benign communications into another role? This role may operate on another frequency for espionage and surveillance, or to increase the power as a weapon and deny us our Constitutional right for assembly. It would be easy if that maligned capability was built into the hardware that we purchase as a Trojan horse. There is once piece of good news in this. The atmosphere attenuates the signal fairly strongly.

There is a spectrum on the last page. In the mm band, there are really only a few windows. The military application picks the biggest of the three peaks between 1-10 mm at 3.75mm and those are also the same bands you want to use for communications. The Air Force began development of "Active Denial System" in 2000. It used 3.25mm (95Ghz) RF as a crowd-control device whose range was "greater than conventional small arms" (3km). In testing, it could cause "an instantaneous burning sensation" in .1 sec

exposure, along with first and second degree blistering burns on human subjects for exposures of less than 10 secs. One case required a two day hospitalization. It was tested as a 30MW mobile truck-mounted “area denial” system in Afghanistan in 2007. Could a malign player (foreign or domestic cyber-attacker) pursue a nefarious use of RFR against our civilian population? All of this suggests a couple of avenues we could consider.

Prevent the rollout of antenna array that can be used as a phased array. Transmitters should be built using MIL-SPEC US component suppliers, with the same degree of security and oversight used in other weapons systems. Do any citizens in the US ever worry about their constitutional rights, or oppression at the hands of their own government?

Abrami: We need to end here. We are going to have to follow up on your major points.

IV: Tim Schoechle PhD: National Institute for Science, Law and Public Policy presentation:

Schoechle: Computer and communications engineer for 45 years and on the faculty of the University of Colorado for a number of years prior. I’m speaking now for the National Institute of Science, Law and Public Policy think tank in Washington that writes on health and safety issues as well as telecommunications and energy issues.

The purpose of this paper is to give an overview of current technology and both the technology and the policy issues in telecommunication including internet, wired and wireless.

1934 the Telecom Act established the FCC which regulated broadcast radio and telephone service.

1986 The Bell Monopoly (AT&T) was broken up.

1996 Telecom Act revised the 1934 Act. Wired Communications were covered under Title II (common carrier), leaving the wireless and cable essentially unregulated.

1990-2010 Wireless rolled out 2nd and 3rd generation wireless.

What developed out of that was the reincarnation of the Bell Monopoly that began around 2000 which resulted in today’s duopoly of Verizon and AT&T. This is not the Bell AT&T.

A major point here is: the massive cost subsidization of wireless by diversion of fiber to serving cellular network. One notable point is Verizon’s abandonment of FIOS that it was marketing in 2000.

Abrami: You say there are two major players but what about T-Mobile?

Schoechle: Cable is the third player. It makes it more complicated because it’s a wired service and wireless. It’s really a trio-poly. The rest is much smaller.

Abrami: Talk about the flow of money and the diversion of subsidization. Are you talking about the charge on landlines that were supposed to be used for optical fiber infrastructure?

Schoechle: The “Book of Broken Promises” is a 600 page book that describes in detail how this diversion took place. The obligation was to upgrade wired infrastructure from the charges that ratepayer money for on the telephone bill. That money was charged against the wired and used for the wireless. It amounts to about 500 billion dollars. Basically, it made wireless look a lot more profitable than it would be otherwise.

The drivers: the need to sell more phones and now its 5G. It’s about selling equipment. There has been a slowing on the sale of cellphones. The industry philosophy is planned obsolescence.

The new subsidy is YOUR public rights of way. It’s a preemption of local property rights and rights of way that give telecom a grant by right to public property. Over twenty states have adopted legislation to take away the rights of localities which was inspired by if not written by the American Legislative Exchange Council (ALEC). It was written to take away control of states and localities of deciding on this equipment.

The FCC is a captured agency and presently chaired by a Verizon attorney, Chairman Agit Pai. It’s not surprising that it serves their purpose.

Surveillance Capitalism: There has been a transformation in the past twenty years that began in 2000 to a surveillance business model. This is really important if you want to understand the telecommunications industry and particularly the IT industry.

It has gone from selling products and services to the new model of trading in personal data. The tail is wagging the dog. The data is more important than what the equipment does. This was developed by Google and refined in 2010. It has been adopted by Facebook, Microsoft, Amazon and now Verizon, AT&T and the entire IT industry. There is a book called “The Age of Surveillance Capitalism” by Shoshanna Zuboff of Harvard University. She has written a monumental piece that details how this occurred and the social implications. You have to understand this to understand why information technology is going where it is today. It is selling data, selling behavior and advertising primarily. It is also selling behavior modification, which has political implications as we know. Selling control of people is where this is headed.

Wireless devices and networks are complex and proprietary. I am going to compare wired and wireless. The wireless is unregulated. It has progressed rapidly. It is extremely complex and changes all the time. Wired networks that are copper or fiber are simple stable technologies and are open. What you have is essentially a generation of wireless technology which is designed primarily to gather data about you. Wired networks particularly optical fiber, are much more secure than wireless.

Some of the risks of the wireless industry:

- Loss of community rights, property rights and rights of way for private corporate gain.
- A loss of revenues that come out of that is essentially a forced subsidization of your community to wireless by giving them stuff they would have to pay for.
- If 5G was not subsidized through this form, it would not be feasible.
- The loss of community environmental regulation is a critical factor. There are a lot of environmental implications to this technology.
- Risk to personal privacy and corporate and government surveillance.
- Risk to public health and safety. Vast literature on this suppressed by industry or ignored by federal regulators.
- Damage to the environment birds, bees, insects, plants, animals, tree, etc. particularly mm waves.
- The FCC limits are obsolete and they have no health expertise and have swept this under the rug.

What can states do?

- Let's get fiber to everybody. Fiber should be the first priority. Fiber is a basic utility like sewer, water, roads, etc. Wireless is an "adjunct service". The fiber should be owned and controlled by the municipality. This should not be privatized. Fiber access is superior to wireless in every respect except mobility. The fed has no policy on this and local power companies and rural electric companies are stringing fiber optic. It offers speed, stability and better privacy, safety in weather events, reliability and it's cheaper.
- Internet access is a necessity to modern life. You can't operate government today without the people having access to the internet.
- Cellular wireless is an energy hog as well.
- Community fiber would reduce the need for cellular wireless.
- Enable community fiber.
- Integration of distributed energy. Fiber will be needed for solar/storage and the future of the electric grid.
- Enable local control of cellular wireless facilities: Initiative in Colorado is repealing ALEX laws passed in 2017 which preempts local legislation.
- California just enacted CCPA (California Consumer Privacy Act). Take a look at this.
- Health and safety studies of EMF need to be supported.
- Enforcement of Environmental Protection laws. The appellate court just overturned part of the FCC order on the basis of its failure to enforce NEPA, the Environmental Protection Act.
- Antitrust enforcement and divestiture. The last thing we should do is allow merger between T-Mobile and Sprint. Fifteen AG's from states have filed a separate lawsuit challenging this merger.

- Read ,”The Book of Broken Promises” and do something about it. There is a case proceeding in the 10th district in Washington, DC in January on this investigation.
- Support the Green New Deal: 1/ a distributive solar micro grid and 2/fiber smart grid and optical fiber nationwide.

FCC has abdicated its responsibility to public health and safety as have other regulatory agencies.

FAA has failed to regulate creating a debacle which could sink Boeing.

California PUC has failed to regulate PG&E, one of the country’s largest utilities and is in bankruptcy largely due to the failure of regulators.

Another example of regulatory capture and the revolving door is now we have the FCC’s failure to investigate cellphone radiation, safety and their obsolete radiation limits which flies in the face of the NIH Toxicology Program study that shows cellphones can cause cancer.

Abrami: You have reinforced many of the things we have been talking about in this commission. What do you know about what is going on in China and their 5G rollout?

Schoechle: I submitted a paper ,” What is 5g and why do we care?” In it, it refers to China. It’s a financial driver in China and part of a surveillance state. It takes surveillance capitalism and the capitalists are the government.

Abrami: So we should be concerned about the chips and things coming from China?

Schoechle: It’s not just China. Korea is also a major manufacturer. They have become famous for LG, the television that are watches you. Those televisions are sending information to Google and Facebook and who knows where else on the internet. You don’t even know that is happening.

Sherman: Is there somebody in the legislature in Colorado that you have been working with who has been translating some of the work you have been doing into legislation or bills?

Schoechle: The majority leader is on board with this. I wrote a 20 page report named “Reclaiming local control over cellular wireless facilities”. I just sat down with a member of the House and went over that in great detail. We are looking for a sponsor for that bill. We are in recess right now. I can give you more detail on that if you want to follow up with me.

Sherman: That would be great. I am chair of Senate Health and Human Services. We try to not reinvent the wheel. If there is legislation enacted or in process that seems to be working through the system in Colorado that may be appropriate here in New Hampshire, we would like to take a look at that.

Schoechle: If you send me your contact information, I will try to facilitate that. The big focus in Colorado last session was major changes in energy policy. Electricity, oil and gas have been a major political debate in Colorado and we have made progress on that. Telecommunications will be in our next session.

Heroux: In your report in section 3.3.3 pg. 34, you say most of these sources never turn off and cannot be turned off. I believe you say this in context of IOT. Would you agree that the hardware switch on these devices would allow a person to eliminate radiation and eliminate transmission of information if the user wants to? Do you think it's feasible to implement or to legislate for such a device that would restore an individual's right to privacy and manage his radiation exposure?

Schoechle: That is a good question. The trend in the consumer electronics industry is to develop products that don't turn off. They look like they turn off and you think you turned it off but they are still on. This is a problem from an energy standpoint and from a data standpoint. I think what you are suggesting would be a good idea and we would have to look at how policy would influence the consumer electronics industry.

Heroux: You could design it that the switch is only disabling the transmission. You make it unable to send out data and you eliminate the radiation. You could also say that the fact that it is off, you do not disable the other functions of the device. It is a matter of engineering. We all depend on engineering. This type of switch could go a long way toward protecting privacy and making it possible for Electro-sensitive people to survive. How can this be imposed? Do we need IEEE to promote this? Do we need the Chinese government to promote this? How can this be achieved? You know industry well. If the goal is to restore that kind of power to the individual, what is the path to achieving this?

Schoechle: That is a wonderful question. I will have to think about that. It's not so simple. Particularly, with cloud data, the whole business model on these products is capturing that data. You are asking to change the business model for a whole industry. I agree with you completely. We will have to think that through very carefully but I think there is a path. Maybe the IEEE, but an organization called Consumer Technology Association (CTA) is more likely. I am on the cyber security committee and that would be a good focus for that. We are writing a new standard for consumer products. CTA2088. We also have an international committee that works on this. There is a concept of residential gateway for this as well. We could address it through standards and at least make that an option that people could buy.

Heroux: Since realizing that you are the best person probably anywhere to do this, I assume that we can count on your cooperation to further this idea perhaps in cooperation with the Committee in some form or other.

Schoechle: Absolutely yes!

Miller: I would like to explore your statement on enabling community fiber. You also said community fiber would reduce the need for cellular wireless. I am not sure I agree with that statement since we like to be mobile and fiber is not mobile. The other thing is why do you say community fiber owned and operated by municipalities?

Schoechle: Well, because for the municipality, there is a political process for governing it. If it is provided by a Century Link or Verizon, even if it's fiber, you don't have any control or assurances of net neutrality or if it will be equitably distributed in the community. You don't have that control. It's not something that should be privately controlled.

Miller: You go on to state that cooperative electric utility is a better model in some ways for smart grid which would be enabling fiber to the premise. That is not community controlled either. That's controlled by members through charter but not a community controlled network. So I am not sure what you mean, totally controlled by municipality? Or partnered with an electric coop to disperse fiber? Can you elaborate on that?

Schoechle: My first choice is municipal electricity and municipal fiber together. I consider the perfect model as Longmont, Colorado. They have done both of those. They have the most advanced fiber system in the country. That is preferred. But America is very diverse country. The rural electric associations are called coops. It is possible to go through the coops in a democratic way unlike a private corporation. They are like a Frankenstein monster, out of control and basically ungovernable.

We are looking at a new technology standard Ethernet cable Cat5 or Cat6 copper wire. This can carry data over short distances at the same speed as fiber. This can also deliver DC power. You can plug phones, computers to a USB connector throughout your home so you don't even have wireless in your home. That is coming... a USB connector standard USB3 type C something like that. This will be the new standard because this is the new internal wiring in cars will be gigabit ethernet.

Miller: This doesn't address mobile access. People want to be mobile.

Schoechle: I am saying it will lessen the dependence on mobile. Right now, if Verizon had their way, you would only have mobile access whether you want to be mobile or not. If you have fiber, you will have faster better service and when you are mobile, you have a mobile phone. I have a mobile phone and it's an old flip phone. If I want to do data, I use my laptop plugged in at home. I am not going to do that in a car driving around. People need the choice.

Sherman: I am not sure people would be quite so wedded to their phones if they were aware of the health impacts to themselves and the environment. If you were to take that new USB technology, would you be able to go to airplane mode on your phone and still have complete access to your phone? Would an on/off switch shut down antenna? Like an airplane mode for television or CPAP machine which is now wireless, as well? Would the concept of being able to shut down on all devices be what we are talking about?

Schoechle: Yes. It's analogous to airplane mode. Airplane mode is to prevent radiation for interference with aircraft systems. Right now many cell phones have a feature called wifi calling so you are not using cellular calling but using fiber access or whatever so you are not using cellular wireless network. Of course the cellular operators don't like that but all the phones now work that way. You could plug in your phone when you get in the house and turn off your cellular antenna and still have phone access.

Ricciardi: The town that I live in is entertaining fiber optics. We would have to put it on our ballot for the people to vote. I have two questions: I have heard different things. If we put fiber optic in, would that make it easier for 5G to come to our area? Would that give them a segway to attaching themselves?

Schoechle: That is a very good question. Many of my colleagues and I have arguments about this. Some say you are just going to enable 5G sites by putting in fiber. Well, that's why it needs to be democratically controlled by the people in the community.

Ricciardi: But my understanding is that the FCC can just allow them to come and put the 5G in. You won't have a say as a municipality. If that is the case, we would just be making it easier for them.

Schoechle: They can't make you use their fiber. The FCC ruling is just about siting, not the use of fiber.

Ricciardi: Oh, so it could help you keep 5G away.

Schoechle: The issue is not whether there will be fiber or not. The issue is who is going to own it and control it. That's the issue. If you put it in, you control it. If Verizon puts it in, they decide how it's used. That doesn't stop them from putting in 5G but they have to put in their own. They don't get their subsidy off of us.

Ricciardi: In the state of New Hampshire, our utilities are in the public right of way. There is a NH law that I have looked into. I have been looking into an ordinance for this. That is a factor in our state. It is a little difficult to overcome.

Schoechle: Yes. A lot of these laws were written that way and need to be revised. That's unfortunate. The goal should be Local Control.

Heroux: I have a comment about mobility. We need mobility. The cellphone industry has paid little attention to reducing exposure of users. There are some people who occupationally need to use the cellphone. They don't even have a choice. In other words, I recognize the right of people to accept EMR exposure if they want. However, there are people who do not have a choice to use the devices that are on the market. It is possible to reduce the exposure of a person by a factor of about a hundred if you make the proper engineering efforts to do so. You can have the exactly the same services you have now but your risk would be reduced a hundred fold by design of the antenna and software adjustments to the phone. There will be no loss of functionality however, an enormous loss of biological impact. Industry in the past has not done it. It needs to be told.

Schoechle: I agree completely. That is a very good point.

Abrami: Here's the issue. 5G is a concept that means something different to every one of the phone companies. They are all developing their own version of 5G which makes it hard to track. One thing for this commission will be a Health issue potentially and definitely a political issue is the deployment of these small cells at telephone pole heights in front of people's homes. That becomes a real intrusion. Regardless of what the science says, many people will say, I don't want that. We already know the

battles in our communities to put in a regular cellphone tower somewhere in the town, let alone a small cell in front of a home.

What is your view on that? We have engineers, doctors and toxicologists on this panel so we are having interesting conversations that really should be happening at the Federal level. What is going on in Colorado? Are there deployments of these small cell towers?

Schoechle: Well, yes. Verizon is rolling out in Denver. The issue has not come to Boulder yet. But the issue is what they have done with these ALEC laws and the FCC. They have lawyers that go around and tell city councils and county commissioners... oh.... you need to change your codes now to be in compliance with state and federal regulations. Our response is, let's change those. Of course that is a bigger hill to climb. People are getting up in arms because they are seeing the permitting of these small cells. Just the permitting has raised concern and communities are mobilizing around here. There are over a hundred cities around the country that have bonded together to sue the FCC. They have had some success. In November, there was a ruling in the 10th district. Industry wants to do this because 5G will need a shorter range. People don't realize that 4G and 5G will be bonded together. You cannot separate them. You will have both 4G and 5G. The new small cell sites being put in are 4G which will become 5G as well when they figure out what that's going to be. The technical standards aren't finished, the spectrum isn't allocated. 5G is an add-on to 4G which allows faster data transfer. It does not support voice communication. It doesn't support a lot of the things that your present cellular supports.

They talk about 5G for autonomous vehicles. I think that is a bunch of hype. There are safety issues that have not been addressed at all. It's marketing hype. The term 5G is a marketing term. It is not a technical term.

Sherman: My nephew is an engineer on the autonomous car, Waymo .They have no dependence on the internet. It is completely autonomous. So it's not just hype. It's a lie.

Schoechle: Right.

Abrami: Thank you for your time.

Schoechle: I would like to connect with the commenters. Thank you. I like the idea of technical standard approach to devices.

V. Next meeting: January 10 8:30-10:30 Devra Davis and Theodora Scarato

We are now going into Legislative Session. We need to do meetings on Monday or Friday. What about professors? Friday seems to work best.

VI. Meeting Adjourned at 10:35 am.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

1/10/2020

8:30-11:00am:

LOB 308

Meeting called to order by Rep Abrami at 8:30 am.

In attendance: (12)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Carol Miller-NH Business & Economic Affairs Dept.

Senator Tom Sherman-president of the senate appointee

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Brandon Garod-AG designee, Asst. AG Consumer Protection

Not present: (2)

Frank MacMillan, Jr. MD-NH Medical Society Environmental Medicine

David Juvet-Business and Industry Association

Agenda:

I. Approval of minutes from 12-13-19:

Minutes were approved. Unfortunately, the minutes were posted on our website prior to approval. We will make sure that does not happen again.

Abrami: Discussion about subcommittees and members meeting outside of the regular meetings. Small groups are allowed under the rule is 50%+1. If groups are larger, we will have to develop subcommittees.

II: Theodora Scarato, Executive Director Environmental Health Trust:

Environmental Health Trust is a scientific think tank. We coordinate with scientists all over the world on issues such as wireless, climate change and environmental health issues. Dr. Davis has long worked on climate change, toxic chemicals, environmental possible causes of breast cancer and toxins in the environment. I have a lot in a power point. I hope it will be useful for you. I will not get to everything in here as my focus will be on policy.

At EHT, we publish research and brief policy makers as well as develop educational campaigns for people and for parents on how do you reduce exposure. I have a lot of materials. The most recent paper I published was with Frank Clegg, former Microsoft Canada President. There are links to all of this and more in the power point and it's all hyperlinked.

The Babysafe Project: There is a campaign that we have co developed with Grassroots Environmental Education is called the Baby Safe Project. This campaign has been signed on to by over 240 doctors and scientists and educators, to reduce exposure to pregnant women and developing babies because of research showing brain impacts. Dr. Hugh Taylor, who presented at the press conference for this campaign talked about his research showing damaged memory and increased hyperactivity after cellphone radiation exposure to pregnant mice. There is other research that Dr. Davis will go into as well showing impact on brain cells to what would be legal exposure limits of radiation.

Many pregnant women take the phone and rest it on the abdomen because they don't know. People don't know to keep the device away from the abdomen or use safer technology and you won't get that exposure. I have a quote from Dr. Taylor, chief of Obstetrics at Yale. That might be someone that you would be interested in having to talk about his research. He has a quote: " I am deeply concerned about growing exposure to cellphones." There is a video online at the BabySafe Project where you can watch him talking about this with recommendations on how to reduce exposure.

Wireless and energy consumption: Health and environmental effects of 5G are not just about the radiation, it's also the energy consumption from all of these devices and all of the additional small cells. There is a French climate think tank report (The Shift Project) which talks about the explosion of energy use. Even though there are energy efficiency gains, they are not keeping up with the amount of devices and these new installations, which create an increase in energy use. They document that as well as the environmental effects and every part of the life cycle of devices. For example: You have conflict minerals, e-waste from disposing devices and energy use of the manufacturers. All of these are polluting our environment. This report has a short two pager which is useful for the highlights.

Insurance coverage: I know that one of the questions of the commission is: why don't insurance companies cover damages from electro- magnetic field exposure? As you probably know, in the annual reports of almost all of telecom companies are statements to the shareholders such as " If radio frequency emissions from wireless handsets or equipment on our communications infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues". "We currently do not maintain any significant insurance with respect to these matters."

We have a page on our website linking to all the annual reports with these statements. Why are shareholders being warned of potential risks in the future and not people? I got involved almost a decade ago because I am a parent. I did not believe this at all. I knew enough that I had to take some time to dig in and here I am.

We have list on our website that we try to have a repository with compendiums of information that has all the white papers of industry where the insurance companies rate EMF as a high emerging risk. The SwissRE report just came out rated 5G mobile networks: the impact is high. The quote in this report with regard to health effects is: "As the biological effects of EMF in general and 5G in particular are still being debated, potential claims for health impairments may come with a long latency." I think that's most people's concerns here.

The Harvard Center for Ethics Report: What's going on here? If there are all these studies showing adverse effects, why isn't there the follow up that we would all expect from an exposure this great? In this report, the investigative journalist talks about money that has gone to Congress and the way that the FCC has former telecom executives as commissioners and also when you retire from the FCC, many commissioners end up working for the industry. This is all documented and he also talks about the correlation to Big Tobacco. "It is these hardball tactics that recall 20th century Big Tobacco tactics." This report is from 2015 and I really want them to update it because so much has happened since in terms of this issue with the revolving door. The title of the report is: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates by Norm Alster. There is also published research that has found industry involvement affecting the quality of the results, the design of the studies, sponsorship and publication bias just like there would be in most industries. The consulting firms of Big Tobacco are now working with Big Tech. There is a report out that we are looking at a 12.3 trillion dollar market.

Revolving Door: This is a slide that I made showing the Former FCC Chair, Tom Wheeler was the former head of CTIA, Ajit Pai, the current FCC Chair was formerly a Verizon counsel, Brendan Carr, FCC Commissioner who was a former lawyer for Wiley Rein LLPP who represented the Wireless Industry in suing San Francisco for their Cell Phone Right to Know Ordinance. Bruce Romano, Asst. Legal Chief in the FCC's Office of Engineering and Tech went to the law firm of Wiley Rein representing the CTIA.

Short Timeline of US Regulatory Action on RF and Human Health: This is probably one of the most important slides that I have. You don't have it in your packet.

Abrami: please give us your non PDF versions of your files that we can click hyperlinks.

Scarato: I will do that. This is just a short timeline. It does not have everything in it.

In the 1970s-1990s, the EPA had a robust research program tasked with developing RF safety limits.

1996: the EPA was defunded and told that they could not work on EMF as they were set to release their phase one of safety limits which was on heating effects. The second phase was supposed to be on non-thermal.

1996 FCC adopted RFR exposure limits based largely on limits developed by industry and military connected groups (ANSI/IEEE C95.1-1992 and NCRP's 1986 Report).

We adopted those limits without our experts setting what is a safe limit? What is a safe limit for long term? What is a safe limit for children and pregnant women? Later in 2008, the National Academy of Sciences did a report documenting gaps in our understanding of the issue. What is going to be the impact of children exposed for a lifetime? That is my number one question. My background is as a social worker and I directed programs in schools. I worked with a lot of kids who were born of crack addicted parents. I know the differences between the kids. You have trauma, brain impacts from prenatal exposure. Kids who have been adopted and we know their history. That's what really brought me into this too. Knowing the challenges of my clients and knowing the impact that brain damage can have.

2001: GAO report and letters from experts in government saying there were problems with these limits. Those were not responded to. In 2008/2009, there were Congressional hearings on cell phone radiation.

2012: GAO Report: "FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure." Reassess RF limits and update phone compliance testing requirements.

2012: H.R. 6358 The Cell Phone Right to Know Act was proposed at the federal level and not passed. When I found out cell phones emitted non ionizing radiation, I thought what?? Why didn't I know that? My kids spent time on the phone because long distance was free and I spent hours on the phone talking to my girlfriends. I just wish I had known and I could have made that decision.

2013: FCC open inquiry proceedings (in response to GAO 2012 report) We have links to the docket and the submissions, doctors, scientists, industry, cities, lawyers.

2018: GAO listed status of the 2012 report as "closed/not implemented". But just recently, the FCC issued an item closing the inquiry, saying there is not science that says we need to update our limits. They based that on the FDA's opinion. There is a three page letter in the docket. You can see all of these.

Abrami: Just so you know Theodora, one of our goals is to try to get someone from the FCC to actually talk to us. We are a state. We are not the federal government. But I am not going to give up trying to get someone from FCC to answer our questions.

Scarato: I would hope the FCC as well as the FDA would answer your questions. We have questions. Scientists have been writing letters. I have a slide on letters that have not been responded to. I believe the American people need to have answers to these questions. What the FCC did on Dec 4, 2019 was to say there is no need to update the limits, "that we decline to revisit our RF exposure policy as it pertains to children". "Similarly, the FDA maintains that the scientific evidence does not show a danger to any users of cell phones from RF exposure, including children and teenagers" even though there was a submission in the docket on damaged brain cells.

There were submissions that said the testing of the phones should require zero spacing. They don't think that they need to. They think the information in devices is adequate to inform people of these issues. I think I am pretty smart and I did not know that information was there. I have a Samsung Android and I cannot find my SAR testing easily at all. It is not in my phone. It is not listed online. The only way is to go to the FCC and type in your model and make to figure it out. That is not adequate. I would expect more of our government.

Gray: Mr. Chairman. I do object to some of this testimony. Let me explain why. A lot of the testimony that we are getting right now is: somebody wrote a letter and we didn't get an answer. Somebody else wrote a letter and we didn't get an answer. I have sat through many hearings on vaccines and listened to this electromagnetic radiation all the way from when I was a teenager and we were worried about the power lines. I would love to hear the data that you have got. The experts from the FCC have said there is no scientific data out there. That's what I am interested in, the scientific data that deals with 5G, because that is the crux of this committee. If there is data about the scientific problems with 5g then I want to hear that but I don't want to hear that I wrote a letter and I didn't get an answer.

Abrami: Well, I don't disagree with you. We are trying to get at the essence of this. I want to talk to the FCC directly and the IEEE. We are still trying to get at the facts. We have talked a lot about the science on the commission probably more than any other state legislature. I am hearing conflicting things about the FCC. Did they look at biological effects or not? I want to know. It would help us as a commission to understand. As the Chair, I am not releasing a report if the FCC says X and we say Y without data to base that on. People will ask, just like you did. What did you base that on? The FCC says its fine. That's why we have to keep digging.

Sherman: I want to remind the commission that this is our guest. We don't usually shut down a guest because we don't like what they are saying. I would ask that we let her speak as invited and you can be your own filter for what she has to say rather than objecting to her testimony.

Woods: I understand the Senator's concern. But by the same token, even if we have scientific data, we need to know what context or social context this has been interpreted and conveyed. That is just as important to me. If we find that the FCC got a letter and didn't respond and we know there is a study about that, then that non response is important. I understand that data is important but the context and how it is conveyed is also important.

Abrami: The other thing Theodora, you are doing a great job laying this out. This commission is deep into the weeds on this. We don't know all of what you are saying here. We are filling in gaps so continue along your presentation. The other thing we will be talking about with Devra is we need to see that some of these studies are replicated. We can't look at a study and say that's bad if it's not replicated. For me to feel more comfortable, science has to be replicated.

Scarato: She is going to be talking about that. I had read the questions that your commission is tasked with. I was basing my presentation from the policy side based on those questions. I am trying to explain why and give you links to it. For example, the American Academy of Pediatrics sent a letter with concerns to the FCC. I felt it was important to talk about this.

Abrami: I agree. Public policy wise, like you said earlier, most people don't know you shouldn't keep it on your body. I did not know that myself until about a year ago. As a commission, we would really like to see what other states and municipalities are doing if you have that.

Scarato: I can fast forward to that.

Abrami: You may want to do that because we may run out of time.

Scarato: The Systematic Review: This is important. It is a gold standard and I want to point out that it hasn't been done. When scientists are writing letters, one of the questions asked is where is the systematic review? Where is the full report on all the studies and what they found and how to weigh them by independent experts? What does the science say as to what is a safe level? I know that is a question that you are looking at.

What do US Health Agencies say about NTP study? I am pointing this out because I think it's important for the commission to see what different federal agencies are saying on their websites about this issue. For example, on the National Cancer Institute, unless you know what you are doing, you would be hard pressed to even know what this study found. All they say is, "primary outcomes observed...". This is not what most of the American public would even know what that means. The FDA disagrees with findings of NTP yet no systematic review, no report, no citations, no FDA peer review. The CDC says nothing about NTP. EPA says nothing on NTP and sends you to the FCC. The EPA used to actually have statements on their site. We watch all the sites and you can see what they previously said. They had a statement about an open question of safety, but that's been changed.

2014 The Department of Interior letter states "however, the electromagnetic radiation standards used by the FCC continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable to today".

2002 EPA letter to the EMR network of VT: "federal health and safety agencies have not yet developed policies concerning possible risk from long-term, non-thermal exposures"- Robert Hankin, EPA,2002.

FDA: Scientists 2019 letters to the FDA that have not been answered.

NTP: Ron Melnick is a 28 year NIH senior scientist, who lead the design of the NTP study. He has published how there are unfounded criticisms of the NTP and addresses that.

The FCC said testing phones are zero mm is unnecessary. Women put their cellphones in their bra. I can probably find three or four women on the street in DC who carry their phones in their bra because they don't know. Phones are always radiating even when you are not on them. They say that operating instructions are adequate. Kids don't know.

Abrami: Theodora, please for the sake of time, it would be great if you get to what states or municipalities are doing.

Scarato: Montgomery County, MD has a federal court challenge to the FCC. This was filed before the FCC did its filing stating they don't need to update the limits. This case is still proceeding. How can the FCC be streamlining 5G when they haven't completed their inquiry? The FCC should complete the 2013 review before issuing 5G streamlining order. See the links to [Putting the cart before the horse-“FCC’s 5G first, safety second” policy](#) by Albert Catalan, Eric Gotting and Timothy Doughty, the Journal of Local Government Law. That's one of the lawsuits to know about. I have a link to the filing.

Cooley: Mr. Chairman and Ms. Scarato, I don't mean to interrupt but I think there needs to be some clarification to that slide. The way that you characterize it is that Montgomery County is suing on RF grounds. Montgomery County raised the RF issue in light of the FCC's state and local item with respect to streamlining 5G facilities. I think that's an important clarification for the minutes. I hope I wasn't disrespectful by interrupting you but I wanted to make that point.

Scarato: I hope I was clear on that. What they are saying is, how can you streamline 5G without having finalized the inquiry preceding it or pushing something forward without having done the review?... not that there is a health problem. That is what I meant if I wasn't clear on that.

Cooley: I believe that Montgomery filed again though after the FCC item on Dec 4th. I would like that to be clarified.

Scarato: Oh. I know they are continuing their case.

Cooley: They are continuing their case. I am not disputing that.

Abrami: Theodora, you may want to check that out and get back to us.

Scarato: Yes. I will

Letters from Senators: We have links on our site of senators who have written letters to FCC and FDA, asking for their review on 5G and their letters.

Lawsuits: I wanted to point out two lawsuits: 1/ Irregularators vs FCC and the Fegan Scott lawsuit. Irregularators lawsuit alleges that there was money for maintenance of wired lines that was switched to wireless. I am summarizing. The Fegan Scott lawsuit is about separation distance in phones.

NEPA decision: The FCC's action to streamline 5G, has stripped local authority with regard to infrastructure. There was an appeal by the National Resources Defense Council and Native American Tribes that was won. There needs to be compliance with NEPA (National Environmental Policy Act) for small cell and wireless facilities. Cities and states have argued about amount of caps and leasing spots. There are two separate cases. The FCC has vacated a part of their order saying they do not have to be in compliance with NEPA. So now, small cells need to be certified it meets NEPA requirements. The NRDC did a Q&A about what this means in terms of municipalities. I will provide a link to that.

Federal level: Three Bi Partisan bills on 5G passed the House at the federal level. (H. Res. 575, H.R. 2881, H.R 4500)

Local ordinances: Cities and towns have been coming up with in order to address this because many people say ,I don't want these in my front yard and what do we do? Then they realize they don't have an ordinance in place to handle it. They don't have a permitting process. They don't have any kind of authority. Cities and towns are trying to find out what authority they have and make the most of it. Examples: (City of Los Altos: installation of small cells on public utility easements in residential neighborhoods is prohibited; 500 ft. set back from schools; 500 ft setback for multi-family residences in commercial districts; 1500 ft separation between installations)(Petaluma: 1500 foot minimum separation; No small cell shall be within 250 ft of any residence)(Bedford, NH: 750 foot setback in residential) (Burlington, MA: annual recertification fees; applicant must pay for legal notices of public hearing) (Fairfax, CA: small cells prohibited in residential zones; 1500 ft separation; city to study citywide fiber optic cable network)

Example of issues that come up from lack of infrastructure and permitting/compliance: I will tell you what happened in our town. On this slide, that small cell on private property is illegal even when it was placed on private property six years ago. It was placed there even though the permit was for down the road. The owner repeatedly testifies asking, can you please remove this from my property? Everyone says they can't because no one has authority. It is still there. What is happening is that there isn't the infrastructure that there needs to be to oversee the permitting process that needs to be done. Community members started looking in to this and found several permits that were incomplete and over a dozen that were placed where they shouldn't be placed. Then there is the whole issue on, why can't this woman get that removed from her home? You could have a whole meeting on permitting, review and compliance.

Sherman: I don't understand. We already have utility poles and rights of ways. If this is in violation, why doesn't it fall into the utility right our way or violation thereof and why can't it be removed on existing statute? For example, in Rye there are double telephone poles going in and they are failing to remove the old poles. That's a violation of the right of way and now will be removed. I don't understand why this would take five years if they are in violation of the right of way.

Scarato: I am not going to profess to know all of the details of it. You can watch her present just a few months ago. Every jurisdiction has different policies.

Abrami: I know this isn't the science part of our discussion. 5G means something different to everyone. Different companies are rolling out differently. We are concerned what's in those antennas, how much power is coming from them, how far away should they be from each other, a home or business. Eventually, we will get to that. From a policy stand point, we have to understand the science to be able to make intelligent recommendations Just from an aesthetic standpoint, as a homeowner, I would be upset too. We need to separate the aesthetics from a science too. Some people just don't want it for aesthetic reasons. We are concerned about both because there will be push back. We are trying to get ahead of the curve and understand the science.

Scarato: We all had that question but it's quite complex because every antenna or small cell facility will have different antenna depending on the network using a variety of frequencies. 4G is a backbone of 5G, as I understand it. There is a study that came out that I don't know if Dr. Davis will talk about. There is a study that looked at small cells in communities and communities without them and found there will be an overall increase in environmental level. Industry will say it's negligible. Scientists looking at biological effects will say it's important to consider, I believe. I don't want to speak for anyone but I know that is what is being put forward. That's a good question. We aren't getting 5G but are getting 4G and they put cells 2-10 homes.

Abrami: Usually, we hear of 5G in mm waves, further up the spectrum.

Scarato: But they aren't going to be using only mm waves. They are also using low, mid and high band frequencies, at least from the CTIA report. All of those frequencies will be utilized in 5G depending on the carrier and location. So, to say it's only mm waves is...

Abrami: Every company is different is my guess.

Scarato: What can cities do to retain their authority? Many cities want to retain as much authority as possible related to 5G. There are now 120 cities in Italy passing resolutions on 5G. In Cyprus, they removed wireless from pediatric units and provide safety information for parents. Internationally, is all online on our website EHTrust.org.

Cooley: Thank you for your presentation. We can talk about what is happening internationally but the US has a unique set of laws. In terms of what cities can do, we have to remember the FCC state and local order is the law of the land. It went into effect in January 2019. Yes, it is being litigated. Oral arguments are February 10th in the Ninth Circuit in Pasadena, CA. As we are looking at policy recommendations, we have to remember there is federal law. There is also the Communications Act section 332, specifically which we should delve into because other states are looking at what they can and cannot do in this space. I want to frame that properly. Yes, there are ordinances around historic preservation, aesthetics that cities can look at. But in terms of legal framework, I don't think New Hampshire would want to be inviting litigation by recommending something that would perhaps run afoul of federal law. On that slide, I wanted to make that point.

Scarato: I would expect that lawyers would assure that local, state and federal law was being evaluated depending upon where you are. There is a lot that you can do and a lot that you can't do. There is a lot that cities can do actually.

Cooley: Yes. Absolutely, I am not disagreeing with that. The only other point I wanted to make. You mentioned a Federal Right to Know law that was introduced in Congress in the early 2000s and you mentioned the San Francisco Right to Know Ordinance which you seem to allude could be something the commission could look at.

Scarato: As I understand, San Francisco continued their arguments and decided to pull out because whoever won would have to pay the court fees and it was not implemented.

Cooley: That's correct. It was never implemented.

Scarato: Also, the Berkley cell phone law did pass which I did not talk about. It basically says that people have the right to know when they buy a phone from a retailer that if it touches the body, it could exceed FCC limits. The Supreme Court let it stand.

Cooley: It was not implemented.

Scarato: Right.

Roberge: On your slide that had cities with protective ordinances, you use the term facilities in terms of setbacks for facilities. Are you referring to antennas?

Scarato: When I said facilities it refers to the installation of equipment and antenna.

Roberge: I just wanted to make sure we were talking about antenna and equipment not a facility as in a building.

Sherman: I have a quick question. With multiple different networks and multiple different carriers in any one municipality are there multiple different 5G networks being proposed? Does each one emit a certain amount of radiation? If for example, you have T-Mobile and Verizon in same setting, what does that mean for total exposure for the public? Is it double? How does that work?

Abrami: To add to that question. Currently, there are towers with multiple antenna, will there be sharing?

Cooley: Yes, there will be sharing and Theodora made a great point. Carriers will be using different frequencies. T-Mobile for example, their 5G will mostly be on their existing macro towers. So they are going to be 200 feet in the air vs Verizon or AT&T who might be using the millimeter wave on that light pole. It's not kind of a yes or no answer.

Sherman: If we are in Concord and we have T-Mobile, Verizon, AT&T all providing service, are we going to have three different networks to which we are exposed all at the same time? Or is it one shared network? The ultimate question is does it mean are we going to have 3X the 5G exposure? And what does that mean?

Cooley: I am not an engineer but the answer is no. Depending on the facility being used, they are going to have different power levels which will change the amount of non-ionizing being emitted. So, it's not really apples to apples to say.... you've got one Verizon, one AT&T, one Sprint and one T-Mobile because they are probably not all going to be on the same facility because they are using different spectrum frequencies. So, it's not just to say, Yes.... You will increase by four. This is really an engineering question.

Scarato: While that's true, it's also true they don't want to share installations. It came up in Washington, DC. They don't want to share a hotel but that means that different carriers don't want to share an installation. Each will have its network rolled out. You will get the increases.

Cooley: But that's specific to DC. There are locations where hoteling does occur and carriers share one pole. It's completely specific on the network needs and the spectrum being used.

Abrami: We have an engineer right here with a question.

Gray: I wanted to go back and defend my comments in the middle of the presentation. When a guest is asked to come given the criteria, I expect certain things from that guest. I don't expect to get bombarded with health things that are trying to tug on my heart strings, other information that doesn't go back and say yes. We have this but here is the data that I can look at that says this is happening. I've got a lot of people from Health and Human Services coming to talk to me about vaccines that say here is anecdotal information that this person ended up with because of that vaccine. We go through this whole presentation and we say, so what real data did they present at all that says here is this radiation, this frequency of radiation, this level of radiation that caused these things and that is why we are protecting you. So, when we go further than that and you say there are a bunch of cities out there who have regulated placement of antennas. What information did they use to regulate that? If it's clearly identified information then everybody across the country would have done it. Or is it because they were scared? I am on the planning board and City Council in Rochester. There are people there who would like to regulate all kinds of things. It's just like the environmental thing, global warming. Give me data. Don't give me, I asked a question and I didn't get an answer.

Scarato: Dr. Davis will be talking about that data and all that data is on our website. Dr. Davis is presenting the science. I am presenting the policy.

Abrami: Yes, Theodora. You did exactly what I asked you to do. I was trying to get a sense what's going on around the country related to this in terms of ordinances and states taking action and all of that. We, as a commission are doing a pretty good job of not taking things on face value. We are trying to understand the science. This may have not met your needs today on this but we are trying to get as much information on this as we can. I understand your position, Senator Gray. When I talked to Devra the other day, I told her what I want to know is what studies have been replicated multiple times.

We will be meeting through October on this and we will continue to try to bring in the right people. We have the outlines and the picture and we have a lot of filling in to do as a commission. Thank you for your comments but our guests are our guests. As a commission, we do appreciate you coming here.

Wells: I just want to make a quick point from a moment ago, just to clarify the science of electric fields and magnetic fields. When we talk about electromagnetic radiation, they are additive. It does not depend on the frequency you are talking about. It does not depend upon what brand name it is or the locality. It's called the superposition principle. If you have multiple carriers in an area, they will overlap and add.

Sherman: I think that answered my question.

Chamberlin: The 1996 Telecommunications Act says that health effects from exposure to radiation cannot be used for objecting siting. How does that come into play or does it come into play in the legislation you are familiar with?

Scarato: Well, it says that concerns about environmental effects cannot be used in the siting of facilities. This was then interpreted by case law and lawsuits to be health concerns. If there is a community and people only talk about health concerns and the city says because of these health concerns our citizens have, we are not going to site the tower, then they can be sued. People say don't we have a right? How can this be? (Section 704 of the 1996 Telecom Act) I didn't mention this, but at that time, this was the most heavily lobbied bill in the United States. The lobbying only increased after. The amount of money that went into that bill was pretty impressive. I would say that everyone should be able to have their time in court to argue if they have been harmed.

Cooley: I would add that there is litigation just filed yesterday actually in Camden County, Georgia with Verizon. They are suing on the merits of that very issue. The FCC has exclusive jurisdiction over regulating anything that emits RF. So, if a locality does violate that, they may see litigation as we saw yesterday.

Scarato: Several times companies or CTIA have sued and they haven't always won. They haven't always talked about health issues but aesthetics and other things.

Sherman: For my part, I found this very helpful. So, thank you for coming. We are trying to make our decisions on whether or not to move forward or how to move forward based on as much science as we can. You have given us a nice framework on what others are doing in terms of implementing policy. With your help, there has been for me a nice framework on what are the limits of our capacity to do so.

One of the most troubling parts to all of this and you are not the only one who has shared this with us, so you are not alone is that it sounds like the FCC has sole jurisdiction over what happens with the rollout of these networks, yet they are completely in bed with industry.

In the medical world, which I represent, we have a similar problem with pharma and their regulation and the FDA. This is not something this commission can take on but you provided a framework in a nice way to help us understand what are the limits of policy that we could actually consider and roll out if we wanted to provide regulation. Thank you for coming and providing some of that perspective. I think we need both policy and science. So this has been helpful.

Heroux: I would like to address you as representative of CTIA. I just want to drag you out of your comfort zone. As a specialist, I have heard hundreds of reports of deleterious effects of electromagnetic radiation, and you have sat very patiently as we outlined these things in sessions.

What about the positive effects of cellphone use? What I mean by that is, if because of wireless and a cellphone, I can avoid a car trip and then perhaps a car accident. Then surely there are benefits to this,

right? There are benefits to the use of wireless. Has the CTIA supported and documented the benefits to using wireless? After all, we have to balance the negative with the positive.

Cooley: Thank you so much for that question. This is a policy question, right in my wheelhouse. Absolutely, I will do a plug for CTIA.org. Accenture and Deloitte have done host of studies on the benefits of what 5G will bring to this country. Nationally, 3 million new jobs, 500 billion contributed to the US GDP.

Heroux: I am sorry. I don't mean about economic activity because that is dollars that can go one place or another. I am talking about avoiding deaths and diseases. Surely, wireless has substantial capability. I perceive that your industry has not documented these things in great detail but have been driven by an alternative variable, which is commercial success. In other words, if things are bought, people want them. So this is an index on how useful they are. My point is...we love potato chips but we can have trans-fat potato chips. You see where I am going?

Cooley: Yes. The benefits of 5G for remote health care. If you live in a rural area and you don't want to have to drive into the city or remote surgery. AT&T is doing some really exciting stuff. There is the first 5G hospital at Rush hospital in Chicago. There are absolutely benefits to consumers and society and agriculture. Drones survey networks so we can see where people are without service. We need to save them if their houses are on fire so we can communicate with first responders, so yes. There is a ton of research on that and independent agencies as well. I would be happy to provide this commission with those studies.

Heroux: Most of those things like remote surgery doesn't need 5G. It can use fiber optics. What I am talking about is specifics. So you could come up with a report that would document the advantages of wireless specifically independent of data transmission. We have not seen that much documentation on this aspect of it. Ultimately, we will have to balance these things right?

Cooley: I am happy to share those use cases with the commission because I disagree.

Abrami: yes. I would agree.

Cooley: I am happy to share those reports we have right now and there are a host of reports coming out, I think second quarter of this year that are not CTIA. We don't do the research. Other entities do the research. I am happy to share those.

III.Devra Davis PhD, MPH, President, Environmental Health Trust (via speakerphone):

I have been working in science at some of the highest levels for many years. We started Environmental Health Trust when I was at the University of Pittsburgh Cancer Institute, where I had set up the Center for Environmental Pharmacology. I worked as a member of the President's Cancer Panel. I was

confirmed by the Senate. So, I have been around for a while. I have written two books. The most relevant and recent book is "Disconnect: The Truth About Cell Phone Radiation".

I am going to first explain that when it comes to getting information about any toxic agent whether it is chemical or in this case, RF, we look at experimental studies including *modeling* of exposure. Please understand that that is all we have for exposure. We can't go inside the brain and actually pick up exposure when it comes to humans. What we can do is use computer simulations that are anatomically based on models of the human brain including specific parts of it that are relevant. I will talk about today, particularly the hippocampus. We can fairly accurately model those. Those models have been validated and are used right now. Some of the models I am going to show you are used to set the standards for surgery or approval of equipment by the FDA.

Then there is *in vivo* testing which means whole animals. We take animals and expose them usually over a period of several weeks or some time for two years. Rarely, are animals exposed from before birth to their death.

Next we have *in vitro* studies which look at cell cultures either animal or human cells to measure DNA damage or other things that happen in cells. Those studies, I want to stress are done in order to predict human effects and prevent them. That is why every drug that you take is subject to animal testing. The same standards being applied to testing drugs have been applied to testing RF. Please keep in mind that everything we know for certain causes cancer in people because we have data for example from asbestos or arsenic will produce it in animals.

In terms of *ecological* studies, we can look at trees and grasses. There are experimental studies as well on bees and other smaller animals.

Finally, we have *epidemiology*, the study of people and I am a fellow at the American College of Epidemiology. I was also a member of the American College of Toxicology. So, I am familiar with both of these overall approaches both, toxicology and epidemiology.

For epidemiology, *cohort* studies are the weakest form of analysis that we have. In the case of what we are looking at for brain cancer, we cannot follow people through their entire lifetime with detailed information. We therefore rely on case control studies of those with the disease and compare those to others who do not have this disease but are otherwise similar.

The next slide shows you a child. It explains that because of the modelling studies that have been done, we can conclude without question, that children will absorb more RF into the brain soft tissue inside the skull and 10x more into the bone marrow of the skull, compared to adults.

Virtual reality simulations: I just showed that to you because virtual reality is a very cool and exciting thing but the way it is often used is with wireless transmissions and when you have a microwave radio right in front of the eyes and frontal lobe, you are getting greater exposure if you look carefully through the top of the skull of the six year old on the right side. You can see much greater penetration into both eyes and we are very concerned about the eyes of children right now from a number of exposures.

Summary of the EU REFLEX Project: The European Union in about 2000, funded about ten million dollars for twelve different research labs in seven countries. They were asked to look at the question of whether or not the same radiation that would be received from cell phones could break DNA in a variety of human cells and by the way including brain cells and human lymphocytes and fibroblasts. The conclusion of that study, much to the surprise of the people doing it, was that they found clear evidence of DNA damage. At the beginning, when they first found positive results, they assumed they had faulty equipment. They had so much money that they went out and bought new equipment to test things. Those of you with a medical backgrounds, which I am pleased to know are on your commission and also part of your legal body there, understand that being able to buy new equipment means you have a lot of money. The results shocked the researchers. They clearly showed changes in gene and protein expression in several different cell lines. Interestingly, they did not show damage in the mature human cell line. Damage was much greater in human fibroblasts and human cell lines that are less mature, stem cells.

Abrami: Can you go back to that slide please? So, they replicated a study that was done in 1994 but it was a 2004 study they replicated again?

Davis: Yes. In 1994, Lai and Singh produced a study showing damage to the brain of the rat from cell phone radiation, DNA damage. They were shocked by the results. They did the study all over again. When they were about to publish the results, the industry engaged in what was called "War Games". That was the strategy and what it was called in 1994. Remember, in 1994, very few people used cell phones (about 10%). People in industry understood the importance of this, went to the journal that accepted the article for publication and tried to get it unaccepted. They went to the NIH and accused the researchers of fraud and went to great lengths to conduct what they called War Games. That was 1994. In 2004, when another group was asked to see if there was anything to this, they were confident they would find nothing. In 2004, they replicated it.

Abrami: This is the EU REFLEX group.

Davis: The Comet Assay: Right but there's more. I'd like to show you more about the replication of the DNA on deregulation of cell proliferation and exaggerated programmed cell death otherwise called apoptosis and genotoxic effects all show from very little exposure. The next slide is a summary from there (The Comet Assay). You can see the sham or the perfect cell on the left is a cell with no DNA damage. When you have damage, you get a common tail. See the tail on the top right and the bottom. In 1994, those tails were only measured by somebody looking at them and giving you an estimate of what percent tail there was. Now we have much more sophisticated ways of automating the measure and extent of that tail. The top right is damage from gamma radiation like you would get from massive exposure from a CT scan which could happen in a pediatric CT scan where the scanner is not properly set. The top left slide is your control. The far right on the top is the impact of gamma radiation from xray like pediatric CT scan gives you that much exposure. The bottom right was what they achieved after 24 hours of exposure to mobile phone like radiation at 1.3 watts/kg.

Abrami: Is that continuous exposure for 24 hours?

Davis: Yes. It was exposure like a cellphone. A cellphone is not continuous. Within four seconds, you get huge changes in power density over time.

Abrami: I am trying to understand how far away that cellphone was from the eyes. This is eyes right?

Davis: No. These are not eyes. These are cells taken from the brain.

Heroux: It is slightly lower than the FCC SAR limit.

Davis: It was below the US current standard of 1.6 watts/kg.

Subsequent work confirms the REFLEX project. They showed clear evidence non-thermal microwaves from mobile phones affected repair of DNA in human cells. They showed the same effects at the GSM frequency of 915Mhz. These studies referenced at the bottom of the slide, were all produced subsequent to the REFLEX Project from 2004, 2005 and 2009.

Abrami: so there are four other studies listed there?

Davis: That's correct.

Sherman: All of those corroborate the findings of DNA damage?

Davis: That is correct. Further, the next slide is from Lerchl.

Lerchl: Lerchl was widely known as a skeptic of any of this. In 2015, Lerchl started with exposure at conception. The rodent reproduces in three weeks. In a very short time, you can follow these animals through their lifetime. Then the equivalent of early childhood, the animal was injected with a known carcinogen, something that we know causes cancer (ENU). Then, those animals were subsequently exposed to RF exposure. The levels of exposure were .04 watt/kg, .4 watts/kg and 2 watts/kg. What you can see is that the control animal developed very few liver cancers. The ones exposed to the carcinogens developed more. But the ones exposed to cellphone radiation developed far more. Much to the surprise of the investigator, they were able to show that the mice exposed in the womb to a known cancer agent, then exposed to cellphone, had significantly higher rates of cancer, tumors to the lung and liver. The study was designed to replicate an earlier study by Tillman, also of Germany. When he first presented his results, said they were remarkable. His study was ignored. Lerchl found higher rates of cancer in all of these mice. Also survival times of the animals were much lower of those who were exposed. This was a very powerful replication as well and further replication because you had asked me, Mr. Abrami about focusing on replications.

The NTP study: You already heard about this so I won't go into that. But, I want to remind you that what is on the website of the National Toxicology Program right now summarizes this information. It states clear evidence of tumors in the *heart* of male rats. I want to stress these are very rare cancers. I suppose in a way, that's the good news. There was also some evidence of tumors in the brain of male rats, again rare. There were multiple cancers in other organs, some of which did not achieve statistical significance

but were still elevated. In the NTP study, they said, not only do we have evidence of cancer but precancerous conditions of the heart, meaning damage to the heart. This is quite worrisome.

The publication that came out from NTP shows DNA damage to the *frontal cortex* of both rats and mice. I want to stress that although the cancer showed up only in the rats, the DNA damage showed up in both the rats and mice. There is clear evidence of replication of results of DNA damage. The cancer results are also replications. This is not a one off study.

I want to stress something about the frontal cortex. It's really hard to get mice to make phone calls. That is why the exposure has been carefully calculated not to increase the temperature of the animal but to allow whole body exposure that simulates the kinds of exposures that can occur today.

Slide 14 and 15 give you a much more detailed analysis of NTP. Slide 14 looks at the tail of DNA using computers now. In 1994, they had people who could just look at the tail. Now we have computers to do it. They can score the number of cells in terms of the evidence of fragmentation of the DNA. Zero is your control. You will have some fragmentation of DNA just because that's life. We are breathing. We have sunlight. We get DNA damage all the time. If we are healthy, we eat our broccoli and sleep in the dark, we will have repair of our DNA. This is showing that exposure to CDMA which is a type of cellphone radiation. You get statistically significant damage indicated in the male rat *hippocampus*. The hippocampus is what allows us balance, memory and impulse control. It has been well studied in many different systems and shown to be damaged by exposure to cell phone radiation. Slide 14 is showing you the rat and slide 15 is showing you the mice.

Slide 15 shows the effects to mice are in the *frontal cortex*. In the rat, it was the *hippocampus*. Slide 16 discusses the implication of the NTP result. Dr. Melnick was involved in setting up the study originally in 2008. The study was designed to test whether or not heat was the only effect. They set up a study that did not heat up the animals. That design was carefully calculated by Swiss engineers using methods that are validated, they were able to show results that I just showed you, increases in brain tumors, increases in heart as well as DNA damage in multiple organs in both rats and mice.

Abrami: Is that the replicated study that was done?

Davis: Yes. Smith-Roe is the first author of that study that was just finally published in 2019. Dr. Melnick and I and many others believe that the FCC by issuing its latest order saying we are going to be keeping our 23 year old standard for RF is ignoring this body of evidence I just showed you and more. I would like to show you a little bit more.

Gray: Before you leave that. The radiation that you applied is less than what it would take to heat. What is that in relationship to normal radiation from a cellphone an inch away from the head?

Davis: Thank you for that question. It is the same radiation you would get from a phone and they did it with ten minutes off and ten minutes on simulating the way we are exposed. As you may be aware, even when a phone is in your pocket as long as it's turned on, it's constantly checking for signals from a tower.

Gray: I understood that it was the same radiation. What is the level of radiation? I want to know if the radiation that I would get from a cellphone an inch away from head is a higher level than what these rats and mice would have experienced just below the level that would cause heating.

Davis: Well as a matter of fact. I am really glad you asked that because the answer is we get more exposure from our phones than these rats got. The reason we know that is because I assume you have seen the results of the Chicago Tribune test. Have you?

Abrami: No.

Davis: Theodora, I think you should show them the 60 second video of the test from Chicago. Do you have that? The Canadian Broadcasting Corporation, the French government and most recently the Chicago Tribune have actually taken real phones and tested them. They have found that the phones when in your pocket emit actually more radiation than the NTP study. The NTP test, tested the amount that they are supposed to emit. The Chicago Tribune paid for independent testing at an FCC approved lab. They took phones off the shelf and what you may not be aware of is that the way phones are tested today. They are provided by the manufacturer to a test facility and they select the phone to be tested. There is a whole scandal about that because as it turns out when you do that, of course the phones pass the test. When you take phones that you can buy and test them next to the body, they all fail the current test. (Nine out of ten of them to be precise) They fail it by as much as five fold in the United States.

Sherman: That is significant, what she just said.

Scarato: I wanted to say that when you put a phone near your body, you are getting an intense localized exposure near where the phone is. NTP did that at localized exposure, not the full body number. They wanted to see what the intensity would do to the tissues. This is not a whole body number but a localized number that we are talking about when we are comparing. The FCC occupational limit is 8.

Abrami: So, when they did the test and took the phones off the shelf what did they do?

Scarato: They measured the SAR levels at body contact and at 2mm and the French government measured hundreds of phones and body contact and found excesses of the limit.

Abrami: Most of the public is putting it next to the body because they don't read the fine print.

Sherman: I am trying to get at what is the significance of exceeding by five fold in the Tribune test? What does that mean to us?

Davis: The significance of the Chicago Tribune test should be that it would call for re-examining the whole test approach.

Sherman: So we are basing the emissions coming from phones based upon the tests done by the manufacturers under FCC guidelines but these independent tests in Europe and by the Chicago Tribune

and Canada are showing no, that's not necessarily the case. We may be getting five times that exposure of RF. Is that correct?

Davis: That is perfectly said. Thank you.

Scarato: in high exposure conditions.

Cooley: I just want to add to the record from that Chicago Tribune story which came out in August. The FCC immediately opened an investigation to look into that. On December 19th, after doing their own independent investigation, the FCC published a report saying they tested the same models and found all of them compliant with the FCC exposure limits.

Sherman: This is the FCC that currently has every member as a member of industry, former, future or current. Is that correct?

Cooley: The commissioners. If we are talking about the "Captured Agency" slide that Theodora had. The commissioners don't do the testing.

Sherman: No. But they are the ones who approve what comes out. It's like an Editorial Board. Is that correct?

Cooley: I don't know how or if they approve of a report. I don't know that process.

Davis: The protocol for the FCC was developed based on the assumptions that the only effects that needed to be avoided were heating. The tests were developed 23 years ago when phones were solely used by medical and business people. How many of you used a phone 23 years ago?

Sherman: I did.

Davis: Well, you are probably the physician in the room.

Sherman: yes.

Davis: My dad was a brigadier general and he also had one but very few people with normal jobs had phones. It was only about 10%. That's when phone protocols were set up and they were set up to be tested up to an inch away from the body because they would be in a holster which is the way people had pagers and phones in those days. They didn't carry them. They had them in a holster.

Scarato: Can I clarify what Beth is saying here? When the FCC did their test after Chicago Tribune, they tested at 5mm from the body. They didn't test at zero mm which was the whole point. They said they are compliant but if you look at the test report, it says 5mm. Then the news headlines read," they are compliant". But it says right on the report... 5mm. The issue is people have close contact.

Gray: The 5mm problem bothers me alright? The reason it bothers me is there are 2.54 mm per inch so if I take 5mm, I am at a quarter of an inch or so and when I look at where the antenna is in the phone because there is a spacing there, I would think that 5mm is probably a pretty good distance when I have the phone right up to my ear.

Davis: It turns out that the antenna in the old days were towards the head. The newer antennae are toward the thyroid and lower. Your smart phone can have four or five antenna: One for data, one for video, one for voice, one for satellite GPS which is not RF. You have multiple antennae now that are located lower in the phone. We are now concerned that one of the explanations, not the only one but one of the explanations for the increase in thyroid cancer could be cellphone radiation.

Ramazzini: (slide 18) I do very much appreciate the opportunity to speak to all of you. I am delighted and honored to be able to speak to you and the fact that you exist really means a lot to all of us that have been working on this issue for quite a while. I never imagined I would be spending a decade or more of my life on this. I previously worked on lead and asbestos and I thought this would be a pretty simple issue but it's not simple. Ramazzini did a study like Lehrcl but they took thousands of animals and exposed them at different levels before and at conception and followed them until they died.

Their results on slide 19 was to show damage, the same type of damage that the NTP found at levels of exposure to their animals that were far less than NTP. In particular, they showed a *synergy* between RF and xrays (gamma radiation). *This is really important because it shows there is an additive effect between RF and gamma radiation (xrays).*

Abrami: the Ramazzini study was an independent study basically in parallel?

Davis: yes. It is the equivalent of the NTP for Italy.

Uptake of glucose in the brain: Slide 20 is a summary of a paper that was published in JAMA by some of the top researchers of the US government, the Director of the National Institute of Drug Abuse on the effects of cellphone exposure to the uptake of glucose in the brain.

Slide 21 shows the study design. A person with two cellphones strapped to their head. The study was done more than a decade ago. They had a PET scan which can measure the uptake of glucose in the brain. The person with a phone strapped to their head did not know whether the phone had been turned on or not.

Slide 22 is the results. If you look at the slide to the right, it shows the increase in glucose in the parts the brain that got the most exposure. Look at the slides comparing glucose uptake when the phones were turned off compared to the slide with the phones on. Look at the increased amount of glucose in the exact part of the brain there was the exposure. Why is that important? *Alzheimers* has been called *diabetes of the brain* because people with Alzheimers have too much glucose in the brain. Nobody knows the consequence of having too much glucose in the brain from holding a phone next to your head. It remains unknown. This study was subject to "War Games" as well.

Slide 23 explains part of what might be going on. You will see the control on the left without exposure. The slide on the right shows little tiny dark spots of damage, *indicating that the blood brain barrier has been breached*. At the bottom of the slide you will see references.

Abrami: is this a human brain? Or no?

Davis: oh no. We can't do that. These are Sprague Dawley rats.

Davis: at the bottom of the slide you will see references to subsequent studies. The first study showing this was in 1975. Alan Frey did that work. Cold War was still on and radar is a vital part of it and he was basically told to stop doing research. All of that is documented in my book.

What happens when you have a cellphone in your pocket: I have done a Ted X talk that I think you will find interesting. I make the point that sperm have to swim the equivalent of the distance from Los Angeles to Hawaii in order to succeed in fertilizing an egg. Do you know why it takes at least a quarter of a million sperm to make a healthy baby?

Abrami: why?

Davis: It's because they don't know how to ask for directions.

Abrami: I fell for that one.

Davis: When you get these slides on your own computers, you can simulate the exposure. Look at the white in the control slide. That indicates either the nucleus or the border. On the exposed slide, you can see that on some of the cells, the nucleus has been degraded and in many cases, the border is gone. Again, indicating damage to the membrane. So, cellphone radiation damages the membrane of the *brain* as well as the *testes*. I believe the *eye*, as well.

Abrami: I see the Cleveland Clinic quote there. Was this research done there?

Davis: Yes. Some of this research has been done there. Some of it has been done in Australia at their equivalent of the Cleveland Clinic and other work has been done at other clinics. What's interesting is that people doing this research started to do it two decades ago because they were concerned with the number of doctors showing up having fertility problems. What they concluded in a cross sectional analysis was that those who had the most beepers and things on their pelvis had the lowest sperm count.

Recent study glioma on Slide 28: Summary of the most recent work I have done with Prof. Anthony Miller who has himself authored more than 600 publications. It basically shows every study that has looked at people who have regularly used phones for ten years or more, for an hour a day or more we found an increase in *glioma*. More studies have been done now. The most recent study was released this week.

Thyroid Cancer: The American Cancer Society supported a study of thyroid cancer. It was done at Yale University that shows a double risk of thyroid cancer from those using phones that had specific SNPs which are quite common. These SNPs have to do with repair like p53 and other things that have been identified. The newer phones have antenna located closer to the thyroid. The study concludes that they have found a link to an increase in cancer from regular cell phone use. *It was just published this week.*

Effects on children's brains: Slide 31 tells you of the effects on the brains of children are substantial. Here is a study that looked at the brain matter of preschool aged children, using MRI. I don't know how they got approval for this study but they did. They concluded that there was degradation in the brain white matter looking at microstructures with heavier regular screen use, which is further reason why the American Academy of Pediatrics has said we must reduce exposure in young children.

Abrami: They based it on one study or the preponderance of evidence thus far?

Davis: Well, this is one study but it's a replication of many other findings on effects of attention, behavior and learning in children.

Effects on memory in teenagers: Slide 32 looks at teenagers and again they find a deficit in memory of kids. I will let Theodora talk to you about synergies on slide 33 they found in Korea. Mr. Abrami, you had stressed you wanted replication. I am showing you these are all replications of results on adverse effects on learning, behavior and attention from cell phone use in children.

Why so many conflicting studies? Slide 37: The answer is, follow the money. The majority of the studies in this field have been funded by industry or the military. That's just a fact. Analyses of the studies show that 75% of all the negative studies have been funded by industry or the military. Microwave News 2006 assessed *funding bias*. You don't need to be a statistician to know which way the wind blows.

Insurance Industry Slide 39 shows secondary insurance Swiss Re and Lloyds of London and others will not cover damages from wireless devices or EMFs. They rank it in the same category they once ranked asbestos.

Abrami: We were well aware of this fact. Have you spoken to anyone from the insurance industry about this? Why don't they insure?

Davis: Several years ago I did. They run the numbers. They think there is sufficient scientific concern and the 10K reports of wireless industry say they may face liabilities from lawsuits. There are lawsuits right now on behalf of people with brain cancer that are still going through the courts. They have not been thrown out and frankly I think they are going to win.

The last slide is the one of the cartoon. I just want to remind you. It had been very difficult to get people to stop smoking in the environment of children because the science had been deliberately manipulated. Unfortunately, that is what we are dealing with here as well. Why did the FDA reject the NTP? They have not even given a reason.

Sherman: We kept hearing about the need expressed by federal agencies for a comprehensive review of all the studies that have been done and yet that hasn't been done is my understanding. Is there any plan for comprehensive review? If there is, would that review take into account funding sources? We know from several other medical studies that the impact of funding is huge on conclusions and editorial control of final conclusions on the studies.

Davis: Environmental Health Trust, I can say is that we are the mouse that roared. We have managed in the paper that I shared with you, Miller et al. That is the closest thing to a comprehensive analysis. That was done in 2018 two years ago.

Abrami: We have to pause. Beth has to leave. I am thinking about the 14th of Feb for our next meeting.

Cooley: I am not available but I can see if someone internally is.

Davis: What is your schedule for completing your work?

Abrami: We have until October to have our report finalized.

Davis: Your work will be vitally important because there is a huge gap. The federal government has abdicated it's authority for years. We have been really shocked at the appalling situation with the FDA. It just flies in the face of science I have shown you just briefly here. I could have shown you even more on male and female reproduction in animals. I could have shown you more effects on humans. This simply indicates that there is a robust body of scientific evidence, including the study I just showed you that just came out on the thyroid (Luo 2020). That study is putting another nail in this coffin. We know industry knows how to make safer phones. The real question is for 5G, what does all this mean?

Sherman: Can we get a link to that?

Scarato: Yes, and also the bees because they look at MM waves specifically.

Abrami: Yes. We are interested in bees. That is an area we want to pursue.

Davis: I have a video in my slides of the bees. This study was done by bee experts with three hives. What it showed was the hive with phone off and the control hive had no effect. The hive with the phone turned on, those worker bees did not return and they stopped producing honey. Obviously, you are not going to have a phone in a bee hive. But it's clearly indicating a susceptibility to this exposure.

Abrami: This has been very helpful. We are trying to get the facts and understand. Unfortunately, as a commission, we don't have the resources of the federal government here in New Hampshire. We don't get any funding to do anything other than us being here as volunteers. We are going to work as hard as we can to get at the facts. We would like to hear from the FCC somehow or at least a member that was in the room. You suggested that there may be someone that may be willing to chat with us.

Davis: I think he may be willing to do it without being identified by name. It is a tough business.

Abrami: Well, we will take him anonymous.

Davis: I will ask.

Sherman: I can talk to our federal delegation and see if they can twist some arms to get somebody here. This is something Jeanne Shaheen should be able to compel.

Davis: I fully agree by the way .The appalling thing is there isn't any staff member at the FCC now with any training in this field of bio-electromagnetics.

Abrami: I would like to know in their last ruling, what they based their decision on?

Davis: Montgomery County if preparing to file suit against the FCC because in their statement, they confirm the 23 year old standard. They do not show any recognition of the 1900 pages of scientific evidence they received in response to their proposed rules. They asked the question: in advanced notice of proposed rule-making, should we change our standards? They received hundreds of scientific statements including from us stating that they should. In failing to review the 1900 pages, they are violating the Administrative Procedure Act. I don't know if any members of your commission are a lawyer.

Abrami: We have someone from the AG's office on our commission.

Davis: That's wonderful! I would like to talk to the AG and see if the state wants to join this lawsuit as an Amicus. It doesn't cost any money. Montgomery County probably has a budget equal to your state.

Garod: have any other states joined?

Davis: We think California is going to. What I have been told by a reliable source who was at the meeting, was that Ajit Pai said, I don't care about science. This is what we are doing. That is so arrogant.

Sherman: Are the FCC meetings public?

Davis: This one was certainly not.

Abrami: Devra, I will connect you two by email and you guys can have a chat.

Davis: and I will connect the AG person with the AG person in California.

Abrami: well, we will start with you talking to him. We are out of time now. We would appreciate maybe down the road having another conversation with you.

Davis: I am happy to do that. The fact is that the federal government is failing in its duty to protect public health. That's very unfortunate and therefore you guys are in a very important role. You really are. I have been accused of being a closet Republican. The fact is it may take Republicans to do this because the Democrats have been in bed with these guys for a long time. I hope I don't offend anybody.

Abrami: Let me see, about half anyway.

Davis: The fact is both Republicans and Democrats are both well supported by this industry.

Abrami: At the state level we do this on the cheap. We don't get any money.

Davis: I know you are a citizen legislature with real lives and real jobs and you are doing this as well and I am truly grateful to each of you.

Abrami: We are trying to do what we can do and to get the facts. We appreciate your time and Theodora as well. I will connect you with Brandon our Asst. AG. Another other questions:

Woods: how do you know the level of scrutiny the FCC gave to the scientific information provided? You say they didn't look at it. How do you know that and what level of scrutiny did they give it?

Davis: I know that because of a person who was at the table when this happened.

Woods: Ok

Sherman: Is there any reference to the science?

Davis: No. it's as if all of it doesn't exist. Let me be clear, five years ago I brought a number of different scientists who had done this research from Turkey and England to the FCC and met their so called interagency group on RF radiation and briefed them. There is such a group. They have no power. They have no authority. They have no statutory standing to do anything at all except to advise. I don't go into the FCC to brief anyone any more. There is no one to brief. In fairness to the agency, they have huge responsibilities to a lot of different things. This issue is one where yes, you want faster connections to your services. You don't want you fire and police to rely on wireless. It's not reliable. Snow and rain can interfere with it. When you have too many people trying to call, its slow. We cannot afford to have emergency services, public health and the hospitals relying on wireless. It's not safe. We need wired connections and we need to have a major push for fiber optic cable and broadband access to and through the premises.

Abrami: We saw that on 911 in NYC.

Davis: From the point of view of the Dept of Defense, they have issued a report on this warning about the vulnerabilities we face. Demanding wired connections for those that need them is the way to go. I think those in public safety have to reset the conversation. If you are really going to protect public health and safety, you've got to have it wired. It's the only secure connection you can have.

Scarato: I want to add to what Devra was saying about to the two questions about the FCC. How do we know what the FCC did or did not review? There is actually an item the FCC released where they talk about the decisions they made and based on what. As an example, Environmental Health Trust put in countless submissions. We were one of the high submission groups and they didn't address our submissions at all. They addressed some but the large majority of research on biological effects was not addressed in any deep way that one would expect. On the NTP, they just said we are going with what the FDA said. There is a three page paper on what the FDA says and there is only one paragraph on the biological effects. Scientists would expect a more robust document that goes over you gave this study but this scientist thinks this. That wasn't there.

My second question of who is doing a systematic review? The WHO EMF Project which is different than the WHO International Agency for Research on Cancer, there have been a lot of criticisms of transparency on the WHO EMF Project for many reasons of which I have a link to. They have been trying to do a review and it's been mired in questions of transparency. Who are the experts? Who is picking

the experts? Whereas, the International Agency for Research on Cancer, when they did their 211 determination that you are familiar with Class 2B possible, they vet the researchers for ties with industry and I should add that they are now calling for a reevaluation for the carcinogenicity of RF and that should be completed before 2024. That is model systematic review on everything.

Miller: I would argue that the solution that Devra is proposing does not solve the problem at all. Our public safety entities all have fiber to the premises. They don't have access to fiber when they are on the road. So mobility and interoperability are key.

Davis: Let me be clear. There is no 5G for voice. There is probably not going to be 5G for voice for perhaps a decade or more because 5G as you all know is fast and short. It doesn't go very far. In order for you to have 5g on the road, you need to bury it in the highway and people are proposing that by the way. The 3G and 4G that you use now travel miles.

Miller: Are you saying that 5G is the only product or technology that causes radiation?

Davis: No.no.no.

Miller: So, it doesn't matter which generation, 3, 4 or 5. They all cause radiation. I think the mobility factor is very important. So the solution needs to come elsewhere within the design of the devices and not to be taken lightly.

Davis: I completely agree. That's why California issued safety advice about how to use cellphones more safely which your commission should consider. The French government issued a guidance that will take effect in July that said, the abdomen of teenagers and pregnant women should not be exposed to cell phone radiation. That's the French government conclusion. We need to educate the public about how to use cellphones more safely and we need to encourage cellphone designers to do frankly what many of them are already doing to redo the software and the hardware so exposures are much less. There are things that they are doing to do that. Within the industry, there are people I have talked to who say the only problem is the lawyers, no offense again.

If they come out and say now we have got a safer phone and people will say, why didn't you make one before? What about all these people who have tumors in their ears and tumors in their brain and other problems that came from their phone? It's a huge liability problem for them. You are absolutely right. We need safer phones. By the way, our twitter handle is @saferphones.

Abrami: We have had conversations about that in this commission recently as well. This shouldn't be adversarial with industry. We should be shooting for the same goal. Let's make it safer.

Sherman: Devra, two of my close friends were Marianne Donovan and Ron Herberman.

Davis: oh my goodness. Two of my dearest friends.

Sherman: I served on a board with them. But back when Ron was testifying and taking an awful lot of heat for that in Congress, one technology that was available was a very lightweight shielding along the skin side of cellphones to shield from RF from the antennas. Do you know what happened to that? It was low cost and light weight and could have been incorporated into the phone without much difficulty.

Davis: That was a company called Pong but has been renamed. There are cases that have been devised that do reduce the radiation somewhat.

Gee, then you know then what Ron went through. You know what happened to Ron who was such a distinguished scientist. He told me had never experienced anything like that in his professional life.

Sherman: yes, I was there when that happened.

Abrami: Out of respect for everyone's time, we need to go.

IV. Next meeting: February 14th. 8:30-10:30 Agenda to be determined.

V. Meeting Adjourned at 11:00am.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

2/14/2020

8:30-10:40 am:

LOB 202

Meeting called to order by Rep Abrami at 8:30 am.

In attendance: (10)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee (*Augustinus Ong attending for Michelle*)

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Senator Tom Sherman-president of the senate appointee

Brandon Garod-AG designee, Asst. AG Consumer Protection

Not present: (4)

Frank MacMillan, Jr. MD-NH Medical Society Environmental Medicine

David Juvet-Business and Industry Association

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Carol Miller-NH Business & Economic Affairs Dept.

Agenda:

I. Approval of minutes from 1-10-20:

Abrami: Michelle is not here but we are allowing *Augustinus Ong from the Radiological Health Section of DHHS* to sit in for her.

For us legislators, it's been an interesting past couple of weeks with most of us running non stop. Bethanne Cooley could not be here and we knew about that. I am not sure about Carol Miller. We are allowing Augustinus Ong to sit in for Michelle Roberge from DHHS. With regard to the minutes, Bethanne Cooley sent me a note saying, she was incorrect to say that the San Francisco Right to Know Ordinance was struck down. So I am going to adjust the minutes on page 9/10 and take out those comments. I give her credit, she went back and checked and found she was incorrect. With those corrections, minutes were approved.

II: Denise Ricciardi- Outside call concern:

Ricciardi: I debated about this but I think in the interest of transparency, it is important to mention. I received an email in my personal email which is not the email that I use for this commission, from Dr. George Carlo in Washington. He said that he wanted to speak to me and thought he could be of help to this commission. I called and I was uncomfortable and uneasy with the conversation and I asked him to speak to our commission. He said that he could not do that, that he has to work under the radar. He kept using the word “we” when talking with me and I asked him who is “we”? I asked him how did you get my personal email? Oh, somebody gave it to me.

This went back and forth on the phone and we followed up via email and I used the right email that I use for the commission. He asked, why can't you and some of the delegation come to Washington and talk to me? I said because of Right to Know laws and transparency and I was very uncomfortable. I am not implying anything... for the record. I did research him and do you mind if I just read this?

Public Health Scientist and Epidemiologist, is one of the world's leading experts on Electromagnetic Radiation. But from 1993-1999 Dr. Carlo headed a 28.5 million dollar project funded by the telecommunications industry. It went on to say that he studied cellphone health effects and discovered that the risk of acoustic neuroma, a form of brain tumor was 50% higher in long term use of cell phones and it goes on. I am just putting it into the record for the interest of transparency. I am not implying anything. I just want it to be known.

Abrami: thank you. Are there any questions on that?

Heroux: Most of you are aware of Dr. George Carlo's past involvement?

Abrami: not really.

Heroux: He is an epidemiologist and a lawyer and at one time he was retained by the cellphone industry in wireless technology research to devise a research program that would shed light on the effects of cellphones. After he was recruited by the cellphone industry, it seems that things became very complicated and nebulous so people have various takes on that but he is a very important central character in this whole issue. But, I would say that his motives are a little bit uncertain for many people. So, that is his history but he is a very central character in this issue.

Abrami: Did you ever ask him if he would be willing to speak with us here?

Ricciardi: Oh yes and I have it in email. He says he can't. He has to work under the radar that what he says could be taken out of context. I just felt uncomfortable. I debated if I should address it or not but I think it was the right thing to do in bringing it up. I hope you all agree.

Gray: I just want to remind the commission here that your task is 5G. It isn't 3G. It isn't 4G. Your task as defined in legislation is 5G. If you are going to say other technologies you should relate it to that there could be difference because of mm waves and get it back to the topic. Your task is not 4G or 3G. It's how 5G affects and whether we should do something about 5G.

Abrami: We discovered early on and I didn't realize this when I wrote the bill for this commission, that you can't talk about 5G without talking about 3G and 4G. We broadened it early on in our meetings. It turns out that 5G is this nebulous thing. It depends upon what company you are talking about with 5th generation. Will they use mm waves or not? I understand what you are saying Senator but it seems we cannot talk about 5G without talking about the others.

Gray: Representative, there was the opportunity to put a bill in this term that would have expanded the scope of this but we didn't. I am just trying to do what the law tells me. The law tells me this commission is supposed to look at 5G. What is the health effect of 5G vs 4G? We talk about the size of the wave. We talk about how that can affect and again, a lot of the things we have had as testimonies don't deal with 5G at all. They deal with 4G technology, things that were studied and not using the same size waves that we are talking about in 5G. Again, that is what our task is.

Abrami: If you go back to one of the earliest meetings and review those minutes, I said I believe if there is no objection, I think we have to broaden this a bit. I have been on plenty of commissions that things get broadened as they come up.

Today we are going to get at the towers that are 5G with Paul. We have conversation among us that the technology is hidden in the antenna. So it's very hard for us to understand even that if this is proprietary how much power, the configuration of the antennas and all that so

Ricciardi: It is my understanding that if 5G were to hang in front of everyone's home, that it can't solely work on its own. It would be piggybacked with 4G. If I am correct in that, that's where they come together.

Woods: Two aspects. Number one, looking at 5G is relatively new and research is not as robust but looking at using 2, 3, 4G it's like any other research protocol. You look and say what does that tell us? Then you look at mechanisms and then you say, let's look at 5G. It gives us a basis in which to look at 5G and educates us for parameters that we need to verify. Secondly, we also need to understand what 4G does because we haven't really gotten into synergies yet. Physical systems and biological systems for sure become more complex with synergies. We really haven't but I am sure we will as we go along, talk about synergies. I think those two things are important for us to look at both. I understand the concern and we have to focus more as we go along in terms of decision making.

Gray: The things the good doctor has said is consistent with my statement. If you are going to talk about other technologies, you need to say why 5G is going to be harmful, how it compares to it. Again, don't just throw out a study and say its cellphone technology, so it's bad.

Abrami: I agree. A lot of the testimony we have had is on cellphones themselves. Again, a cellphone is communicating with whatever.

Wells: Just to reiterate something we talked about before. When we talk about electromagnetic radiation, you talk about characterizing it by frequency, energy intensity and polarization. That's really

what we need to talk about whether its brand name is 5G or 4G is immaterial. The characteristics of the waves that we talk about are given by the physical parameters.

Abrami: To me, what we are discussing is all things RF radiation. Our goal is to try to understand this. Where is the line drawn and where or if, are the health effects? We are in contest with FCC and FDA. We are just a little state here but what keeps me going is there is enough compelling research out there saying something that it seems we should pay attention to. Where we end up late summer or early fall, I am not quite sure. We haven't started bringing this together. What can we do as a state? Where are we heading with this? First of all there are a bunch of lawsuits out there right now against the FCC and those things will play out. The other reason for the bill was to get ahead of the curve as a state on all the push back that is going on around the country. I don't know whether that pushback is based on hysteria or not. I don't know. But, there is pushback. Every day I get stuff sent to me like yesterday from Huntington, NY. My brother lives there. I said to him, do you know anything about this? He said not really. Are we straying off the theoretical parameters a little bit? Probably but I think we need to. Is someone going to slap my wrist for doing that? I think you have to, in order to be able to discuss this topic.

Chamberlin: Because 5G is an add-on to 4G, the more we understand about the preceding technologies, the more we are going to understand about the impact of 5G technology. It is really important that we look at the body of information that is out there on previous generations.

Heroux: With 5G, we have no epidemiology and relatively few studies. The other aspect is that there are low, middle and high frequencies for 5G. As Mr. Wheeler of the FCC said, the technology is ill defined. So we don't have a very precise target. They are going to be on common structures. To be well instructed about health impacts, you have to know about EMR as a whole and experience we have is from earlier generations, if we are going to epidemiology information as a goal at all.

Abrami: the studies of 3G and 4G impacts do impact what we are looking at. I appreciate the comments but we have to plow forward. Obviously, in our report we are going to be addressing 5G but if we find out that there are things we should mention in our report related to RF radiation, we should do that. We are going to vote and I mentioned this once before. A House commission is different than a Senate commission. You sign off on a report on a Senate Commission. We don't sign off. Your way of not agreeing with the majority is to write a minority report. That's the way our commissions work.

III. Pat Abrami: Smart Meter Bill:

The next thing on the agenda, is this on topic or not on topic? We have heard some discussion about smart meters. I was minding my own business one day when I overheard the prime sponsor of the smart meter bill. I said we are doing 5G, sign me up. Senator Sherman signed up too. I think the Representatives can understand, sometimes you look at a title and think I could contribute to this bill. Unfortunately, I had not read the bill until just before the hearing a few weeks ago. It turns out that the prime sponsor knew nothing about the topic. He was submitting it for a constituent. NH has a statute on the books about smart meter gateway devices. That was passed eight years ago. It's a pretty strict provision. My understanding of a gateway device is that it gets readings from your

refrigerator and different appliances and that connects to your electric meter. My sense and I am guessing now, is that this was more about security than RF radiation when they passed this bill. We are big on security in legislature. If electric company wants to put one in your home, you have to “opt in” not “opt out”. That’s a tougher climb. You have to sign a piece of paper that says, yes, I want this device in my house. This was almost like a preemptive strike on something that someone was anticipating.

Sherman: I remember the discussion on this. I think one of the problems was if you have a meter that can be read by anybody because it’s transmitted then this was mostly a privacy issue. If your use goes up significantly, that’s your business. I think the big concern was law enforcement being able to tap into this.

Abrami: So it was a totally different angle.

Ricciardi: Do we have a law here in NH about privacy protection because that segways right into the lack of privacy with 5G. I just wonder. Do we have anything in place?

Abrami: I don’t know.

Sherman: I don’t think we have a single law about privacy protection. Even the technology of license plate readers being used by police was blocked in the Legislature. So we don’t allow them to hold onto the license plates after you go through the toll booths. We don’t allow police to go into a parking lot and do license plate scans. I don’t think there is a single bill on privacy but I do know that as bills come through there is a high level of scrutiny on how much personal freedom this might impede.

Ricciardi: That should coincide with 5G then because that is surely a lack of privacy.

Abrami: When I read the literature on preparing because I testified on this bill. There were four issues: One was privacy with the smart meter relaying to electric companies.

Chamberlin: I don’t know if we are talking about the same bill but there is a current bill that came before the House Science, Tech and Energy Committee about 5G smart meters and one of the concerns was health, so they deferred to our commission.

Abrami: Yes. That’s the one. I testified that day. You missed the hearing that day. The bill was filed and what it did was mark up the existing statute basically taking away what we have. I testified in the hearing and said this bill needs to be worked big time. It turns out that there are different degrees of smart meters. There are like three layers of smart meters. Eversource came in and said, wait a minute. We have a truck that drives around and it activates when we want to take a measure that is very low level. It only pulses when it is signaled to pulse. Eversource saying wait a minute, what are you doing to me and you would have to agree with that. Then there’s the electric coop, which is bigger than you think. They have it and they say that theirs only pulses 14 times per day. You can’t really say there are any health affects because it pulses 14 times in a day. The continuous pulse is the third. I think that’s the one related when you read the list about health effects. So

clearly, in your committee there wasn't enough evidence for them to consider so what they did was they asked if our commission could take a look at this. So, if we have time, we will take a look at it. Does it have to do with 5G? I don't know. But its continuous pulsing and people are concerned about continuous pulsing.

Sherman: We actually have a new lawsuit in Rye. A resident is having to leave she said because of the smart meter pulsing from a town building which is actually the school. She is suing the town for cost of having to move to a new location. The concerns are already out there and are affecting municipalities.

Abrami: The big thing especially apartment buildings where all the meters are in one spot, that's the ones that I read are problematic. Supposedly there are ways of shielding that.

Wells: I think we should hear some testimony on that. I am very skeptical that a metal plate is going to do anything except radiate on the other side. A faraday cage will keep the field out but it won't keep it in.

Abrami: We have to bring in the right witness who knows this topic cold with the different types of smart meters. They did the right thing. The bill was not ready to be passed and Science and Tech did not have the time to fix it. They have 50-60 bills I think in their committee. They have a lot. That was the smart meter update.

IV. Dr. Paul Heroux-Cell Tower Placement

Heroux: Essentially, this is about 5G. 5G will have as a primary consequence installation of a lot more towers in our environment. The question is, what do we know about the impact of EMR coming out of towers from the past? I did a short study trying to gather the written literature on this. I have a number of articles that I will leave with you and I have as well an Italian film on the Vatican. What this film does is help us gain historical perspective on how long conflicts relating to the radiation can drag on throughout the years. The situation with the Vatican is still ongoing. They are going on trial for manslaughter. This is something that is very old but persists today.

Essentially, we don't have epidemiological evidence obviously, on the impact of 5G towers because they are very new and sometimes they are not even activated yet. Some of these units can function in one mode or another. The experience we have is from towers of the past. I have assembled some publications. There is a publication here by Michelozzi, 2002 that describes childhood leukemia up to a distance of up to 6km from the powerful Vatican radio transmitter. The Vatican needs to broadcast throughout the world. They have very interesting antenna. They are huge structures that rotate. Of course the intensity of this radiation is very large which is why it seems that the epidemiologists have detected health effects as far as 6km away. This is an extreme area of antenna not representative of cell phone towers that we have in our immediate environment.

Abrami: That's an important point. They are their own little country. Do they have standards?

Heroux: They have standards of radiation that are different than those of Italy. Of course the radiation is coming across the border which is a problem we all have. Radiation from one in multi-family dwellings impacts the neighboring family. This is not an uncommon problem. In the Vatican, you have a very powerful transmitter with a very small population of people affected because it's mostly small cities and countryside around these huge transmitters. But epidemiologists observed very high relative risk.

Abrami: Can you give us a sense though of how intense?

Heroux: It was at the legal limit for Italy.

Chamberlin: These are under 30Mhz aren't they?

Heroux: Yes. There are a number of antenna there and the relative risk was 7 for lymphomas and for non-Hodgkin's lymphoma and leukemia 5 times. So there is very high intensity and very high relative risk of these diseases.

Then Santini in 2002, this is a study that is remarkable in that it documents a number of health effects, not only cancer but other neurological effects. But, it is weak because it was based on questions asked of people, which is always much less reliable in terms of epidemiology. Of course the investigators tried to do the best they can. This is not like the documentation of say a tumor but they said up to 300 meters, they could observe neurological effects from cell towers.

In 2010, Khurana provides a review of 10 base station proximity and neurobehavioral effects and three investigations of cancers. He reports that 8 of the 10 studies report increased prevalence of adverse neuro-behavioral symptoms or cancer in populations living a distance of less than 500 meters from base stations.

Probably the most convincing evidence, I would say is from Dode in Brazil 2011. This is a study that if you read it through, is performed in a way that is very open handed. They used tumor classifications and sub-classifications from the international committees. They used public health records. They had the cooperation of utilities as well as many universities and their documentation is very detailed. So, if one is to be given weight, it should be that one. Essentially, they came to the conclusion that yes, they can document these effects.

What is most striking, is they can also detect that if they install a cell tower near your home, within two years, is when you will get the maximum incidence of cancer. They documented cancer because, unlike neurological symptoms, cancer is not subjective especially when they are quantified by histology and by international classification. This report of a large city in Brazil with a large population which is known to have a public health system that documents. Within 500 meters of a base station and there are many base stations that are documented, you will have increased incidences of cancer. These exposures are much smaller than the FCC limit of course. They have a range of exposures that they measured within the study. I think this, needs to be read.

In 2020, Pearce essentially provides the most recent assessment. Each of these studies of course goes through a bibliography of its own. It promotes, again the 500 meter setback to limit future liabilities of

the cellphone industry. He is talking mostly to the cell phone industry and saying if you want to limit your liability in the future, you should respect the 500 meter distance.

In 2018, I have an article by Affuso which examines the economic impact on home values. If you are within .72 kilometers or 720 meters of the base station, your home value goes down by up to 9.78%. As the NTP studies are more widely known in the population, this is probably going to increase.

We do have studies of high intensity that have documented cancer at long ranges. We have studies over large populations that also confirm the 500 meter danger zone. In other words, your health will not be the same in terms of cancer and neurological impacts if you are within that zone. So when we are considering 5G, we will be considering antennas that apparently will have more powerful output because of this radiation goes less well through oxygen and water. It has focused beams to go through structures to attain people who are hidden. So as a result, exposures will be more transient, more focused and more intense. But we don't have epidemiology on that. We would have to wait 10 or 20 years before we have the information. Sadly, the only information we can rely on is information from the past. I think that anyone should read the study on Belo Horizonte, the third largest city in Brazil will see that this study was done very carefully and in my opinion is very convincing.

Ong: Dr. Heroux, in the Brazil study, was there any comparison between the pediatric incidents and the types of pediatric cancers before installation of these towers and comparison of those rates and incidents after these installations?

Heroux: I believe that all the cancers were classified according to international standards so some of these classifications are specific to pediatric but the control were regions that had no cell towers that were investigated at the same time.

Ong: But you mentioned earlier that the Belo Horizonte have very good cancer registry. So for the same region, you will have the same data prior to the installation of towers vs. the rates after installation.

Heroux: I believe their data covers approximately ten years. I believe that they used the reports within those ten years and discriminated between those near cell towers and those that were not.

Abrami: Well, what I think he is trying to say is, are there other reasons for this higher rate of cancer and filter out the other effects that may cause it. I understand what you are trying to say.

Heroux: I guess you would have to read the study to satisfy yourself about these details.

Sherman: Getting at one of Senator Gray's concern, to fully understand. This study was done with presumably 3G and 4G towers. Is that right?

Heroux: Yes. Those are similar to ones that you would see here.

Sherman: One of the things that you mentioned was that the peak cancer effect was within two years. So we wouldn't have to wait twenty years to know. If we used this as a springboard for what is

happening with 5G, it would be interesting to do a study in a city that has already implemented 5G then you might be able to do the before and after registry.

Heroux: Yes, ideally but the wheels of government and science turn rather slowly in a sense. This was done in 2010 but this technology is about 10-15 years old already...before you get the agreements between the number of universities and public health systems and so on and so forth. But they have a record of when the antenna was installed and when the cancer occurred which allows them to come up with this statistic.

Abrami: This is the thing that has been nagging me about the small cell tower. We just don't know. That is the whole premise of this. We just don't know and how do we get at that? Clearly, there is not money supporting research.

Gray: Part of what we are hearing is that if there is a 500 meter limit then the amount of radiation is very important in to the rates of cancer. I am accepting your data at face value okay? Now, we look at 5g technology. We have smaller towers. We have less power. So that 500 meters may be 275 feet. You talk about being able to submit a minority report. If I was to try to do the peer reviews about all the different things that people have presented to this, I would be talking about billions of dollars. I go back to 1960's when I was watching 60 Minutes talking about the EMR coming off high power lines going through the Midwest affecting the cattle that we eat and we are all going to die because of it, okay? Again, I am just trying to get you to stay on topic and the 500 meters... yes. There may be a component in there that the amount of radiation nearness to it, you said 30 Mhz and below and 5G starts at 30Ghz and above...all of these things affect what we are supposed to be looking at and the results we are going to get. The one study that we were given that they talked about it wasn't fair to do whole body radiation on a particular animal because that would have a much more devastating effect and all you have to do is find one cell within that whole body that would react.

Abrami: we are not there yet. We are still working on this.

Sherman: We have had a lot of scientists around this table. I think nobody is pretending to come to any conclusions at this point. But in science and in healthcare, we try to look at all available data which is what we are doing. Some is going to be historical data that comes from other RF sources. I think it's perfectly reasonable to look at other RF sources especially since those aren't going away. 5G isn't coming in and replacing all of this as far as I understand it. 5G is coming in on top of 3G and 4G. So, I think it would be a little bizarre for us to look at 5G in a vacuum without the understanding of the current environment and the data on the current environment. I think with a cautionary tale that I hear coming from Senator Gray is that doesn't necessarily mean that we can extrapolate data from 3 and 4G and say that this is going to be the impact of 5G. Study commissions go where the data takes them and I think we are doing that. I haven't heard of anybody coming to any conclusions yet. I think we are still looking at data.

Ricciardi: I just wanted to mention that I believe I forwarded Rep. Abrami information on a town in the Netherlands that put in the 5G, the town became rapidly ill. I can go back and find that. That is 5G and that is evidence on human beings. And that is on topic.

Chamberlin: That was a small study as I recall.

Ricciardi: Yes. They put it in and very shortly after the whole area became very ill.

Chamberlin: True. But somebody could claim that maybe it was a water problem as well. I am interested in following up on that.... particularly, in places like South Korea where they have installed on a larger scale. We need to keep our finger on the pulse there. If you find any more of those, forward them to the rest of us.

Heroux: Can I have one last remark? Essentially, the tower question of course takes care of the general environment but in relation to the new phones which will also have this and possibly more radiation from these phones. The phones could be altered in a very simple way to simplify things for users in terms of health impacts and even perhaps for industry. These cellphones are immensely useful. But one of the problems is that when we hold them close to our body, they tend to over expose us to radiation. There is all this controversy around the proper SAR. They can put 5 cameras and 10 antennas in the most recent phones.

What you can do is put a proximity detector in a phone so that when it comes near to your body, it doesn't work and doesn't radiate any more. This would mean that you could use your phone exactly as before but the risk of overexposure of the phone would be severely reduced, in my opinion. You would cut out all the extreme radiation putting it in your bra, your pants near your genitals or near your head. This is something that is not done right now but technically it is far from impossible. It's relatively easy to put in a distance detector and you would be instructed by your phone to expose yourself less. I think from the point of view of industry that if it is told by government to do that, they don't incur any more liability. If they do this on their own, their lawyers will tell them...hmmm.. you are admitting to something that may not exist. This is a problem. But if it's imposed on them, you are solving a problem for them as well.

V. General Discussion:

Abrami: Thank you. So I have amassed a list of potential speakers. I have reached out to most, but not all of them yet. If there is no comment on the paper, it means I have not talked to them yet either by phone or by email. Dr. Carpenter we will hear from in a minute. Dr. Martha Herbert can do something in April or May. Dr. Sharon Goldberg has been in conversation with Michelle. You can read through the list. I wanted to talk to Hardell because he is the former WHO fellow who is retired that was involved in this whole thing. Kelting is retired and will be our speaker next month. Dr. James Lin, I am really interested in. He is an electrical engineer but his appointment is in a medical school. He has published a lot in IEEE. I talked to him the other day and told him he could do it by phone. He doesn't like to do it that way and wanted to know if we could pay for his travel. I said, well, you don't understand. This is New Hampshire. We don't have a budget! So he is thinking about it. I have not contacted everyone yet.

Dr. Chamberlin, I was going to talk to you if you have any need to have a fellow electrical engineer come in for any kind of seminar series, maybe we could tie it to that.

Chamberlin: I will check into that.

Abrami: I think this guy is worthwhile having. I have checked some of his papers. They are very technical papers that he presents. I know that there are some others names that aren't on this list that people are suggesting to me. I am going to warn you Senator, that Carpenter may be a little broad so bear with us. He is aware of some legal actions in NY State. I know it would be great and I am trying to get more focused on the technical. With this group, I think we know what the issues are. We understand the science here.

We can start the discussion about the next meeting. March 6th won't work because Dr. Sherman, Sen. Gray, and I are on the Seacoast Cancer Cluster Commission together that day. Beth told me that she cannot make the 13th. On the 20th, Senator Sherman will be out of town.

Gray: On the 6th, you could do an afternoon meeting because the Cancer Cluster meeting will be over.

Sherman: I have a Seabrook working group on the opioid crisis so I can't be here.

Abrami: We could do the 20th. Out of fairness, I want to make sure we have Beth at the table.

Garod: I have a jury trial the week before that. There is a possibility it may not be over.

Abrami: Brandon, did you ever connect with Theo or whoever?

Garod: After you sent the email, I responded to her but have not heard back. I encouraged her to reach out to me.

Ricciardi: So, you did reach out to Theodora? Ok.

VI. Dr. David Carpenter-University of Albany "What is 5G and what do we know about the health effects of 5G?"

Abrami: David, welcome. You are in our meeting. We have someone who will move the slides for you. Please introduce yourself.

Carpenter: I am David Carpenter. I have two titles here at the University of Albany part of the SUNY system. I direct the Institute for Health and the Environment which is an interdisciplinary research institute that is a collaborating center for the World Health Organization. I am also the Professor of Environmental Health Sciences and the former Dean of the School of Public Health. I have been involved in issues related to electromagnetic fields for a long time. I first came to NY as the director for the state health Wadsworth laboratories. Two weeks before I arrived in New York, there was a settlement between the state Public Service Commission and the State Power Authority asking the question was there an elevation in cancer risk by high voltage power lines? As a new guy on the block, I was given the responsibility of administering that program. We had 15 research projects funded by state utilities. At the end of that project, we did find elevations in childhood leukemia in children living

exposed to high magnetic fields. I became the spokesperson for New York State on that issue. Once you touch a controversial issue like this, you never escape. It's never been my personal research but I have been involved in this and published extensively on it. I have been on national and international committees.

Abrami: What did NY State do about that?

Carpenter: Effectively nothing. They did establish a standard for the magnetic field for the edge of Right of Ways. But they determined that standard by measuring the magnetic field at the edge of Right of Ways and the standard was the highest one there so there wouldn't be any new magnetic fields greater than those that were existing. This is really one of the problems with RF fields. We are all so dependent on things like electricity and communication frequencies and nobody wants to restrict use of it and hopefully not make it worse than it presently is. It's very difficult to restrict use.

Electromagnetic Spectrum:

Let's go to the second slide, the electromagnetic spectrum. The form of EMR that most people know is visible light. At higher levels than that, we have the ionizing portion of the spectrum that includes x-rays and gamma rays and these have enough energy to directly damage DNA, cause cancer and birth defects and that sort of thing. Below the visible light, we have infrared radiation which is heat from the sun. Without that, life on Earth would not be possible. Below the infrared, we have the communications frequencies. It is important to note that the 5G that is being proposed is just below the infrared. It's Gigahertz frequency. The electromagnetic spectrum is all packets of energy with different frequencies. The higher the frequency, the more energy it contains. But the frequency is important. At the left of the slide, the extremely low frequency that's the magnetic fields associated with electricity that I was originally involved in.

Radiofrequency (RF) EMFs:

The point is that these radio frequency EMFs are communication frequencies, everything from radio to television to cell phones to radar. This exposure has increased enormously in the last number of years. Now we have Wi-Fi everywhere. We have smart meters put on many of our homes. These are meters that use RF waves to transmit your use to the utility. In the future, there are going to be ZigBee drives in your refrigerator, dishwasher and every appliance and it's going to communicate your electricity use to your smart meter. That's going to make the kitchen and laundry room particularly hotbeds of exposure. Driverless automobiles will use RF fields to see the car ahead and will enormously increase exposure to these things. The microwave oven uses RF fields and most of these frequencies are in the microwave range. Clearly, if you can cook your potato with a microwave, there is potential harm from exposure. But most government agencies, certainly the Federal Communications Commission (FCC) has the position (which I think is wrong) that there is no hazard from microwave exposure if it is at an intensity that is not sufficient to cause tissue heating.

RF in the Ambient Environment:

It used to be that RF environment was really radio and television. In the past few years we have increased the RF in the ambient environment enormously and with the imminent rollout of 5G there is going to be a great increase in human exposure. One punchline is that 5G has not been studied. It has not been around long enough and we don't have any population of humans that have been exposed so that we can determine whether it's really dangerous or not. We do know a lot about our existing 3G and 4G. As these generations develop, they go to higher and higher frequencies. Our cellphones, Wi-Fi, smart meter are all 3G and 4G frequencies. What does this sudden increase in RF exposure suggest regarding human health?

Health Risks to Humans from Existing RF:

We know very well that extensive use of a cellphone held to your head increases the risk of cancer. Gliomas particularly, less so other forms of brain cancer, and particularly glioblastoma which is a very malignant form of cancer. This is the cancer that killed Ted Kennedy, Beau Biden, John McCain, the lawyer in the OJ Simpson case. I am not saying that it was definitely cell phone use that caused all their cancer but these are people who undoubtedly used cell phones a lot. The cancers only occur on the side of the head that people use the cellphones most of the time. In addition to the glio cancers, there is a Schwannoma tumor of the auditory nerve that we see commonly called acoustic neuroma. It's not a cancer but a tumor that grows in the bony cavity in the ear and causes problems. There are some elevations in cancer of the parotid gland on the cheek and the thyroid gland. It seems likely that excessive exposure to RFR at non thermal intensities increases the risk of a variety of cancers and what is really critical is which part of the body is exposed.

National Toxicology Report/Ramazzini Institute Study/Other:

Now the International Agency for Research on Cancer (IARC) which is part of the World Health Organization (WHO) has rated communication frequencies as possible human carcinogens. This was a number of years ago and one of the reasons why it wasn't a stronger reading in that there hadn't been clear evidence that cellphone frequencies cause cancer in animals.

National Toxicology Program (NTP) which is part of the National Institute of Health (NIH), just last year came out with the results of a two year study. It demonstrated that rats exposed to cellphone frequencies develop schwannomas of the heart.

Abrami: Just so you know, we have talked to those folks.

Carpenter: Ok. Let's go on. The Ramazzini Institute did a similar study but at much lower intensities. They found exactly the same thing. We now have good animal evidence in addition to human evidence. There are other health effects that are well documented, particularly reduction in sperm counts and infertility in men from abnormal sperm and some evidence of spontaneous abortion and premature birth in women with excessive exposures. There is some evidence for cognitive alteration in children, if

they are on their cellphone too long. It's difficult to understand if it's a direct effect of the radiation or because kids aren't sleeping because they are talking all night.

Then there is the very controversial but pretty clearly real problem with Electro-hypersensitivity. Some people, by no means all become the best way to say it is "allergic" to the RF fields. They develop headaches, nausea, vomiting, and a sense that the brain isn't working properly. Sometimes they have heart palpitations and a general feeling of ill health. This has been seen in adults and now fairly frequently in children in school environments where there is intense Wi-Fi, much more controversial than brain cancer.

Emerging wireless technologies:

5G (5th generation cellular technology) as I have said, is RF but at a higher frequency that we have at 3G or 4G. It's being promoted widely just about everywhere. This is the whole concern of the Trump administration with Huawei the Chinese company. The idea is that 5G when fully developed is going to just change the way that life on Earth is done. It's going to be the Internet of Things, Smart Appliances, Smart Cities, certainly self-driving vehicles and wearable devices. A lot of hype about this and a lot of sense that somebody is going to make a pile of money and that this is going to be good for communication at the much faster rate than we have currently with 3G/4G. The 5G frequencies will be in the Ghz range which is higher than current 3G/4G which are lower than 1Ghz, in the MHz range. Ultimately, the 5G can be up to 70 Ghz which is almost at the frequency of infrared radiation. It will be 100x faster than 4G, potentially add new jobs and a lot of economic growth. It's a higher speed greater capacity.

Limitations of 5G:

The problems with 5G are several. Because it's at much higher frequency, the waves do not penetrate as far as the 3G/4G waves do. They are easily blocked, even by weather. The radiation will not penetrate a building. It will not go through glass and won't travel so far. This is a real problem so as 5G is being implemented around the country and world, instead of the cell towers that have ranges of over 2,000km, the 5G will require mini cell towers to be placed in front of every 6-8 houses in urban areas. The 5G will only have a range of 20—150 meters not kilometers. That means that as these are placed everywhere, you are not going to be able to walk down a side walk anywhere without being continuously exposed. Now if you are in your house, since the beam won't penetrate the house, that's probably a good thing. Now one of the real problems however, as we are rolling out 5G, our current infrastructure is 3G and 4G. These mini cell towers places all along the street are not just going to be exclusively 5G, they are going to be 3G and 4G as well. While we haven't really studied health effects of 5G, I have already told you of health effects of 3G and 4G. This is going increase the exposure to 3G/4G dramatically. These mini cell towers are going to be everywhere. That is a real problem totally independent of the question what are the hazards of 5G.

Abrami: We have talked about these things in our commission. We are trying to get at what is in those towers. It's really about the power. Let me ask you though, the issue with the small towers is you get every company with different strategies of 5G. Can you discuss that a little bit?

Carpenter: Well, I am not an expert on that. I know that each company has their own power also they don't share their information very much. It is very difficult to get that information. They really don't want the other companies to know what they are doing. I can't really answer that question. But I do know that all of the ones being implemented right now are not exclusively 5G. I think the expectation is probably pretty good that 5G is not as dangerous as 4G. That's because 5G is not likely to penetrate the brain. It's not likely to cause brain cancer because it's going to be blocked by the skin. Now that raises a whole series of other questions. What is going to be the effect on the skin? Is there going to be an increase in skin cancer? Is there going to be alteration of sweat glands? We don't really know that answer. Again, my big concern is the greater exposure to the 4G frequencies which we know to be hazardous in extreme exposure.

Abrami: This is the discussion that we are having. The towers are lower to the ground. They are right in front of your house. There are science issues and all that but there are emotional and aesthetic issues that people are pushing back on. Our understanding is that it is less power and we are trying to grapple with how much damage compared to a large cell tower.

Carpenter: In the large cell tower, there have been studies showing increase in leukemia in people who live close to the large cell towers. But the large cell towers direct the beam at the horizon. That's for the purpose of having a reception over a very long distance. These small cell towers close to the ground are going to have beams directed right at everybody. It's going to dramatically increase exposure relative to that you would get from a large cell tower.

Abrami: It's the $1/R^2$ rule right? The closer you are to the tower....

Carpenter: that's right. The question is ...whether the beam is directed or if it's like a radio transmission tower which is 360 degrees. Our current cell towers have a focus beam at the horizon. For some reason, people living very close to a cell tower probably get less exposure than people living some distance away where the beam then sort of spreads down. These mini cell towers on a lamp post or wherever they are on the street are going to be very close to the ground level and it's going to be impossible not to have elevated exposure.

Abrami: Usually with cell towers, there is a radius around and there is nothing there. There are plenty of studies showing the fire station concerns but these small cell towers are going to be right on the street and low to the ground.

Carpenter: yes. I was actually in California for the Fire people opposed to towers on every fire station just for that reason and they did block that plan.

Sherman: On these small cell towers that will have 5G and 4G, is it a lower power 4G since there are going to be more and they are going to be closer and there is not going to be the same need to shoot at the horizon? Or is it the same power as the big towers?

Carpenter: I don't actually know the answer to that question. I suspect it's going to be a lower power. But, I don't actually have good knowledge of that.

Abrami: Let's keep going.

Carpenter: The issue is there is no real research on 5G. There are a few animal studies now. Again like any new technology, there are people making outrageous claims for hazard and others that make outrageous claims for safety. So, I think we just don't know. But the issue of cancer from RFR, that is very strong. The issue of effects especially on male fertility is very strong. The Electro-sensitivities are certainly going to increase as people are exposed more.

Carpenter: Is there anything uniquely bad about 5G? I think the answer is no, other than the fact that the way it's being implemented is going to increase exposure.

Who is protecting us?

The FCC has no health expertise. I visited them several years ago trying to push them to at least have some cautions in their recommendations. They basically said, we don't have any health expertise, we depend on other agencies for that. Then they don't have any other government agencies that are pushing them. I am actually a plaintiff in a legal case against the FCC for their standard, which says that there are no adverse health effects except those caused by tissue heating. That simply is not true.

Abrami: Can we pause on that for a second? Which suit is that? There are several out there now.

Carpenter: Well this is all fairly recent. Bobby Kennedy is the lead attorney on this suit. But there are several out there. It's really sort of outrageous that the Federal Communications Act of 1996 specifically prohibits placement of any cell tower based on concerns of health. This is a real problem for many localities and states because this is federal law. You can object for other reasons but not for health concerns.

How Strong is the Evidence of Harm?

The evidence is very strong for 3G and 4G, especially for cancer and effects on male fertility. It is less strong on some of the other things but certainly enough evidence to merit concern.

There are so many sources of RF and the average rate of exposure to RF has increased over time. Since 2003, there has been an enormous increase as we have gone to just about wireless everything. The latency for many of these health effects, especially cancer is going to be long. We know from ionizing radiation that the latency is 20-30 years. One big concern is we roll out all these new sources of exposure, what is going to be the long term impact? We are seeing an increase in glioblastoma risk in the US and around the world. Not so much in other brain cancers. Actually, some of the other brain cancer rates are going down. But, there is reason to be concerned.

The conclusion is with 5G, you can download your movies faster. There may be other benefits. It is not obvious to me what the other benefits may be to the individual, maybe to business, maybe to government but it's just that we are rolling out 5G very rapidly without any good information as to whether the risk might exceed the benefit.

Abrami: Well, thank you on this. Let's talk about NYS. That is where you are based. Are you aware of anything going on legislatively in New York? I thought I read that they may be thinking about forming a commission like ours.

Carpenter: They haven't gotten past that. It's being rolled out across the state and there are a number of legal actions. There have been a couple of meetings in the state assembly on the issue, but no significant legislation has passed. There is a growing concern. It's interesting, one of the Vice President's here at the University of Albany, asked me to give a talk for a public group and he knew nothing about the issue until they put a mini tower in front of his house. That seems to be happening around the state. Little information, if any and then the mini towers are placed and implemented and that gets people pretty concerned. There is a fair bit of angst among the population but only the population where it's being put out otherwise there is very little information.

Abrami: I just received something about Huntington, Long Island. I had seen this before, a public hearing in their town council. For five years they have been complaining to the town officials and they are very concerned because these small cell towers are going up in their community and a lot of people are pushing back. We are seeing this across the country.

Carpenter: Sure. It's really across the world. I am being taken to Australia to talk about 5G this summer.

Abrami: We just heard that Switzerland put a hold on 5G until they understand the science a little better.

Carpenter: Yes. I think one of the concerns is that there seems to be absolutely no benefit to the ordinary individual maybe to business and industry. Other than the fact that you might be able to download a movie more rapidly, what's the benefit?

Abrami: one of the things that I saw was autonomous vehicles but it turns out that the industry is not going in that direction with the little towers along the road. It's going to be built into the cars.

Carpenter: It's going to be built into the cars and likely to be lower frequency.

Ricciardi: I just wanted to clear up a question I have or make sure I understand it correctly. Although our commission is tasked with the health effects of 5G, what I understand and correct me if I am wrong, because it will actually be placed approximately every few homes and because it cannot work independently and has to work with 3 and 4G, what's going to happen is whether we know much about 5G or not, the fact of the matter is everyone is going to be living under a cell phone tower and being exposed to radiation continuously which can heat tissues over time. Is that correct, Dr. Carpenter?

Carpenter: Well, the last part I think probably is not correct. If you have low intensity to these, there may be a level of heating that can't be measured but you would be constantly exposed but there would not be any measurable increase in temperature. That's the debate with the FCC because there is this enormous amount of information showing health effects at non thermal levels. But, I don't think because you are continuously exposed at a low intensity that there would be a measurable increase in temperature.

Ricciardi: Okay, but you would be exposed continuously which would potentially precipitate other health effects.

Carpenter: That's correct. I am sorry I probably should have prepared a more technical presentation. I didn't realize that you were so well informed on this. We have a pretty good idea what the mechanism of these damages is. The primary mechanism is that non thermal levels of RFR generate Reactive Oxygen Species (ROS), commonly known as free radicals. If you remember in the NTP study, they demonstrated direct DNA damage in those rats and these were clearly non thermal intensities.

There are many nasty things that generate ROS. In fact, our body generates them just as part of the normal metabolism. We also have a whole series of enzymes in our body that are there to protect us against them. Very clear evidence that non thermal levels of RFR cause the generation of these ROS. If you are exposed continuously, then you have a continuous generation of those ROS. You don't need the temperature rise, to cause harm. The ROS can damage proteins, lipids, carbohydrates and DNA. The evidence is quite strong that this a common mechanism that then leads to a whole variety of other changes. For example, changes in brain metabolism and blood flow to the brain and whole variety of things. There is a good body of evidence that allows us understand how you might get damaged from continuous exposure to RFR at levels that don't raise body temperature.

Sherman: Just a quick question. What you are describing is the epigenetic impact of non-thermal RF levels. You are actually changing the DNA. Do you know of any evidence of people who are more predisposed like family history like genetic makeup? In other words, is there anything in your genetic makeup that would predispose you to increased risk of being within an RF field?

Carpenter: I don't know of any real study on RF fields. There is a very interesting study on the magnetic fields from power lines. There is a study on electricity from China I believe that did look for different genetic traits in children that developed leukemia from being near power lines and children exposed who didn't develop leukemia. They did find there is a genetic susceptibility factor there. I would be quite surprised if that weren't also the case with RF but I am not aware of anyone that has really studied it.

Wells: On one of your slides, you talked about current 3G/4G cell towers having a range of 2,000 km. I just wanted to check on that because my interest is not just on the transmitter power but the power over the area and what that means in terms of the intensity in watts per square meter to which people will be exposed. So, 2,000 km is the correct figure for 4G?

Carpenter: Well, yes. That's the correct figure. Of course not every cell tower has intensity that goes that far. For example, in most urban areas you don't have that intensity. But in rural areas and so forth, you have a higher intensity. That's also true when you use your cellphone. If you are a long way from the tower, your cellphone automatically increases the intensity of the signal it sends back to the cell tower. That 2,000 km is sort of the upper limit of a cell tower.

Wells: If I can just follow up on that. You talk about 5G only penetrating skin. I was wondering if you would comment on current SARs on Watts/kg versus intensities of watts/square meter. Which do you think is the more appropriate way of looking at exposure?

Carpenter: well, certainly with 5G watts/square meter is more appropriate metric because we have no reason to believe 5G is going to penetrate beyond the skin. The 5G is actually being used a little for crowd control. If you have sufficient intensity with 5G, of course you have tissue heating. You can direct a beam at someone who is trying to escape the police.

Abrami: Rep. Wells is all over that one!

Chamberlin: So, I have a question about the strength of the evidence that exists. Since getting on this commission I have been reading a lot of papers and I find that there are lots and lots of papers out there. You can't deny that there is a risk of harm. It's also somewhat overwhelming, the number of papers that exist. Have there been attempts to bring that all together to these meta studies that you mention? Where can I get access to them with high statistical confidence that a problem does exist?

Carpenter: That's a good question and it's a complicated one. The place where most of the evidence is put together is in the BioInitiative Report. I was the co-editor of that. But that report was criticized by just about every national and international body, as being selective. In fact, it was not selective but we have not had effectively any government agency with real credibility and that's true around the world acknowledge the strength of the evidence that I think see and I think that you see. The problem is, first of all you have a powerful industry that doesn't want their product tarred as being dangerous. Secondly, we are all so happy with the benefits that come from modern technology that we don't want to hear that it's potentially harmful. I am frankly baffled by the antagonism that the Bioinitiative Report has received. It was criticized as not being peer reviewed. Well, the original report wasn't peer reviewed but almost everything in it was published separately in peer reviewed scientific journals and passed review. But it remains a very controversial subject.

Abrami: Can you send us that report? The chair has been corrected. We already have it.

Carpenter: It was originally published in 2007 and updated in 2012. There have been some additional updates in 2014. It's huge and much more than anybody ever wanted to know and I think the individual chapters on specific subjects. I think there is something like 3 or 4 thousand references in the report.

Abrami: Are you the prime author on this?

Carpenter: No. I was a co- editor. I had the major role in writing the public health chapter. But each of the chapters was written by other people and actually Cindy Sage was my co- editor and was the power behind it but I had a major role in identifying who would write chapters and so forth.

Chamberlin: As a follow up question, can you give us the sense of relative risk? Is the relative risk something like 1.2 or something like 10? And do these have associated low e values?

Carpenter: Well, I am involved in all kinds of hazard investigations. My major research actually is PCBs and dioxin and pesticides. Some of my colleagues wouldn't agree with me but I don't think the relative risk here is anywhere near as it comes from things like smoking and chemicals that are toxic but one has to be careful about this because again, our exposure has increased so dramatically so recently. We have evidence in links to cancer but in latency being long, what's going to happen twenty years from now? You can look back at smoking and you can look back at PCBs and DDT and these things in the 60's and 70's were thought to be quite harmless. Now we know they increase the risk of all kinds of diseases. That's why that last slide I mentioned the Precautionary Principle. At the moment I don't see that the relative risk comes anywhere near the risk we have of other kinds of exposures but I am not sure that it's not going to be viewed as much greater in the future. If you put a mini cell tower in front of every 8th house, in every street in the US, who knows what the outcome is going to be in 20-30 years? The cancers that we see are relatively rare. But they are also fatal when you get them.

Sherman: Dr. Carpenter, I am also a physician. I am a state senator here in NH. I sense some frustration in your voice. One of the issues that we have been grappling with which is what Rep Abrami talked about is PFAS how it's in our drinking water. But the similarities between both of these is that we have very powerful and well- funded industry that is basically dismissing all science that is raising alarms in both of these areas and one of the big concerns that I have is that well- funded would not be a good description of the NH legislature and certainly not the people who are pushing back against industry. You are in an academic setting and you are doing some really good work on this. Do you have any suggestions on how we can lift up the Precautionary Principle before everything is installed and in place and we have to wait 10-20 years to know that we have just done in an entire generation? Do you have any models or any communities that you worked with that have been able to mitigate the influence that some of these companies so we are not regretting down the road that we did not provide at least some precautions as we move into this new era of RF exposure?

Carpenter: well, I certainly work with a number of communities that are trying to do that but I can't say that it's been very successful. The big barrier here is the 1996 Federal Telecommunications Act. There have been some communities where industry has sort of backed off hoping that the angst will go away but in others, the telecommunications companies has basically taken legal action on the basis of the Federal Communications act saying we have the right to put these in and you have no right to object to it.

I think what I would really like to see is that provision in the Telecommunication act being invalidated. It is outrageous that communities and states are prohibited by that regulation from opposing this kind of development. We don't have that similar kind of thing with chemicals like PFAS and PFOA. This is a very strange situation where we are prohibited from protecting the health of the public. You can debate how hazardous this is but it should not be up to industry just doing anything it wants to and public and other forms of government having no ability to block it.

Abrami: Let's go back to the Kennedy case. What are the two sides on this? Is it the FCC?

Carpenter: The case is that the FCC by virtue of having this philosophy that there are no harmful effects other than those caused from tissue heating is causing severe harm to the US population. The plaintiffs are a public health person and a mother of a child that died of a brain tumor. There are a couple of people that have Electro-hypersensitivity. The goal of the suit is to get the FCC to tighten the standard of exposure for RFR.

Abrami: we are probably the most lax of most countries, right?

Carpenter: Oh yes, by far. There are other countries that are equally as lax but we are way more tolerant of exposures than others. The Russians have had the lowest standards for the last fifty years. Now, I don't know that they reinforce it that much. Our standards are just ridiculously high.

Abrami: What court is this going to?

Carpenter: I don't know. It's directed to a federal court but I am not clear where it's going to go yet. This has all happened in the past couple of weeks. There are other suits pending too.

Abrami: The Environmental Health Trust that we head from a month ago. They have a suit as well against the FCC. As a commission, we want to talk to the FCC and also where they get their guidance. If the FCC says well, we listen to the FDA and FDA is saying there is no problem, I think that's part of the suit the EHT is involved in. But IEEE is setting standards, right?

Carpenter: Engineers and electricians setting standards for health is pretty ludicrous.

Abrami: We would love to talk to someone from the FCC but that is proving to be a bit of a problem and the FDA. EHT said what we should do is write a letter to the FCC with questions and the same thing to the FDA with questions. They have been known to respond. I think we need to do that. If we can't bring in a human being to testify, we can at least say we tried to elicit comments from the FCC. What I am suggesting to everyone here, send me your questions. I will sort through them and we can talk about it for the next meeting.

Carpenter: I think that is a very good plan.

Abrami: If you have any questions, send them to me, too. Someone in the back of the room would like to talk.

Public speaker: I have one quick question. For all the doctors in the room, I recently saw a video with Dr. Lena Pu who had done a blood test on a teacher who was in a classroom with Wi-Fi and the blood test indicated after a day of exposure that the viscosity and quality of her blood had basically coagulated like it was cooked. Would it be simple to do a study on people who say for a week have not been exposed to any cellphone, Wi-Fi, television and do the blood test and then test again after exposure? I am wondering if there are any other parameters besides cancer that should be looked at. I think blood quality is pretty important and leads to all kinds of other stuff.

Abrami: I thank you for your comment. We have been trying to explore the different research that is out there. Does anybody recall anything on blood?

Heroux: Yes. The rouleaux formation is very well known. Even short term tests can show if you expose blood to EMR and you have some but even if you show that to the FCC, they will say...so what?? This will dissipate after some amount of time and the mechanism for that is probably that you have free mitochondria in the blood actually. It's very new data. You have a lot of mitochondria floating freely in the blood and they help the red blood cells to coagulate together. There is plenty of that kind of evidence. What does it mean for the people in that class? If no one is willing to take that step, we are wasting our time.

Abrami: In the classroom situation, we are talking about routers everywhere. One of the people who testified for us when we got the bill passed was Cece Doucette who years ago was involved in getting wireless technology into the school until she realized, what have I done? Now she is working to try to undo some of it and have safer technology. There is no reason schools need these routers. They can be hardwired for instance.

Carpenter: With hard wire, there is no exposure whatsoever.

Abrami: And actually speeds are better.

Sherman: Speeds and reliability.

Sherman: Do you know any blood impacts Dr. Carpenter?

Carpenter: There are colleagues in Paris that have done some very good work on measuring some things in the blood that are markers of people that are electro-sensitive. They focus mostly on this electro-sensitivity. Again, all the markers they are finding are related to these Reactive Oxygen Species (ROS). Dominic Belpomme in Paris is the one who has done that. We have published with him and I can send you the article with that information and I would be happy to do that.

Woods: We already know that blood can be temperature sensitive. There's cryoglobulin anemia in people where if you put an ice cube on their skin, they get hives. This is a known entity and it's not everybody. Again, it's a genetic variation. But it bespeaks a broader picture in fact that a lot of the studies at least to my eye have been bulk tissue or bulk material investigations. What we are wrestling with now is getting down to the molecular level instead of bulk tissue, we need to look at cellular and molecular levels and that's what we are hearing here and what we have been surmising where we need to go. We don't have a lot of these good molecular studies although we know mechanisms clearly can take place already, like you mentioned the mitochondria and we have talked about other issues before that get away from what the IEEE looked at and getting down to the molecular level. We are trying to make that transition.

Sherman: I have one question. We are mainly interested in human health impacts but we have heard some rather frightening studies on environmental impacts. Can you comment on those Dr. Carpenter if you have any expertise or knowledge about environmental impacts, specifically of 5G but since this is going to be ubiquitous, the concern is this is also going to be 3G/4G... bees, insects, plants. Any thoughts?

Carpenter: Well, there is some evidence for effects on bees for example, some concern that the demise of the honey bee may be related to the RFR distorting their ability to find their way back to the hive. Again, that evidence is somewhat weak. There is a tendency whenever there is a health problem, whether its bees or humans, everybody has got their favorite villain to blame. I don't think that the effect on honey bees is very strong. On the other hand, the suggestion that hives that are placed near cell towers lose their population of bees relatively quickly. I had a high school student do a project with me last summer. She was looking at the effects of cellphone radiation on the growth of plants. She used wheat seed and had an active cellphone by one plot and an inactive by another. The active cellphone resulted in poor growth of the wheat. So, there is some evidence but again it's not 100%. Again, I agree the concern should be human health. Unlike many of the toxins that we have studied, I think we have stronger evidence for human hazard than we do for plants, bees and animals. It should be humans we care about. That's why I emphasize human research.

Abrami: There aren't research dollars coming this way.

Carpenter: They are not coming this way. They are not there at all. Again, that is the influence of the industry.

Ricciardi: I just want to comment. Knowing whether we know all we need to know about 5G or not, it disturbs me that we know it is going to work with 4G. We already know what that can do and living near a tower can do. They roll out 5G in the state of New Hampshire and it is going to be in front of our homes. Essentially, they are forcing our residents to live under a cell phone tower. I don't understand that. We know 4G is not safe and they are going to hang together in front of people's homes.

Carpenter: That is exactly right.

Sherman: And there is nothing you can do about it.

Ricciardi: This is the "Live Free or Die" state here. Now that you are putting something in front of my home that may make me ill, I am sorry, I just had to put that out there.

Abrami: Well, we can do what we can do as a state but there are laws that trump others. The 1996 law, that's the real issue.

Ricciardi: Well we are certain that 4G will do harm. Whether 5G does or doesn't they will be hanging together in front of my house. That's my point.

Abrami: There is evidence. Yes. There is frustration with the current state of affairs. As a commission, I think we are all more educated on it than three or four months ago. Dr. Carpenter, I really appreciate, the dialogue was great. Thank you. If you send us that one article, that would be good.

Carpenter: Alright. I will do that right away.

Sherman: thank you so much.

Carpenter: My pleasure and I really appreciate the fact that your commission is looking into this.

Abrami: Ok. Thank you. That was a good summary and it sounds like we keep coming back to the same thing. We know what the issues are and I would really appreciate any comments or questions please send to me via email on the FCC and the FDA.

Sherman: For my part and this is not a part of the commission but I will reach out to our federal delegation on the clauses in the FCC law. I don't see any reason why health effects should not be part of, it doesn't matter what political party you are from. If there is a health impact or potential health impact, it should be part of the decision of whether you can roll out new technology.

Abrami: Well, politically they figured it out if there were health effects, it would slow the whole thing down. That is the political reality of what happened and here we are. I have been in meetings on just regular cell towers in my town and know how hard it is to get just a regular cell tower up. People are up in arms about that, let alone be in front of their house. Verizon was getting very upset with our town as it took three or four locations before they said okay since they were concerned we would be sued by Verizon. So, the last location, they said okay. This is where it is going to go, despite upset residents in nearby areas. I was in these meetings and the neighbors were arguing health effects even with 4G towers. They said no, can't talk about that. That's just the reality.

Sherman: One of the things that he said that struck me was essentially the further you are from the source, the higher the energy that is going to be generated by your phone so while we worry about Rye has the same issue. We can't seem to get a cell tower. We have spotty cell service all along the seacoast. Does that mean that our cellphones are maxing out with our local exposure? Could the fact that you don't have a cell tower nearby and have to have a more powerful transmission from your phone increase your risk more than having a cell tower closer?

Gray: I can comment on that part. There is a decrease risk from radiation that comes from here. There is an increased risk of the radiation that comes from the cell tower antenna. You are closer to the antenna, you are getting more radiation. But with this, the power level of the phone goes down.

Sherman: That is what I am saying.

Abrami: I think we have concluded that from our meetings is that's the reality, the your cellphone works harder, the further away the tower is, it's really working hard to make a connection and is continuously trying to make that connection and will wear your battery out quicker too.

Wells: I was wondering if we could take a look at that FCC act of 1996, The Federal Telecommunications Act. If it's about cell tower placement with respect to health effects, there may be another way of addressing this.

Abrami: Section 704. We will have it for the next meeting.

Heroux: It was interpreted in the courts as meaning "health" but the wording is "environmental" that they use in the act itself.

Abrami: so the court interpreted the words.

Heroux: Yes. It's an interpretation.

Ricciardi: There was an incident in Bayville Elementary School in New York. You can research it. They put the tower near the school and after five years, 30% of the students and teachers got different cancers and three of the children died. They had a lawyer, I can't think of his name but you can google it. They went to court over it and they definitely conclusively showed that it came from that tower but because of that Telecommunications Act of 1996, nothing could be done about it.

Heroux: So the mechanism by which this occurred is very simple. In Washington, industry lobbied the government elected officials for a uniform law that would implement prosperity, essentially. But they confused communication with wireless and the deregulation of the industry when the breakup of AT&T happened, made it very profitable to promote wireless vs. optical fiber. Essentially, those are all unintended consequences that happened historically.

Abrami: there have been arguments from other speakers we have had here that on your phone bill, they have been deducting money for wired communications (landlines) but that money has been diverted to wireless.

Abrami: I will see everyone on the 20th. We won't see Senator Sherman.

Sherman: I will be here in spirit.

Ricciardi: Dr. Sherman so you will be getting someone to move forward with the FDA or FCC?

Sherman: yes, that gives me two things to talk about with our delegation. I will do both.

Ricciardi: Ok. Thank you.

VII. Next meeting: March 20,2020 8:30-10:30

Meeting Adjourned at 10:40 am.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

7/1/20

1:00-3:00 pm EST

Via Zoom (<https://unh.zoom.us/j/98794338097>)

Via telephone-US (+1 646 876 9923) ID: 987 9433 8097

In attendance: (11)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Senator Tom Sherman-president of the senate appointee

Brandon Garod-AG designee, Asst. AG Consumer Protection

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Not present: (3)

Frank MacMillan, Jr. MD-NH Medical Society Environmental Medicine

David Juvet-Business and Industry Association

Carol Miller-NH Business & Economic Affairs Dept.

Meeting called to order by Rep Abrami at 1:01 pm

Abrami: To respect everybody's time, I am going to start the meeting. This is the Commission to Study the Environmental and Health effects of evolving 5G technology. This is the first time we are meeting via Zoom. We have had a hiatus of about 4.5 months. The last meeting was February 14th. The State House has been closed for many months and we finally got the green light to proceed via Zoom. We are using Zoom, courtesy of University of New Hampshire through Kent Chamberlin who is the Chair of Electrical and Computer Engineering Dept. Kent will go over some technical things then I will read a paragraph about why we are doing it via zoom and not in person. Kent, I will turn it over to you.

Chamberlin: This is very brief. I am assuming most of you are pretty familiar with using Zoom. In your upper right corner, you have speaker view or gallery view. You can play around with that if you want to only see the speaker or the whole gallery. You may want to play with that. You won't hurt anything. Also, if you are not speaking, please mute yourself. You will see the mute indicator on the lower left. If you wish to speak, you can unmute yourself or push the space bar, say what you are going to say and when you let up on the space bar, you will be muted again. It's a good idea if we all mute ourselves so we have no background noise. Also, if you are dropped or have any problem, you can always rejoin the session. That's really all I wanted to say on how to use Zoom. Anybody have any other comments on how we might best use zoom?

Abrami: Kent, we wanted to save the gallery squares for our members, our guest, Joel and Deb. How do we do that?

Chamberlin: If you go to a block that only has a name on it and you right click, it should give you an option to only show those who have their video turned on. This will reduce the clutter on your screen. Is that working for people?

Anderson: I think there are several members who have their video turned off, Senator Gray and Senator Sherman and Brandon Garod. So they may disappear off the screen as well. You won't see their names. Just be aware of that.

Abrami: Ok. We will go with that. I have to read a public statement now:

As chair of the Commission studying Environmental and Health Effects of evolving 5G technology, I find that due to the state of emergency called by the Governor as a result of the Covid 19 pandemic in accordance with the Governor's emergency order number 12 pursuant to executive order 2020-04, this public body is authorized to meet electronically. Please note that there is no physical location to observe and listen contemporaneously to this meeting which was authorized pursuant to the Governor's emergency order. However, in accordance with the order, I am confirming that we are providing public access to the meeting via telephone and other public access via video means. We previously gave notice to the public of the necessary information for accessing the meeting, including how do I access the meeting via Zoom and via telephone. This information was printed in the House Calendar and Senate Calendars.

Welcome everybody to the meeting. Most of our meeting is going to be hearing the presentation from Dr. Herman Kelting, who has been so gracious to be flexible in his calendar. I reached out to him about four months ago. He was going to be our next guest when we stopped doing our meetings because of the virus. We will be following along his syllabus he sent to us. Before we hear from him, we have to review the minutes of the last meeting which was February 14th.

I.Approval of minutes from 2-14-20:

Dr. Chamberlin gave me two corrections this morning. One on Page 5- one quote Dr. Chamberlin feels was from Dr. Sherman. "I don't know if we are talking about the same bill"....

Sherman: As long as it's not inflammatory, I am happy to take credit.

Abrami: Also, on page 19, the last line Dr. Chamberlin said " low e values should be low p values". Without objection, we will make those changes. Are there any other changes that people noticed from those minutes? If not, instead of taking a vote, I will say without objection, we will approve the minutes as changed. Ok with everybody? We are all set. The minutes are approved with those changes.

II: Direction during the final months: We lost four and a half months and we need to discuss where we go moving forward. I think this is going to be the last presentation on the science. In reviewing Dr. Kelting's syllabus, it is a good refresher. There's a lot of good stuff in there that will get us going again from the science standpoint. Most of us are in agreement, not all of us, that the FCC needs to look at the biological effects. We have been trying to reach out to the FCC and FDA with no luck on this. With that said, it's hard for us as a state government to change the FCC's mind on anything. But that does not mean that we shouldn't focus on certain guidance for our cities and towns on the actions that they can legally take to help mitigate any potential harm. I think that's where we need to spend the next four months on looking at what is reasonable guidance that we can give. What really highlights this for me is that about a month ago: Deb Hodgdon, who takes our minutes and me, who are both from the same town were asked by our Planner to attend a zoom kind of meeting with our Planning Board. All the meeting was really was to give the Planning Board an update on what's coming down the pike on 5G. The two takeaways I got from that meeting are that most planning boards have no idea what 5G is and they have no idea of any of the issues surrounding it. I thought we were just going to be observers in the meeting but they asked me to give an update on 5G. They were very interested in what we had to say. The other takeaway is that they are very interested in what we come up with as a Commission for guidance. They are looking for some guidance as a town. We know that there is pushback in other towns and other towns are doing things. I think we need to formulate what is reasonable and what can help with this issue.

Denise Ricciardi who is on our Commission, is on the Board Leadership in the town of Bedford. They have recently adopted ordinances that Denise was instrumental in drafting. We don't have time today to talk about those. I have done research on what other towns around the country have done and there are a variety of actions being taken. Whether they hold up to a legal standard is another discussion. But towns and communities are trying to at least put some parameters around 5G. We should be looking at those examples and working our way through to what we think is reasonable.

Now, understand as I have said over and over again, as a Commission in New Hampshire, we are going to have differences of opinion among us as Commissioners. The way this is handled from the House is that there can be a Majority Report and there can be a Minority Report. That's the way we handle these things. We only have four months. Denise and I chatted earlier about, is there any way we can get an extension? There really aren't many commissions that have reactivated since the shutdown. I will ask leadership in the House whether we can get an extension. The problem we have is that it crosses over into a whole new Legislature and we may be able to do something next year to continue our work. But I think we have to assume our goal is still to have a report out by November 1st. If we think we still need more time, we could see if we could get legislation passed but that will have to be the beginning of next year.

Because there are a lot of us, what I would like to do is to form a subcommittee to start putting some meat around the bone of ideas. Then present that to the full Commission for discussion. I think that is probably the more efficient way of proceeding. I will be looking for volunteers of those willing to work on that subcommittee. If you volunteer to be on the subcommittee, we will probably have to meet once a week for an hour or two and I don't want to wait any longer than a month for the next Commission

meeting. Because we lost 4.5 months, I can't see any other way to do this efficiently with the time we have left. If everybody wants to be on it and is willing to work every week on it, that's one thing but I don't want to have to ask everyone to do that. Tom?

Sherman: I think it's a great idea, Pat. I unfortunately, cannot be on it because I am chairing a subcommittee for the drinking water/groundwater Commission. It's a great way to get this done as long as it's representative and as long as all of us have ample time for feedback and input. Getting something down as a framework for a report and allowing feedback and discussion as a full group is a great way to do this.

Abrami: Well, the way I have done it in the past is there will be a lot of introductory stuff and all that but there will be sections of the report. I am really looking at the recommendations section that we really need to focus on. I don't want to put people on the spot here. I will just ask you to drop me a note if you want to be on the subcommittee. Denise already volunteered and I think Kent may want to be involved. Any others that want to help, that would be great. If I don't think we have enough, I may be reaching out to you and asking again if that's ok.

III. Next Commission Meeting:

Everybody pull out your calendars. Let's talk about the Next Commission meeting now. How about the 27th?

Sherman: Patrick, I work on Mondays. We usually meet on Fridays.

Abrami: Can everybody do Friday, the 24th? I think we are good for our next Commission meeting to be on Friday July 24th at 9 am via Zoom.

Ricciardi: Mr. Chairman, could I just bring something up for the record? All things being fair and equal, our information is important. As you know, I wrote explicit questions with your permission to the FDA and the FCC and still waiting for a response. At some point if we don't hear back, those are invaluable to making these very important decisions that I think those questions should be put in the record.

Abrami: Ok. Without objection, does everyone agree we should put those questions asked of the FCC and the FDA into the minutes of this meeting? Does anybody object to that? Ok so with that, we will put the record of those questions asked of the FCC and FDA into this meetings minutes.

Ricciardi: thank you.

Abrami: I will share with you those questions after this meeting. By the way, we have been having a problem getting things out the way we should. Because of the virus, the staff has not been as accessible as they should to distribute things or post on our webpage. I am trying to be in catchup mode on the things I thought were sent out but haven't been. So I am working on that. I apologize for that.

With that said, most of our meetings we have had, we have tried to get our arms around the science. We have a group that understands the science to a good degree. Dr. Kelting has put together a

presentation with 13 objections. When I looked at it, objections 7-11 are really at the heart of what we want to talk about more. He can start a little earlier and go a little longer if need be because there is a lot of material here. Dr. Kelting has been looking at this issue for many years and has published on this issue and we welcome him. After his sections, we will pause for questions.

IV. Herman Kelting, PhD presentation *(For more details, please refer to presentation materials)*

“I am grateful that you have invited me to testify on the safety of 5G/4G Small Cell Antennas placed in residential and commercial areas which I. I object to 5G/4G SCAs based upon adverse health results. In my testimony I will discuss the attributes of 5G/4G SCAs and 13 objections related there to; time will permit me to discuss only a few research citations. Since 5G is new and has only limited historical application even in 5G/4G SCAs, and 4G and prior generations well established, my research evidence will emphasize the link between 4G and prior generations RFFR with injury to living organisms. I will also discuss 4G emissions in the context of cell phone, Wi-Fi, macro cell phone base stations, etc. because 5G/4G SCAs add to already high levels of 4G emissions from many other sources. As a general rule, I oppose air-borne, wireless emissions.”

Attributes of 5G/4G that I will use in my objections to 5G/4G.

- A. Two sets of antennas in a “5G/4G SCA”: One beam forming on-demand 5G antenna and three 4G antennas, the latter pulsating 24/7 RFFR sited at about every 100 meters in residential neighborhoods. Movement of 5G source (e.g., cell phone) transfers signal to 4G antenna. Hence, I have concluded that the purpose of 5G is not to get 5G into residential neighborhoods but to bring 4G into neighborhoods to satisfy increased demand and revenue. *SCA wireless emissions may be avoided by **hard wiring from street to homes.***
- B. 4G signals are being increasingly modulated, thereby more biologically active, and potentially more harmful to living organisms. [Oram Miller]
 - 1. Marginal harms to fetuses and young children are very severe from 4G/5G and all other wireless communications with thin skulls, over adults who are also harmed.
 - 2. All RFFR is a stimulant causing anxiety, depression, stress, and many other illnesses. Its radiation places a forced on charged particle on our bodies, namely electrons.
 - 3. **Remember this: All manufacturing processes fail in the sense they operate outside the engineering design:** 5G/4G antennas may mal-function to create very high-power densities and frequencies injuring those nearby, who will not know the extent of the damage because they do not have meters. Even if one can prove harm with a meter, damages are limited to the company’s equity because insurance companies do not insure injury from RFFR.
- C. Power densities of SCAs have not been publicly disclosed. Oram Miller indicates power densities from 5G/4G SCAs may be up to several hundred thousand $\mu\text{W}/\text{m}^2$.

Objection #1: 28 Illnesses/ 20 Symptoms known to be caused by or inferentially linked to RFFR.

[Letter from Herman Kelting to the secretaries of Health and Human Services and Homeland Security; original letter dated October 3, 2019; Revision 1 dated January 8, 2019; Exhibit C Herman Kelting. "United States Congressional Research and Legislative Proposals to Educate the American People About the Power Density Safety of Wireless Communications (uW/m²)."
Indian Journal of Applied Research 8(1) (January 2018): p. 263-271 (hereinafter "IJAR Jan 2018").

- A. There are twenty-eight (28) illnesses known to be caused by RFFR. These include increased risk of brain damage to fetuses, miscarriages, cancer. children's behavioral difficulties, ADHD, cancer of the brain, salivary gland, and breasts; leukemia, anxiety, depression, stress, sleep disturbances, reduction in melatonin, cataracts, inflammation; damage to the testes, sperm, blood brain barrier, DNA (damage through strand breaks), eyes, heart, thyroid hormones, electromagnetic hypersensitivity (EMH), damage to the autoimmune system,¹ etc. [IJAR Jan 2018, p. 264-265] If a woman places her cellphone in her bra for five years, there is about a 1.0 chance of developing breast cancer.
- B. There are also twenty (20) symptoms reported by those living near 4G MCPBS (three 4G antennas housed within 5G/4G SCAs) and earlier generations. These include sleep disturbances, headache, depression, fatigue, dysesthesia (pain, itchy, burning from nerve damage associated with neurological injury), concentration dysfunction, memory changes, dizziness, irritability, anxiety, nausea, EEG changes, paranoid states, adverse neurobehavioral symptoms, etc. [IJAR Jan 2018, p. 264]
- C. Nine Determinants of Injury from Wireless Devices: This is a compilation that I have done on the subject.
 1. Distance from the RFFR-emitting device to a body organ. Since emissions from a device spread out with distance, the closer a body organ is to the emitting device, the greater the percentage of emissions hitting the body—if a cell phone is placed at the ear vs. using speaker phone many inches away, a much higher percentage of total emission hit the brain, salivary gland, and other nearby organs. The brain is obviously the most vulnerable to injury. Storage of a cell phone in the bra for five years has an approximate 100% chance of resulting in breast cancer. 500 meters minimum distance from MCPBS to humans and should be 1,000 meters for a two safety multiple.
 2. Frequency modulation: RFFR signals (e.g., cell phones) utilize a high-frequency carrier wave that is transmitted over long distanced with an attached modulated, lower frequency that carries information. The modulation may utilize frequency or amplitude modulation. Signal modulation is an extraordinarily complex technical process that may cause injury to living organisms.
 3. Peak (not average) power density of pulsed radiation transmitted to the body. Power density is the far field (after joining of source magnetic and electric fields) measure of RFFR strength measured by $\mu\text{W}/\text{m}^2$ (micro watts per square meter). RFFR professionals have concluded that it is pulsating peak power densities that create the most harm to

living organisms; RFFR meters have options to measure instantaneous, maximum (peak), and average maximum (peak) RFFR.

Peak densities vary widely based upon the nature of the RFFR-emitting device and signal strength. I measured the far field of one cell phone at boot up of $500,000 \mu\text{W}/\text{m}^2$, which can exceed $20,000 \mu\text{W}/\text{m}^2$ in normal operation depending upon signal strength and other factors.

4. Spatial RFFR density from multiple sources. The spatial RFFR density is a measure of pulsating radiation density from multiple pulsed RFFR devices such as cell phones, Wi-Fi, cordless phones, wireless security systems, etc. in an enclosed space. It is distinguishable from the metered power density *per se* because it is a function of the number of RFFR emitters in an enclosure (e.g., Wi-Fi plus 25 cell phones in a classroom)
5. Meters understate harm from multiple nearby RFFR emitters. As the number of emitting sources in an enclosure increases, the spatial density increases, but the power density may increase little because of the random combinations of peak instantaneous power densities from individual sources. To the best of my knowledge no one else has discussed understatement of power densities from multiple nearby RFFR emitters.
6. RFFR source enclosed in material space- vs. outdoors-sourced RFFR. RFFR sourced within an enclosure (autos, busses, aircraft, trains, elevators, drywall enclosures; metal is the worst enclosure) reflects off the confining material surfaces making equal RFFRs more harmful indoors than outdoors.
7. Age at first exposure to RFFR. Fetuses have thin, incomplete skulls with six separated bones and RFFR will make direct, almost unimpeded contact with their brain through the six thinner skull bones and cranial sutures between bones, which continue to age two. Thereafter, children have thinner skulls for several years, and continue to receive more RFFR than adults. The most dangerous situation is exposing a fetus or small child to RFFR in a metal enclosure such as a car or crawling around a Wi-Fi-sourced RFFR.

“Children whose mothers used cell phones during pregnancy had 25% more emotional problems, 35% more hyperactivity, 49% more conduct problems, and 34% more peer problems.” [BioInitiative 2012, Section 1 “Summary for the Public 2014 Supplement, Evidence for Fetal and Neonatal Effects,” citing Divan et. al. 2008]

8. Cumulative life-time exposure to RFFR. It is not age linear because younger people suffer more than older people because of brain structure and skull structure.
9. Unique cellular and organ attributes and receptivity to RFFR. Each person has different cellular and organ compositions and, thereby, different receptivity to RFFR contamination.

Objection #2: Evidence of mental illnesses of college and high school students.

- A. 25% of college students and 20% of high school students (2018) are claiming mental disabilities caused by anxiety, stress, and depression to take longer course and SAT testing times and private testing rooms because they cannot tolerate the presence of others. [IJAR Jan 2018, Exhibit G: Douglas Belkin. "Colleges Give the Disabled More Leeway." *Wall Street Journal* 05.25.2018, A3; Exhibit H: Douglas Belkin and Tawnell Hobbs. "More K-12 Students Get Special Help." *Wall Street Journal*. 07.05.2018, A4.] It is known that anxiety, stress, and depression are caused by RFFR and from this knowledge I deduced my inference that these mental disabilities are caused by cell phones and other RFFR emitting sources.
- B. College student depression rates increased from 30.9% in Fall 2013 to 39.3% in Fall 2017 ("Felt so depressed that it was difficult to function.") [IJAR Jan 2018. Exhibit E: *National College Health Assessment Survey*, p. 14]. It is known that RFFR causes depression.

Objection #3: Increases in suicides of young people

- A. Actual suicides for 10 to 14-year age group declined from 242 in 1999 to 180 in 2007 and increased to 517 in 2017 = **11.1% Geometric mean (GM) increase** for ten years ending in 2017. [IJAR Jan 2018, Exhibit F]
- B. Actual suicides for 15-24-year age group declined from 4316 in 2004 to 4140 in 2007 and then increased to 6252 in 2017 = **4.2% GM annual increase** for ten years ending in 2017. [IJAR Jan 2018, Exhibit F]
- C. College students who "Seriously considered suicide" increased from 6.0% in Fall 2010 to 12.1% in Fall 2017 [IJAR Jan 2018. Exhibit E: *National College Health Assessment 2017*, p.14; IJAR Jan 2018, p. 266;] "Seriously considered suicides" doubled in 7 years: **10.5% GM annual increase in "Seriously considered suicides"**.
- D. Notice the similarity in IRR growth rates of 11.1% GM actual suicides for 10-14-year age group and 10.5% GM for college students "Seriously considered suicide."
- E. In my opinion, there is a near 100% chance the increase in actual and contemplation of suicides are caused by RFFR from cell phones, Wi-Fi, MCPBS, and are additional measures of a catastrophic health crisis NOW.
- F. One medical doctor told me this: "Doctors know that cell phones cause suicide."
- G. **In my opinion, there is a catastrophic health crisis NOW that is being concealed.**
 - 1. Reported anxiety, depression, stress, and suicides to Secretaries of Health and Human Services and Homeland Security in original letter dated October 3, 2018.
 - 2. Secretary referred my charge to National Institute of Health immediately.
 - 3. NIH rejected three days later and stated "no notice to sender."
 - 4. HK reported NIH rejection of catastrophic health crisis to federal law enforcement agency as an improper rejection of a catastrophic health crisis.
- H. On May 27, 2020, HK accessed the CDC website for precise reference for the suicide data in Exhibit F and was unable to find it after a 45-minute search. Then called CDC and telephone responder looked for 45 minutes and could not find it. The WSJ has had a number of articles on suicides and it appears to me that the historical suicide data for 1999 to 2016 has been removed from the CDC website.

I made a number of predictions in my published article. I am just going to the last one. Some of the others have already come true of course. The last one is that working lives will decline from the mid- sixties to the mid- fifties as people have more exposure to cell phones and radio frequencies. If that occurs, that is going to pretty much be a terrible situation in an economic sense for the United States because of the additional time for retirement payments plus the loss of the skills.

Objection #4: Species extinction from 5G/4G SCAs/RFFR [Letter from Herman Kelting to Mayor Katrina Foley, Costa Mesa, CA. dated January 24, 2020 opposing 5G; HK presentation to Costa Mesa City Council February 18, 2020]

- A. Barry Trower: Physicist and well-known UK 5G weapons expert, who was associated with 5G weapon systems used to injure Catholics in Northern Ireland stated:
1. Installation of 5G/4G SCAs will result in only one child in eight births being born normal three generations (60 years) from date of 5G/4G SCAs installation.
 2. He also indicated that the RFFR injures 4,500 electrical subsystems in the human body by placing a force on charged particles.
- B. Evidence of species extinction in five generations or less is supported by the following scientific studies and other evidence: (ten supporting references follow but I will only refer to a few because of time.)

1. A Greek study of the reproduction of rodent births exposed to RFFR resulted in "...mice exposed to 0.168 nW/cm² (1,680 μW/m²) became sterile after **five** generations, while those exposed to 1.053 nW/cm² (10,530 μW/m²) became sterile after only **three** generations." [A Balmori, 194] "A progressive decrease in the number of newborns per dam was observed, which ended in irreversible infertility" [Magras IN, Xenos, TD. "Radiation Induced Changes in the Prenatal Development of Mice." *Bioelectromagnetics* 18 (6) (1997): Abstract, 455-461 cited in A Balmori. "Electromagnetic Pollution from Phone Masts." *Effects on Wildlife.* *Pathophysiology* 16 (2009): 191-199, 194] (Foley 01.24.2020)
2. Study of 361 men in fertility clinic had reduced sperm count, motility, (moving property through the female reproductive tract), viability, and normal morphology (size and shape of sperm under microscope, >14% normal) as daily cell phone usage increased from zero, < 2 hours/day, 2-4 hours daily, and to >4 hours daily usage [IJAR Jan 2018, Ref 47, Agarwal, 2008]. When you follow these decreases through multiple generations you have the end of species. That is a 55% decline with an increase in cell phone use from 0-4 hours/day.

CP Group	Sperm Usage	Count	Motility	Viability	WHO Morphology
		% Normal			
A	No use	85.89	67.80	71.77	40.32
B	< 2 H/D	69.03	64.57	68.21	31.24
C	2-4 H/D	58.87	54.72	57.95	21.36
D	> 4 H/D	50.30	44.81	47.61	18.40

3. Experiment showed that the reproductive capacity of the insect *Drosophila Melanogaster* declined 36.4% (1 min), 42.5% (6 min), 49.2% (11 min), 56.1% (16 min), and 63.0% (21 minutes) exposure to a GSM 900 MHz carrier frequency and 217 Hz information frequency with exposure at a power density of 100,000 $\mu\text{W}/\text{m}^2$ (10 $\mu\text{W}/\text{cm}^2$). Again, this power density of 100,000 $\mu\text{W}/\text{m}^2$ is far less than the 6,000,000 to 10,000,000 $\mu\text{W}/\text{m}^2$ FCC MPE safe limits. This experiment showed the important relationship between time of exposure to RFFR and injury to a living organism. [Panagipoulos DJ et.al. "The Effect of Exposure Duration on the Biological Activity of Mobile Telephony Radiation." *Mutation Research* 699 (2010): 17:22.²
4. Cell phones operating at 900 MHz were placed in three colonies of honeybees and turned on for 10 minutes for ten days. After ten days the worker bees never returned to the three test hives because the cell phones were "...frying the navigational skills of honey bees and preventing them from returning back to their hives." Production of eggs by the queens was reduced from 350 to 100 eggs/day. The authors concluded that cell phone RFFR is a better explanation of Colony Collapse Disorder than any other theory. [Sainudeen Sahib S. "Impact of mobile phones on the density of honeybees." *Journal of Public Administration and Policy Research* 3(4) (Apr 2011): 131-133.] (Sisolac 08.29.2019, 13-14)

There are others listed in my presentation but I think this is adequate for proof.

- C. Doctors and scientists opposing 5G/4G SCAs (*There are others, but here is one*)

Baden Wurttemberg, Germany October 23, 2019

Seventy (70) doctors in Baden Wurttemberg signed and 25 doctors in white coats delivered the letter, "Doctors Warn Against 5G Mobile Communications" to the prime minister on October 23, 2019 asking for a moratorium on 5G small cell antennas because of harm to living organisms. They expressed particular concern with "electro hypersensitivity (EHS)" which now affects 5-10 percent of their population. One doctor-signatory in Baden Wurttemberg stated **"To protect the population, we need Wi-Fi free schools and a 5G moratorium!"** *In my opinion, we also need control over macro cell base stations.*

- D. Many communities have stopped 5G or will not be producing it.

Haifa, Israel banned Wi-Fi in schools April 20, 2016

On April 20, 2016, Haifa, Israel banned Wi-Fi in schools because of the increase in EHS/EMH and because many children were contemplating suicide. It is known that Jenny Fry, a UK teenager, committed suicide because of Wi-Fi in her school.

E. HK request for medical school research from a friend at (Stanford University) dated May 18, 2020 9:50 AM

Does RFFR make Covid-19 more virulent? Asked for Covid-19 (1) free of and (2) attached to host cells to be placed under an electron microscope with a variable frequency/variable power density RFFR to determine if the virus is more active under RFFR bombardment similar to neurons being more active in an RFFR field What gave me this idea is that we know that six CA firemen receiving brain and neurological injury from macro cell base station on the roofs of their fire stations resulting in permanent excitement of brain neurons. (high was outputting between 10-20,000 $\mu\text{W}/\text{m}^2$)

Abrami: Herman, can we pause right here and see if there are any questions at this point. I think what Herman is doing is adding to the list of papers and things that we have already heard about and discussed in the past. He is highlighting some of the papers that are of interest to him. Any questions or comments?

Chamberlin: I just have a question and it involves the bee study. We heard about the bee study and saw the paper on it. This is of course, very convincing. If you put a cellphone in a beehive and it's going to destroy the navigation abilities of the bees now that would be convincing. We are looking for strong evidence. It kind of surprises me that this is a fairly simple study to do. Do you know if it's been replicated?

Kelting: To the best of my knowledge, yes. In other words, there are other studies that have also shown damage to bees with the application of radio frequency. What I have done in my work is pick the best study available and I do not do exhaustive searches with additional support.

Chamberlin: Alright. Thank you.

Wells: I have a question as well. On objection 1, you list illnesses known to be caused by or linked to radio frequencies and I am wondering, could these antennas be used or hacked to cause deliberate injury in your opinion?

Kelting; yes, certainly. Remember, 5G is a beam form signal and that means when you turn on your cell phone, there is a beam that envelopes your body about ten degrees wide and if they combine that with facial recognition, they can do anything that they wish. They can change the power of the beam because that's what they did to the Catholics in Northern Ireland. It's not exactly the same because they can use higher frequencies but they can beam form and take out people with facial recognition in the antenna system.

Abrami: We know in China, they are using facial recognition with their 5G. There are plenty of reports showing that. Is that what you are hearing Herman?

Kelting: That sounds sensible but I am not totally familiar.

Abrami: Let's continue.

Objection #5: Injury specifically from 5G

- A. "Preliminary observations showed that MMM [millimeter waves > 30 GHz] increase the skin temperature, alter gene expression, promote cellular proliferation and synthesis of proteins linked with oxidative stress, inflammatory and metabolic processes, could generate ocular damages, affect neuro-muscular dynamics...available findings seem sufficient to demonstrate the existence of biomedical effects..." [Di Caula A. "Towards 5G Communication Systems: Are There Health Implications?" *International Journal of Hygiene and Environmental Health* 221(3) (Apr 22, 2018): 367-375
- B. 5G transmits data in a very short time period, but there are indications that "...these bursts may lead to short temperature spikes in the skin of exposed people." Research has also shown that peak to average temperature ratios "...may lead to permanent tissue damage after even short exposures highlighting the importance of revisiting existing exposure guidelines." This means that current heat standards are too high and should be lowered. [Neufeld E and N Kuster. "Systematic Derivation of Safety Limits for Timer-Varying 5G Radio frequency Exposure Based on Analytical Models and Thermal Dose." *Health Physics* Sept 21, 2018.] [Letter from Herman Kelting to Nevada Governor Steve Sisolac, Nevada Senator Nicole Cannizzaro, and Nevada Assemblywoman Shay Backus dated August 29, 2019 (Revision 02), 11-12].
- C. 5G operates at the same frequencies (e.g. greater than 24 GHz) as the sweat duct, which is a helical antenna operating at a high specific absorption rate in extremely high frequency bands. This suggests 5G will heat the skin, one of the adverse consequences of 5G.
- D. In an e-mail dated May 27, 2020 2:05 PM , Professor Joel Moskowitz stated "**My note:** This review summarizes research on the effects of millimeter waves (>30 GHz) on the skin. None of these studies has examined 5G millimeter waves. 5G employs specialized technology including phased arrays, beam-forming, and massive MIMO (sending multiple data signals simultaneously over the same radio channel). 5G millimeter waves may be more biologically active and result in more adverse health effects than the earlier millimeter wave studies found."

Objection #6: Injury from secondary, endogenous RFFR: Sommerfeld and Brillouin precursors

- 1. Sommerfeld and Brillouin precursors are induced, propagating transient RFFRs generated endogenously in the human body (or other mediums) from an exogenous source RFFR with a changed sinusoidal structure (about 6 times smaller amplitude) that displaces charged particles in human tissue, thus damaging those particles. (A117). This means that Sommerfeld and Brillouin Precursors are RFFR that propagate endogenously within the body from a source exogenous to the body without attenuation and travel faster than the source pulse. They induce movement of proteins, DNA, and ions of potassium, sodium, chloride, calcium, and magnesium. (A117) These movements damage cells and organs [Albanese,R, Blaschak, J, Medina, R, Penn, J. "Ultrashort Electromagnetic Signals: Biophysical Questions,

Safety issues, and Medical Opportunities.” *Aviation, Space, and Environmental Medicine*. May 1994: A116-A120 (“Albanese May 1994”.; see also OMB No. 0704-0188 94-24875 AD-A282 990 dated Jan 90-Aug 93; Jakobsen PK and Masud Mansuripur. “On the Nature of the Sommerfeld-Brillouin Forerunners (or Precursors.” *Quantum Studies: Mathematics and Foundations* (November 8, 2019)] Thus, 5G beams immerse the body in a 10-degree RFFR, enter the skin and breed new, induced RFFR that travel faster than the original pulse with the radiation of the propagated RFFR damaging cells deep in the body just as 4G RFFR does.

2. Regarding the failure of FCC safety limits to consider Sommerfeld and Brillouin Precursors, Albanese stated “However, IEEE C95.1, 1991 was developed from biomedical data on pulses whose onset and offset times (or rise and fall times) were much slower than those shown in Fig 2; the standard does not embody the precursors phenomenon. Thus, in practical term, the sharp ultrafast category of pulses being discussed are not covered by IEEE C95.1-1991 or by any other formal guideline known to us...**Until the issue of tissue damage mechanisms associated to pulses that cause precursors is fully studied, the authors recommend zero human exposure to such unique precursor and gendering pulses.**” [Albanese May 1994, A118]

Objection #7: FCC antenna safety standards applied to MCPBS ignore radiation injury to living organisms at power densities many times lower than the FCC antenna safety standards.

- A. FCC antenna safety standards: 6,000,000 to 10,000,000 $\mu\text{W}/\text{m}^2$ based upon frequency.
 1. These FCC safety limits ignore actual injury from radiation at much lower limits than 6,000,000 to 10,000,000 $\mu\text{W}/\text{m}^2$. Six CA firemen received brain and neurological injury from MCPBS on the roofs of their fire stations emitting 10,000 to 20,000 $\mu\text{W}/\text{m}^2$. [Letter to two secretaries Revision 01 dated 01.08.2019, Exhibit N]

Rep. Abrami, have you heard of this California study before?

Abrami: yes

- B. International antenna safety standards:

Compare the safety of FCC safe limits of 6,000,000 to 10,000,000 $\mu\text{W}/\text{m}^2$ with other countries antennae safety limits. The wide range in country antenna safety limits means **no country really knows antenna safety limits and that the US, with the highest antenna safety limits is clearly in conflict with all other countries in this list.** [Remke, Amar and Mahesh Chavan. “A Review on RF Exposure from Cellular Base Stations.” *International Journal of Computer Applications*. 104(12) (Oct 2014): 9-16]

Power density

%US

Country or other geographical area	W/m ²	μW/m ²	
USA public exposure guidelines at 1800 MHz	10	10,000,000	100%
India	9.2	9,200,000	92%
Canada (see Attachment)	3.0	3,000,000	30%
Australia	2	2,000,000	20%
Belgium	1.2	1,200,000	12%
New Zealand	0.5	500,000	5%
Exposure limit in CSSR, Belgium, Luxemburg	0.21	210,000	2.1%
Exposure limit in Poland, China, Italy, Paris	0.1	100,000	1.0%
Exposure limit in Italy in areas with duration hour	0.095	95,000	0.95%
Exposure limit in Switzerland	0.095	95,000	0.95%
Germany: Precautionary recommendation only	0.09	90,000	0.90%
Italy: Sensitive areas only	0.025	25,000	0.25%
Exposure limit in Russia, Bulgaria, Hungary	0.02	20,000	0.20%
Austria: Precautionary limit in Salsbury only	0.001	1,000	0.01%
Germany BUND 199	0.0009	900	0.009%
New South Wales, Australia	0.00001	10	0.0001%

(1) Building Biology Institute RFFR anomaly standards for up to for sleeping:
 They consider 1,000) μW/m² as an extreme anomaly. They suggest for sleeping purposes that you have considerably less than 1,000) μW/m².
 For example, I have shielding paint on two bedroom walls of my home which brings me down to near zero.

	None	Slight	Severe	Extreme
a. Radio frequency field radiation (High freq., EM waves) μW/m ²	<0.1	0.1 – 10	10-1000	>1000

C. RFFR power density meter readings from emissions of a MCPBS (MCPBS) taken 06.09.2020 by HK. MCPBS located 150 feet from about 100 two-story apartments with more apartments adjacent and to the east of the front 100 apartments. Meter readings taken about 100 feet from the MCPBS and 50 feet from apartments. Meter used: Safe Living Technology Safe and Sound Pro II. (Herman’s research)

1. Power density meter readings in $\mu\text{W}/\text{m}^2$:

108,000	97,300	224,000	159,000
212,000	97,300	147,000	135,000
97,300	311,000	162,000	145,000
135,000	580,000	175,000	200,000
147,000	208,000	224,000	

2. Descriptive statistics

Average	196,663 $\mu\text{W}/\text{m}^2$ Rounded 197,000 $\mu\text{W}/\text{m}^2$
Stdev	109,569 $\mu\text{W}/\text{m}^2$
Coefficient of variation	0.56

3. How would you like to live 150 feet from a MCPBS emitting an average power density of 197,000 $\mu\text{W}/\text{m}^2$ when 6 CA firemen received brain and neurological injury from MCPBS on the roofs of their fire stations emitting 10,000 to 20,000 $\mu\text{W}/\text{m}^2$.

If you look at these statistics with the bolded very high values and recall that the firemen were injured at between 10-20,000. These poor people in 100 apartments are living within 50 feet of this power density.

Abrami: so Herman, this is interesting. I know a lot of people look at the readings based upon an average. What is your feeling on an average v. what the peak would be?

Kelting: Perhaps, I was not clear on that. These are all peak readings. What I do is turn on my meter and clear it and for 15-20 secs it registers peak, hold and gets the highest peak and that's what I record on here. These are not averages. Averages are much lower. Probably less than 10%. Peaks injure.

Sherman: Could I ask a question? So is it how long you are exposed to peak, is the duration of exposure as important as the intensity?

Kelting: It's a combination of both. Remember now, you are talking about a macro cell phone base station pulsating RFs, the peaks of which are within a 20-30 second interval are as I recorded here. This goes on 24x7. Theoretically if you came back one hour later or two days later, you are going to get about the same distribution and the same averages..

Chamberlin: My question involves the bandwidth. Of course, the wider the bandwidth, the greater the peak you will see because you will be looking at a superposition of a greater number of frequencies. Do you happen to know the bandwidth?

Kelting: no. I do not. I only measure radio frequencies and that could probably be one of the inadequacies of my work. But you have alerted me to that and I have a meter that measures frequencies so perhaps in the future I can consider that.

Abrami: But here's the thing. These are still within the FCC standards. Correct? The question on the table is, is the FCC standard set too high?

Kelting: That's correct.

Kelting: On January 14, 2020 I wrote a letter to the Clark County Board of Commissioners on two sets of macro towers and cell phone base stations. One was emitting up to 218,000 micro watts per square meter about 100 yards from the two facilities which was about 100 feet from homes and the second was power densities on a building with two antenna on top which were concealed incidentally. They were emitting in the building up to 37,100 $\mu\text{W}/\text{m}^2$. That building is a Community Center.

D. Studies of harm from 4G MCPBS at power densities small fractions of FCC MPE limits,

1. In a study of 1000 individuals living for ten years within less than 400 meters from a GSM cellular transmitter site in Germany, it was found that the likelihood of getting cancer was three times greater than for those not near a cellular transmitter and that the patients fell ill an average 8 years earlier. Radiation in the inner area was 100 times the radiation in the outer area. The authors concluded it was necessary to monitor the health of individuals living near high radio frequency emissions from cellular base stations. [Eger, Horst, Klaus Uwe Hagen, et. al. "The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer." *Umwelt-Medizin-Gesellschaft* 17(4) (2004): 7 pages]. (Sisolac 08.29.2019, 12-13)
2. An apartment building with two cell phone base stations on the roof had a mean power density of 3,811 $\mu\text{W}/\text{m}^2$ with a power density range of 15.2 $\mu\text{W}/\text{m}^2$ to 112,318 $\mu\text{W}/\text{m}^2$. The mean radiation was reduced by 98% when the power density from the two cell phone base stations was disregarded. The authors concluded:

"Due to the current high RF radiation, the apartment is not suitable for long-term living, particularly for children who may be more sensitive than adults...the simplest and safest solution would be to turn them off and dismantle them."

[Hardell, Lennart, Michael Carlberg, et.al. "Radio Frequency Radiation from Nearby Base Stations Gives High Levels in an Apartment in Stockholm, Sweden: A Case Report." *Oncology Letters* 15(5) (May 2018): Pages 1-29]. (Sisolac 08.29.2019, 12-13)

3. In Belo Horizonte, Brazil, it was found that deaths from neoplasia (i.e., abnormal growth of tissue; cancer) increased with close proximity to cell phone base stations. For those living within 100 meters of a CPBS, the death rate was a relative risk of 1.35, for 500 meters 1.08, and for 1000 meters 1.00. The death rate from neoplasia varied from 5.83 per 1000 individuals to 2.05 per 1000 individuals. Cell phone base stations were concentrated in the Central Southern region and varied from 8,980 uW/m^2 (0.898 $\mu\text{W}/\text{cm}^2$) to 30,660 $\mu\text{W}/\text{m}^2$ (3.066 uW/cm^2) in 2003. Brazilian power density standards were 4,513,400 $\mu\text{W}/\text{m}^2$ (451.34 $\mu\text{W}/\text{cm}^2$) at 900 MHz and 9,024,900 $\mu\text{W}/\text{m}^2$ (902.49 $\mu\text{W}/\text{cm}^2$) at 1800 MHz.

Notably, the death rate from neoplasia in Belo Horizonte occurred at power densities much lower than the US standard of between 6,000,000-10,000,000 $\mu\text{W}/\text{m}^2$. [Dode, AC, Et.al. "Mortality by neoplasia and cellular telephone base stations in the Belo Horizonte municipality, Minas Gerais state, Brazil" *Science of the Total Environment* 409 (2011): 3649-3665].

4. In a study of tree damage in Germany, it was discovered that cell phone base stations damaged the sides of 60 trees facing the MCPBS. The median power density from the MCPBS on the damaged side was 995 $\mu\text{W}/\text{m}^2$ and on the undamaged side was 125 $\mu\text{W}/\text{m}^2$ using peak and peak hold values. A power density of 995 $\mu\text{W}/\text{m}^2$ is obviously far less than the FCC safe threshold of 6,000,000 to 10,000,000 $\mu\text{W}/\text{m}^2$. It is also a little less than the Building Biology recommendations of less than 1,000. The authors quote from M. Repacholi, head of the International EMF Project of the WHO (p. 567), who said in part: [Waldmann-Selsam C, et.al. "Radiofrequency Radiation Injures Trees Around Mobile Phone Base Stations" *Science of the Total Environment*. 572 (2016): 554-569.]

"Given that any adverse impact on the environment will ultimately affect human life, it is difficult to understand why more work has not been done...research should focus on the long-term, low level EMF exposure for which almost no information is available"

5. In an Israel study of cancer rates near a cell phone base station, it was discovered that 3-7 years' exposure times had cancer rates 4.15 times the cancer rate in the entire population and that the cancer rate for women was 10.5 vs. 1.0 for the whole town of Netanya. The power densities were "far below" current guidelines of 5,300 uW/m^2 ($0.53 \text{ uW}/\text{cm}^2$) for thermal effects. [Wolf, et. al. "Increased Incidence of Cancer Near a Cell Phone Transmitter Station." *International Journal of Cancer Prevention*. 1(2) (April 2004).]
6. In a Greek study of the reproduction of rodent births in response to a microwave power density of 1,680 $\mu\text{W}/\text{m}^2$ ($0.168 \mu\text{W}/\text{cm}^2$) it was found that the rodents became sterile after five generations and those exposed to 10,530 $\mu\text{W}/\text{m}^2$ ($1,053 \mu\text{W}/\text{cm}^2$) became sterile after three generations. Note that these damaging-to-living-organisms' power densities are considerably less than the FCC safe limit of 6,000,000-10,000,000 $\mu\text{W}/\text{m}^2$. [Magras IN. "Radiation induced changes in the Prenatal Development of Mice." *Bio electromagnetics* 18 (1997): 455-461 cited in A Balmori. "Electromagnetic Pollution from Phone Masts. Effects on Wildlife." *Pathophysiology* 16 (2009): 191-199.,]

Objection #8: FCC antenna safety standards disregard power densities emitted by body proximate devices (i.e., personal property).

- A. There is only a heat standard for body proximate RFFR emitting devices and it has been shown many times there is radiation injury even though the heat standard is met.
- B. In a letter dated February 7, 2014, the Office of the Secretary of the Interior, stated:
“The electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today.”

Objection #9: RFFR meters understate power densities from multiple nearby RFFR emitters.

This means that when you meter an area with two or more emitters, the peak power densities will not measure appropriately the addition of the second to the first and here is why.

Assume two single 4G MCPBS emitting antennas each emitting peak power densities of $10,000 \mu\text{W}/\text{m}^2$ with a combined theoretical peak of $20,000 \mu\text{W}/\text{m}^2$.

When you meter, you should probably get at some point a peak of $20,000 \mu\text{W}/\text{m}^2$. You will not get that because antennas will be emitting **unsynchronized** peaks and lows. The probability of measuring two MAX peaks of $10,000 \mu\text{W}/\text{m}^2$ each for a combined total power density of $20,000 \mu\text{W}/\text{m}^2$ is zero. Thus, if we have a metered instantaneous peak of $8,000 \mu\text{W}/\text{m}^2$ for Antenna #1 and a metered instantaneous peak of $4,000 \mu\text{W}/\text{m}^2$ for Antennas #2 for a combined instantaneous peak of $12,000 \mu\text{W}/\text{m}^2$, $12,000 \mu\text{W}/\text{m}^2$ will be the peak for the two combined antennas, which is $12,000/20,000 \mu\text{W}/\text{m}^2 = 60\%$ of the true combined peaks. You will likely never get the true a peak of $20,000 \mu\text{W}/\text{m}^2$.

Abrami: Let's pause there. Does anybody have any questions? None. Ok keep going Herman.

Objection #10: Legal vs. equitable standards to measure safe human exposure limits, US statutes and case law.

- A. Legal Standard is from Telecommunications Act of 1995 Section 704(a)(7)(B)(iv) Public law 104 104th Congress 110 Stat 66:
“No state or local government...may regulate the placement, construction, and modification of personal wireless facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commissions regulations concerning such emissions.” [Telecommunications Act of 1995 Section 704(a)(7)(B)(iv) Public law 104 104th Congress 110 Stat 66].

In my opinion, Telecommunications Act sets a legal statutory, not equitable standard, for safety unrelated to actual known injury. **704(a)(7)(B)(iv) is unconstitutional because it violates equitable safe power densities.**

- B. It is essential that equitable standards of the National Environmental Policy Act not be overridden by federal legislation. I believe there is a bill in Congress that is attempting to override the National Environmental Policy Act (NEPA).

One of the fairly good cases is.

1. In *United Keetoowah Band of Cherokee Indians in Oklahoma, Individually and on behalf of all other Native American Indian Tribes and Tribal Organization et al Petitioners vs Federal Communication Commission et al* No. 18-1129 decided August 9, 2019, the court was faced with the following issues and factual situations and held as indicated:

2. *Principal issue:* Was the FCC order “Acceleration Wireless Broadband Deployment by Removing Barriers to Infrastructure

- (1) “All ‘major Federal actions significantly affecting the quality of the human environment’ trigger environmental review under NEPA...42 USC §4332(C). Major federal actions ‘include actions ...which are potentially subject to Federal; control and responsibility.’ 40 CFR §1508.18. Under the Commissions procedures implementing NEPA, if an action may significantly affect the environment, applicants must conduct a preliminary Environmental Assessment to help the Commission determine whether ‘the proposal will have a significant environmental impact upon the quality of the human environment’ and so perhaps necessitate a more detailed Environmental Impact Statement 47 CFR §1.1308; see also 40 CFR §1.1508.9. [7]

The summary of the legal issues that I have in this section is to emphasize equitable standards not legal standards, which are unconstitutional.

Abrami: Let me pause you there Herman. So you are saying that for Indian reservations, different rules can apply now?

Kelting: No. I am not saying that. First of all, I am not a legal expert on Indian Reservations and outside of them. But what I have just quoted you from was from a federal law that is not specific to Indian Reservations. It was applied to Indian Reservations but is broadly applicable in my opinion, to all other circumstances as well. In other words, the NEPA is broadly applicable to all situations where there is environmental injury. That is why we need to use equitable standards not legal standards.

Abrami: So let's take section a/ The FCC granted licenses for the telecommunication companies to install SCA on Indian lands without any historical preservation or environmental review. So what did they do? What happened in this case?

Kelting: I don't know. I think the case was the DC court of appeals.

Objection #11: RFFR-emitting devices may interfere with reception of the Schumann Resonance

- A. The Schumann Resonance is a set of Extremely Low Frequencies caused by lightening in the ionosphere/atmosphere with a main frequency of 7.83 Hertz (cycles per second) and harmonics of 14, 20, 26, 33, 39, and 45 Hertz. Those resonances are very similar to the RFFR harmonics in the human brain.
- B. Practical application of Schumann Resonance
Experiments with individuals living underground indicate they became depressed until the Schumann Resonance was added to their environment. To give you an illustration here, I used a bike helmet lined with a heavy duty tin foil and got a severe headache several times. The tin foil of course should protect me from outside frequencies. When I removed the tin foil, I did not get the severe headache. My hypothesis was that maybe I had become separated from the Schumann Resonance like underground humans and that separation caused the headache.

Abrami: Before you go on Herman, does anyone recall? Didn't we talk about the Schumann Resonance somewhere along the line at one of our meetings? No? Ok. It sounded familiar.

Objection #12: 5G/4G SCA legislation does not provide a reasonable accommodation for those with Electromagnetic Hypersensitive.

- A. SCAs will be universally installed throughout cities and those who are EMH will have no place to go for freedom from RFFR. Your choices will be stay in your home or suicide. There is one lady who has EMH in a place where they have installed 5G and she has to have her meals delivered to her in her house. She can't go outside.
- B. Kalamata, Greece did a pilot study of 5G/4G and rejected it partially on the grounds of no protection for EMH individuals.

Objection #13: Environmental power densities should be disclosed in transfers of interests in real and personal property or in the use and occupancy of public buildings.

- A. Objective: Inform the public of the quantity of power densities ($\mu\text{W}/\text{m}^2$) in their environment.
- B. Regulatory issue #1: Power density disclosure to buyers and lessees of residential real estate.
 - 1. Power density disclosure of $\mu\text{W}/\text{m}^2$ to buyers and renters by state law. State law should require environmental assessments

- a. Meter immediately outside the housing unit. "Outside" means around the outside the walls of the building including only the detached housing unit or around the outside walls of a multistory building containing several housing units all at ground level.
- b. Meter inside the housing units within three feet of all interior walls during ordinary working hours or evening hours as required by the buyer or lessee. Date, day, and time must be shown on the inspection.
- c. Estimate spillover RFFR from adjacent housing units if you are in an apartment or a condominium. Turn off electricity in target housing unit and turn off all RFFR devices. The remainder RFFR is from outdoors or from spillover RFFR from an adjacent housing unit. Can estimate spillover RFFR my metering near party wall. I have personally measured wifi once that was throwing off a million ($\mu\text{W}/\text{m}^2$). I believe that was in the far field three feet away. That's terrible. That means that across the party wall, those people are probably getting 900,000.
- d. Measure of harm: Imagine a six-month old baby crawling on the floor with a 1,000,000 $\mu\text{W}/\text{m}^2$ Wi-Fi nearby in the same or spillover adjacent apt. Getting his or her brain fried from grossly excessive RFFR/EF. That child is going to be injured, perhaps for life.

Abrami: Herman, let's talk about this for a minute. The upper limit of the federal guideline is 10 million $\mu\text{W}/\text{m}^2$ right? Or ten W/m^2 and your example is only one tenth of that FCC limit.

Kelting: Yes and my proposal in informing the public, does not include a safety standard within the legislation. It will only say that every home and apartment will be metered and the results delivered to the renter or the buyer. There will be no notice of what is safe or not safe. The purpose of that is to avoid criticism in comparisons with the FCC. Let people start doing their own research and when they do, then you are going to get complaints. I am thinking this is the golden arrow to defeat the FCC.

Abrami: Right. I think I understand what you are saying. Publish what the readings are and let people make their own decisions.

Kelting: Exactly. It will come to a point where people will say, I am not going to buy your house because I am getting 10,000 $\mu\text{W}/\text{m}^2$ and over there at that house, I am only getting 20 or 30. I bought my house in an area by metering first. I selected my house in an area with low radio frequencies, typically less than 10.

Abrami: Ok. That's something that the Commission will be thinking about.

- C. Regulatory issue #2: Need power density disclosure and prohibition of use of RFFR emitters in public buildings.
 1. "Public buildings" mean all buildings that have unrestricted public access including government buildings, retail stores selling personal property or services, restaurants, exercise facilities, etc..
 2. The disclosure should be made using a time-dynamic RFFR meter showing power densities in $\mu\text{W}/\text{m}^2$ with one time dynamic meter for the lesser of 10,000 square feet of floor area or the actual space. This is so when you go in a building, you know what the power densities are. Those densities will include any cell phones and

wireless devices in the building. That's the beginning of managing radio frequencies in buildings in my opinion.

3. Prohibit use of wireless devices in public buildings (e.g., government buildings, schools, anyplace there are concentrations of people in an enclosure). I am also suggesting this after being a government agent and working in government buildings for thirty years of my life. Now that means that people won't be able to talk to their children at three o'clock while at work or talk to their buddies. That will reduce the power densities in buildings. Furthermore, there are issues of trespass. When you have a cellphone that is emitting a beam that is hitting my body, you are trespassing on me which, in my opinion is illegal under equitable standards.

D. Regulatory issue #3: Need power density disclosure to buyers of RFFR-emitting personal property (e.g., cell phones, Wi-Fi, cordless phones, automobiles) at point-of-sale.

1. Electric field within about one inch of the item (near field), if not a moving vehicle
2. Power densities (i.e., $\mu\text{W}/\text{m}^2$) within three feet (far field) of the device, if not a moving vehicle.
3. For autos, meter inside vehicles in an environmentally near zero geographic area.

So in addition to the mpg on a car, there should be power densities in that car as well. The same thing for wifi, cell phones, etc even though I recognize differentials in signal and signal availability is a factor.

That pretty much closes it. I would like you to comment on what you felt about this presentation.

Abrami: you summarized a lot of work that we had gone over before the shutdown. This is all good. Some of the last comments about not having cellphones in buildings, that's a tough sell.

Kelting: yes. But if you start doing some other things like disclosure in rental and buying property, then people will become acclimated and want disclosure.

Abrami: Well let's open this up.... New Zealand, for example, their standard is $500 \mu\text{W}/\text{m}^2$ or 5% of what our standard is. We have talked about this many times. How can we be so high of a standard and other countries take a totally different position? It's all over the board. Australia is 2,000,000 and Canada is 3,000,000. We have been discussing this a lot which is why we have been trying to get in touch with the FCC to answer our questions. It is hard getting through to them.

Kelting: It's impossible because they are controlled by the telecommunications industry. What happens with federal agencies is that eventually substantially all of them are controlled by the industries they regulate because their managers are essentially appointed by those being regulated.

Abrami: yes. We have heard all those arguments. As a state we can't set up standards. All we can do is warn and give guidance. I want to at least be able to say that we have tried to reach out to the FCC and FDA and others because someone is going to say why didn't you talk to the FCC? We just have to be able to say we tried and have gotten no response.

Chamberlin: At this point, after what I have read and after having other presenters before you and hearing what you are saying, I am totally convinced that there are deleterious effects on health due to radiofrequency exposure. I am sold. But, what I don't know is relative risk. In other words if I have a cell phone and live near a cell tower what is my risk compared to say, smoking or driving a car? Do we have

some dose relationship between exposure and risk? Am I ten times more likely to die from cancer if I have a cellphone? Can you put some context behind this and give me some relative understanding of how exposure is risky?

Kelting: My answer to that question is the probability of extinguishing humanity in sixty years if we continue the rate we are going even without 5G is about 100%. We are in a process of destroying humanity right now and the evidence is being concealed. My letter of complaint incidentally on that case went to the Federal Bureau of Investigation.

Abrami: They didn't respond, I imagine.

Kelting: no.

Gray: I find objections to most of what Mr. Kelting has presented today. I can't count the number of times in his presentation he said, in my opinion. I can't count the number of times he has referenced studies that have been disproved by other things. I would admit that there probably is a radiation level that I can probably reach that would be deleterious to humans but to talk about extinguishing the human race, to talk about suicides and all these other things with studies that have not been reproduced, have not been verified and are using high levels of radiation or animals or different species that aren't humans who aren't affected the same way and taking that as gospel. I just can't get there. Thank you.

Kelting: Senator, you could if you were Electromagnetically Hypersensitive as I am because I can feel the junk.

Heroux: I think that to answer your question as to evidence that there is or isn't... in order to assess the health effect, you have to measure it and you have to believe that there is something to measure. In relation to electromagnetic radiation, when the federal government through the FCC expresses an opinion about risk that is so clear, that there is no risk below thermal levels, there hasn't been much incentive to perform measurements. There are individuals who attempted to do this. So the only variable with relatively reliable documentation is cancer. This is a variable that has a digital quality to it. Either you have it or you don't. There are international bodies who measure this in a routine fashion. What we have on this subject as you already know, are the two reports from International Agency on Research on Cancer that says low frequency and radio frequencies are related to cancer as well as a number of studies like this Brazilian study that I think is very convincing on the impact of cell phone towers because not only do they determine from an established set of cancers but your probability of dying from it is higher if you live near a cellphone tower. The problem essentially with Dr. Kelting's presentation is that he goes to a large number of effects on which there is relatively little proof because it hasn't been investigated in a very systematic way. So, we don't have the means to investigate everything in detail but perhaps cancer is an exception. Thank you.

Abrami: Let's bring this back to 5G vs. cell phones or whatever. The real issue is our communities are going to be asking for guidance on 5G. If they roll out small cells in any community, they will be rolling them out in front of people's homes low to the ground and the great mystery to all of us is how much energy is coming out of them and is it safe to walk near one of these? Obviously, industry is probably saying yes, they are very safe. We wouldn't do it if it wasn't safe. There is enough evidence out there of ills from RF radiation on all topics. You name it, there are plenty of studies. From the beginning, we have

asked, have the studies been replicated? But to me, there is enough evidence of concern. We will all have to put ourselves in the position of asking ourselves if the cell company came by and put an antenna on top of my telephone pole that is 100 feet from my house, would I think that's a good thing or a bad thing? At this point, I wouldn't be too excited about it because I am not 100% convinced that there is not some concern for safety. Maybe it's not conclusive evidence as of yet but I think the body of evidence will have to be built over time. That's the concern that we have to address for the state of New Hampshire and for the communities and citizens in the communities. That's a tough thing to get our hands around but that's what we are being asked to do.

Sherman: I was just going to second what you are saying. Whenever you are looking at studies of human health especially with potentially deleterious exposures, one other that we are grappling with is PFAS. How good are the studies on PFAS? Well, they are good enough to say everything is pointing in a bad direction. Is there something that is absolutely unequivocal? We know that with Mesothelioma and asbestos and bladder cancer and arsenic or smoking and lung cancer? No.

Is there something right now with 5G that says, boy this is really bad for us? I think it depends on who you ask. But you have got a very large, very well-funded, very powerful industry saying, trust us. We wouldn't do this if it were damaging or harmful to human health. It reminds me of some other industry issues we have had in the past saying trust us and not trying to make sure the data is robust. Therefore the data is suggesting that there is no harm. So we are left with the Precautionary Principle of public health which is, we have enough evidence to be concerned but not enough evidence to be definitive as far as I can see from sitting in on these things and what do we do?

I think the most troubling thing for me is that especially in New Hampshire but throughout the country, there is a certain amount of choice of what we expose ourselves to. With 5G, that choice is gone. Unless you want to stay in your home and wrap yourself in aluminum foil, you don't have that choice. You get into people's personal choice. We have a choice whether or not to use a cellphone but we don't have a choice if the 5G tower is going to be right outside our window because the FCC covers that. They are in charge. That is what I find to be the single most troubling aspect to this. This isn't something I can choose like what kind of drinking water I will be drinking. I can choose whether or not I smoke cigarettes. In this case, I don't have a choice. The bees don't have a choice. The environment doesn't have a choice. The trees don't have a choice. And if we get this wrong and the industry is wrong or is suppressing knowledge, which we have seen before for example in tobacco. We could be screwed, to use a medical term.

Patrick, I think you are on the right track which is saying how do we embrace what we have always embraced in New Hampshire which is our personal choice as well as our personal responsibility and recognize different people's interpretation of what is so far to me is not absolute data and what can we come out of this with in terms of recommendations? I think one recommendation is you are not going to go wrong if your community says, no 5G until we know it's safer but my concern is that we may not be able to do that.

Abrami: There are communities that have said that. It becomes how long does that last before the lawyers catch up with that and the company wins that argument. That's something that we have to consider. Whatever we do we have to be pretty confident that it will cut muster and terms of legal action or legal recommendation. I think there are things we can do to nibble around the edges on this. I

think that's what we want to do as a subcommittee is to put some things together that we think might be viable.

Sherman: I also wouldn't try to litigate this in any recommendations. I wouldn't guess where these lawsuits are going to go if a town says no 5G or something like that. I think we can certainly recognize that there is the risk of litigation or some would say with certainty if you try to close the door to 5G. I find that very troubling that an entire community would not have ability to say no to something that has some significant evidence that it may be harmful.

Kelting: How many of you own RF meters? For those of you who believe that RFs are safe, buy a meter and defend its safety based upon what you meter.

Heroux: I can recommend for you a meter, the GQ EMF390 for about \$200 you can get an ELF meter that goes to about 10Ghz and also has a frequency analyzer. It is truly a quantum leap in what is available to the consumer. It is made by an American company. It can monitor the fields every second for 24 hours and download it into your computer. So a lot of the measurements you are talking about for protection of housing and buildings become feasible when you have that kind of sophistication available to everyone.

Ricciardi: I wanted to make a couple of comments and thank Senator Sherman because I echo what he is saying. There are a few things we have to remember. We definitely have enough science and evidence to show that things are unclear and unsafe. But if we were to go and say, ok the Telecommunications Act, the FCC has not provided us with proof that is safe. That is the problem. When you are putting 5G in front of people's homes, we have to remember that it doesn't work alone. It has to have 4G with it so essentially you are forcing someone to live in a soup of microwave radiation because the science is there with the 4G. Really, that is unconstitutional.

In addition to that, we are not a town deciding whether we should roll out 5G or not. We are a group of people that have been selected on what is the best thing to do for the state of New Hampshire. It doesn't mean we have to talk about litigation because our job is to make strong recommendations on our findings whether it's agreed upon or not but that's what we have been tasked to do. That's what we have to do. We are making what we find to be an important decision for the state of New Hampshire.

Abrami: Yes. We do but again I still feel that they have to be, I don't want to say reasonable but that would not violate federal law. I think that one of the recommendations may be that our federal legislators need to do more. I think this is something we need to continue to discuss how far we want to go with this.

Woods: I have a technical question. What chance are we going to have to sort of have an executive session? I don't need to get into detail but some things that Paul and I have raised and Ken and Kent as well. I think some of the basic science things need to be reiterated perhaps. Again, we don't know all of the outcomes but if we can provide a little bit of discussion about the real basic science like we talked about proton tunneling. Our presenter brought up the issue of precursors. I think that is an important issue and I don't think people understand what a precursor is but that can have a significant impact from a quantum mechanical perspective. We have done a couple of things. We have brought this down from concern only about the ionizing radiation. We did point it out to one of our presenters no, that doesn't count. You need to talk about the non- ionizing radiation. I think even though we don't have all of the

answers, I think we can provide in our report the concerns that we have and point out that there is some basic science at the quantum mechanical level that will support that. That needs to be done because of A, B and C consequences.

Getting back to my original question, are we going to be able to do some exec sessions where we can talk about that among ourselves and flesh out some of these other issues?

Abrami: We can't have exec sessions as a whole. They need to be public. We can meet as subgroups I think up to 50%. I would love to see that actually of the more technical folks in the group. All this information is great. We have gathered a lot of good information that we need to not lose. That should be available in the report to all our communities in New Hampshire. Here are some of the facts that we found so far.

Sherman: I was just thinking that maybe before you start your subcommittees maybe the next Commission meeting could be free discussion among the Commission. There is enough resource here, people with enough knowledge. I have some questions about some of the testimony both today and in the past that I would love to just bounce off other Commission members.

Abrami: Tom, at this point I am not planning on inviting any other guest speakers because I think it's time for us to do exactly what we are talking about here. We have to start talking among ourselves and I see a lot of heads shaking yes. I think that is what we will definitely do next meeting.

Woods: That is sort of what I had in mind when I said exec session. I didn't mean exec per se but what Tom is referring to about having an open discussion.

Sherman: And then the subcommittee could take that and I know there has been some really great feedback from Commission members, great questions, and a lot of information. So having a session where we can distill that down and then the subcommittee can then go get to work. We can get a little clearer from all of us, where each of us is. Pat, I don't know maybe it would make sense for each of us to maybe start out with saying where we are and then have a discussion after that of where we are as a Commission.

Abrami: I think that is a good idea. Assume the next meeting will be two hours of discussion among ourselves about where we are at. Everybody will have a chance to weigh in on their position. I think I have a sense but you never know. Then we talk through what we think the structure of a report will look like, too. I don't want to lose some of the knowledge that we have. The report will include the minutes of these meetings as an attachment. Our minutes are quite extensive. I know when I did the report for the marijuana Commission, that report was 200 pages long with all the attached minutes we had to it. There is a lot of information in those minutes that I think is valuable.

Chamberlin: The reason I go back to relative risk is because with a number of things available to us there is a risk associated that we decide is acceptable. Here is an example: We drive cars and yet we lose 30,000+ people per year with traffic accidents. They die but we consider that to be acceptable. With something like 5G, it will clearly have benefits associated with it. Is the risk relatively low that we can go ahead with it? Or is it such that we can't? That is the one thing that hasn't come out in all the testimony that we have heard. How much of a risk is it? Is it comparable to smoking five packs of cigarettes a day? I don't know. If we are going to get traction with this politically, we need to be able to impose the realism

that this is a significant threat or perhaps it isn't. But that's one thing that I haven't yet found out in my reading either. Can anybody shed any light on that?

Woods: To me, there are two parts to the risk. One is the relative risk and the other is exposure to risk. With driving a car, you can take the back roads and stay off the highways but with 5G, you may not have that choice. There is exposure risk vs. personal acceptance risk and that has to be differentiated as well.

Wells: Just a couple of things that Dr. Kelting said today that I wanted to make sure didn't get lost. He talked about disclosure with real estate, etc. and also about RF trespass on my body or on my home. I am thinking there might be a parallel here to 20th century strip mining in Pennsylvania where a farm owner didn't own the mining rights and found himself sitting on a pile of gravel the next day. I am wondering if there is some sort of precedent here that we should be looking at.

Abrami: Herman are you still on with us?

Kelting: Yes. I am here but I am not familiar with strip mining or the case law associated with it.

Abrami: Ken, I am not sure myself but that is a good question though.

Wells: The idea of signal trespass onto my property. Dr. Woods was just talking about whether you can choose to expose yourself to the risk or not. In the case of driving, you can. Whether you decide to smoke or not, you can. But this is more like a second hand smoke kind of thing. You can't protect yourself from it under the current circumstances.

Abrami: the other thing is 5G hasn't really been rolled out extensively yet. The other problem we have with 5G is that it's a marketing concept. Each company, it means something different. Ken, I know we have talked about antennas. What's inside the antenna? How are they configured? I think one thing we can grapple with is how much energy is coming out of the antenna. I think we have boiled it down to that. The FCC standard is set so high that even if we said as a community there would be periodic monitoring of the levels that seems like it's pretty high intensity to have on top of a pole twenty feet off the ground. I think the industry would say no it's not that level of intensity coming out of that but we don't know. A lot of that is proprietary information. We don't know what the intensities are going to be.

One of my thoughts was let's monitor. Let's say a community in agreement with the cellular company says that it should not exceed FCC standards. But those standards are way high. The cellular company shouldn't object to that since they feel that things are safe within the FCC limits. My instinct is that 10 W/m² is very high level. As I said before, why did New Zealand set their standards at 5% of our levels? I don't know. Maybe they are just being more cautious. But it makes you think. Why do some countries have totally different standards than our standard? Some would say they are erring on the side of caution as Tom would like to say. Well, how can they get away with their 5G at their standards and we have standards set at 10 W/m² ? These are conversations that should be happening at the federal level really. We would love to talk to the FCC. We would love to have them on our zoom meeting right now answering our questions.

Ricciardi: I just asked when you say that FCC says this is safe then why does the Telecommunications Act say health cannot be a consideration? If it's so safe, why would that be in there?? Just a question.

Abrami: and it's a good one.

Kelting: I would like to mention one thing here. For 4G, you could insulate your body with silver embedded cloth. With 5G at the higher frequencies, you will be required to use tin foil only. It will go right through cloth even with silver threads.

Gray: Beam forming is something that I don't know that we have explored very well. It would seem to me that beam forming would cause very short time increases in radiation during the time the beam is formed. But may reduce radiation during times when we are just in monitoring or not in beam forming mode. Things like that are things that are unique to 5G. I don't think we have had sufficient discussions to understand what would happen.

Kelting: When you connect the 5G, if you move your source, it automatically transfers to 4G. So what you are really doing is communicating with 4G in all likelihood. The purpose as I indicated earlier, is that they want to put 4G into residential neighborhoods so they can increase the capacity of the system. It's not to get 5G in there.

Abrami: Help me out here. My understanding is that the 4G cell towers will be communicating with the 5G small cells, is that correct?

Heroux: 5G is an engineering concept that is designed to increase the capacity of the environment to transport data. What industry is really adept at is to transport a lot of data through wireless and essentially with the IOT concept, there is no limit to the opportunities there are to increase the amount of data being transmitted whether you use beam forming or to broadcast it. All of these avenues will be exploited and you will get to the maximum allowed standard ultimately in your environment. This is something that is expected because engineers develop applications in as much as they have the opportunity to do it. What is missing in here is that these agencies like the FCC are essentially blind on impacts on the electro-sensitive people certainly and the other health impacts of this radiation. But the intention of industry is to facilitate communications. Ultimately, wireless is a dead end. It's a little bit like oil because the spectrum is limited and you have to have more and more expensive techniques to transport more and more data. What we should be thinking about is society will need a lot more data. Let's favor optical fiber over wireless because it is not only hygienic, very safe and it has a lot of virtues not being promoted simply because of commercial reasons. Thank you.

Abrami: I just noticed we are getting a lot of chat comments. Kent, is there a way we can save the chat messages?

Chamberlin: Yes. I will save them all.

Abrami: Some of it looks like they will be helpful. There is one that says China and Russia have science-based standards on their evaluation that non thermal effects exist. There standards are certainly set a lot lower than ours. European countries have set precautionary limits. If you can share this with me and I can share it with everybody. There is one on India, which dropped its limits to one tenth of what it was before. Parliament addresses issue of beam forming and measuring issues. There is a report that some of the more technical members are interested in and we can have a discussion around. I guess I am not that much of a Zoom expert. I should have been following some of this chat going on here. We will save it and send it out.

Sherman: on the select committee, we incorporate the chat into our minutes. You may want to do that.

Abrami: We have at least fifty people on and I was told there would be people on from around the country, which is good. Herman. Thank you very much for sharing your information with us. It was very helpful. I want to thank everybody. We are getting applause here from everybody. Again, I wish we didn't have that pause for four and a half months. Got a little rusty here but I think we are back in the groove.

Roberge: Rep Abrami, I have a clarifying question. This was a very helpful discussion. As I sort of prepare for our next meeting on our position and open discussion. I need a little clarity on the charge of the Commission because what I continue to hear and this is a little bit challenging is that 3G/4G and 5G really aren't separate. They are necessary in order for the other to exist. My question is, as we begin to think about recommendations, are we looking strictly at 5G? Is that the charge of the Commission? And how do we differentiate that? That's where I am struggling.

Abrami: Thank you Michele for the question. If you go back to one of our early meetings and it's in the minutes. We early on discovered that you can't talk about 5G without talking about 3G and 4G or RF radiation in general. So, we have to talk about it all. We have learned that you can't uncouple 3/4G from 5G because they do interact with each other. We are going to try to focus on 5G but it's going to spill over to the other technologies as well. Are there any other comments?

Thanks to Kent and UNH. We are using their zoom to hold this meeting. We used your space yesterday too, for a House meeting. Kent and Ken were you there yesterday? I couldn't find you. Maybe I didn't look hard enough.

Woods: Yes. I was here.

Wells: I was wearing a mask. It was hard to recognize me.

V. Zoom Chat from 7-1-20 Commission meeting:

00:26:12 Ken Wells: Does NH have any recourse to Communications Act of 1995 insistence that municipalities and states cannot prohibit installation of antennas?

00:35:28 Ken Wells: Meeting again July 24 @9am via Zoom

01:22:30 EH Trust: I think the case is this: <https://ehtrust.org/federal-court-overturns-fcc-order-which-bypassed-environmental-review-for-5g-small-cell-wireless/>

01:23:08 EH Trust: Here is the link to the case decision
[https://www.cadc.uscourts.gov/internet/opinions.nsf/4001BED4E8A6A29685258451005085C7/\\$file/18-1129-1801375.pdf](https://www.cadc.uscourts.gov/internet/opinions.nsf/4001BED4E8A6A29685258451005085C7/$file/18-1129-1801375.pdf)

01:49:22 Ken Wells: GQ EMF390

01:49:45 Ken Wells: RF meter

01:57:10 Bruce L. Cragin, PhD: You just don't want to hear from any more physicists!

01:59:12 Paul Heroux, Dr.: I am amazed that we could not get the FCC to appear.

02:00:09 Bruce L. Cragin, PhD: More good sense. Thanks for that.

02:00:59 EH Trust: The FDA should do a risk analysis of this type but has refused. Dr. Melnick states this should be done <https://ehtrust.org/statement-by-ronald-melnick-phd-on-the-national-toxicology-program-final-reports-on-cell-phone-radiation/>

02:01:34 EH Trust: "A quantitative risk assessment of the data from the NTP studies on cell phone radiofrequency radiation needs to be performed by the FDA and that information should be used by the FCC to develop health-protective exposure standards. In fact, it was the FDA that nominated cell phone radiofrequency radiation to the NTP, and I quote "to provide the basis to assess the risk to human health of wireless communication devices." Therefore, I urge the FDA to immediately conduct the risk assessment of the NTP data."

02:04:06 EH Trust: Plus there should be an assessment of the impact to birds bees and trees but none has been done. There is no health agency tasked to evaluate and develop a federal safety standard regarding impacts to trees, bees and birds. It is a gap

02:06:01 EH Trust: Montgomery county - Maryland did monitoring and found FCC limits were breached until 10 feet around the antenna facility.

02:06:34 EH Trust: China and Russia have science based limits based on their evaluation. That non thermal effects exist.

02:07:15 lori: State Law 12'K:11 e) needs to be amended to allow testing and monitoring of RF . How can we even know if the FCC standards are being met without monitoring, sampling and testing

02:08:10 EH Trust: Several European countries have set "precautionary" limits . I have these details. And some of the documentation can be found here <https://ehtrust.org/policy/international-policy-actions-on-wireless/>

02:08:51 EH Trust: China- [https://web.archive.org/web/20120413171654/http://www.salzburg.gv.at/Proceedings_\(20\)_Chiang.pdf](https://web.archive.org/web/20120413171654/http://www.salzburg.gv.at/Proceedings_(20)_Chiang.pdf)

02:09:09 EH Trust: Russia- https://www.researchgate.net/publication/228104887_Scientific_basis_for_the_Soviet_and_Russian_radiofrequency_standards_for_the_general_public

02:10:23 EH Trust: India dropped their limits to 1/10 th pf what it was before because of this report <https://ecfsapi.fcc.gov/file/7520958381.pdf>

02:10:29 EH Trust: asl understand it

02:11:04 EH Trust: India published their findings as detailed here
<https://ecfsapi.fcc.gov/file/7520943486.pdf>

02:12:14 EH Trust: European Parliament reports address the issue of beam forming and measuring issues in this report
[https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/646172/EPRS_BRI\(2020\)646172_EN.pdf?fclid=IwAR3cD0TDOqGHpOmCWPnANN-Y6RBaa0eoQ4ZN0nuUwpVaLL8MIDtt6aKtiYM](https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/646172/EPRS_BRI(2020)646172_EN.pdf?fclid=IwAR3cD0TDOqGHpOmCWPnANN-Y6RBaa0eoQ4ZN0nuUwpVaLL8MIDtt6aKtiYM)

02:13:57 Bruce L. Cragin, PhD: Don't confuse legislation with science!

02:14:11 EH Trust: European Report here also
[https://www.europarl.europa.eu/RegData/etudes/IDAN/2019/631060/IPOL_IDA\(2019\)631060_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/IDAN/2019/631060/IPOL_IDA(2019)631060_EN.pdf)

02:15:22 EH Trust: According to Belyaev 2019, “the health effects of chronic MMW exposures may be more significant than for any other frequency range.” The abstract states that, “Various responses to non-thermal microwaves (MW) from mobile communication including adverse health effects related to electrohypersensitivity, cancer risks, neurological effects, and reproductive impacts have been reported while some studies reported no such effects. According to Belyaev 2019, “the health effects of chronic MMW exposures may be more significant than for any other frequency range.” The abstract states that, “Various responses to non-thermal microwaves (MW) from mobile communication including adverse health effects related to electrohypersensitivity, cancer risks, neurological effects, and reproductive impacts have been reported while some studies reported no such effects.

02:15:36 lori: Thank you for all your work

02:16:59 EH Trust: Brillouin precursors can be formed by high-speed data signal as Microwave News 2002 pointed out “Introducing Brillouin Precursors: Microwave Radiation Runs Deep.” When a very fast pulse of radiation enters the human body, it generates a burst of energy that can travel much deeper than predicted by conventional models. This induced radiation pulse, known as a Brillouin precursor. Brillouin precursors can also be formed by ultrawideband radiation and, in the near future, by high-speed data signals.” The 2002 Microwave News article discusses the controversy over the Pave Paws radar system which used phased array radiation. In 5G communication systems, the phased-array antenna is one of the lead front-end components. <https://microwavenews.com/news/backissues/m-a02issue.pdf>

02:17:29 EH Trust: ““When a very fast pulse of radiation enters the human body, it generates a burst of energy that can travel much deeper than predicted by conventional models (Oughstun 2017). This induced radiation pulse is known as a Brillouin precursor. Brillouin precursors can be formed by ultrawideband radiation and by high-speed data signals as used in 5G.”found in <https://ieeexplore.ieee.org/document/9002324>

02:18:29 Augustinus.Ong: Thanks for the meeting.

VI. Important questions need to be answered for NH 5G Commission:

(Questions included in the minutes sent by D. Ricciardi to FDA and FCC)

From: "Shuren, Jeff" <Jeff.Shuren@fda.hhs.gov>
Date: June 24, 2020 at 4:28:49 PM EDT
To: Denise Ricciardi <dricciardi@bedfordnh.org>
Cc: OC Ombudsman <Ombuds@OC.FDA.GOV>, Patrick Abrami <abrami.nhrep@gmail.com>
Subject: RE: Important questions NEED to be answered for N.H. 5G health task commission

[External]

Dear Ms. Ricciardi,

Thank you for reaching out to me. I have forwarded your questions to the FDA's Intergovernmental Affairs Staff who handles inquiries from State and local governments. I have included Karen Meister, their Acting Director, on this email, as well.

Best regards,

Jeff

-----Original Message-----

From: Denise Ricciardi <dricciardi@bedfordnh.org>
Sent: Tuesday, June 23, 2020 10:38 PM
To: Shuren, Jeff <Jeff.Shuren@fda.hhs.gov>
Cc: OC Ombudsman <Ombuds@OC.FDA.GOV>; Patrick Abrami <abrami.nhrep@gmail.com>
Subject: Important questions NEED to be answered for N.H. 5G health task commission

Dear Dr. Shuren,

We would appreciate an answer to these questions regarding cell phone radiation. If you could number them one by one it would help with clarity of your response.

Regarding the FDA's report "Review of Published Literature between 2008 and 2018 of Relevance to Radiofrequency Radiation and Cancer" <<https://www.fda.gov/media/135043/download>> <<https://www.fda.gov/media/135043/download>>

1. Why did the FDA only focus on cancer as a health effect?

1. The FDA said of the National Toxicology Program findings that the FDA was unsure if the tumors were a causal effect or if these results were "due to weakening of the immune response due to animal stress from

cyclic heating and thermoregulation”Does the FDA think that cancer could be an effect of whole body heating, that cancer is a thermally induced effect? If so, what other studies show that heating causes cancer?

1. Did the FDA review in a systematic way the research on impacts to the nervous system?

1. At the Commission, a study on how millimeter waves interact with insects was discussed. Did the FDA review in a systematic way the research on impact to bees, insects and pollinators?

2. Did the FDA review in a systematic way the research on impact to trees and plants?

1. Did the FDA review in a systematic way the research on impact to birds.

1. If the FDA did not investigate impacts to insects or trees, what US agencies have done so?

2. The FDA website page Scientific Evidence for Cell Phone Safety <<https://www.fda.gov/radiation-emitting-products/cell-phones/scientific-evidence-cell-phone-safety>> <<https://www.fda.gov/radiation-emitting-products/cell-phones/scientific-evidence-cell-phone-safety>> has a section entitled “No New implications for 5G”. Does the FDA believe that 5g is safe or that 5G has the same health issues as 3 and 4G ? What is the FDA opinion on the safety of wireless?

1. What is the FDA opinion on FCC limits in terms of long term health effects. Does the FDA believe the current limits protect the public, children, pregnant women and medically vulnerable from health effects after long term exposure.

1. The FDA is aware that cell phone can violate FCC SAR limits at body contact on high power. The FDA has written that because there is a safety factor. What is the safety factor for the SAR the FDA relies on. At what SAR level above FCC limits will the FDA intervene?

1. What actions specifically is the FDA doing now in regards to 5G and cell phone radiation in terms of research review? How often will the FDA be releasing reports?

1. Will the FDA be evaluating the safety of 5G cell antennas? If so how? If not, what health agency is ensuring that 5G cell antennas are safe for people, wildlife and trees.

2. Cell phones and wireless devices emit several types of non ionizing radiation in addition to radiofrequency radiation. For example the devices emit magnetic fields and when a pregnant woman holds a laptop on her lap the measured fields can be high even into the baby. What agency ensures safety

related to extremely low frequency (ELF-EMF) electromagnetic fields- also non ionizing? Currently we have no federal limit, no federal guidelines and confirmed associations with cancer and many other health effects. Kaiser Permanente researchers have published several studies linking pregnant women's exposure to magnetic field electromagnetic fields to not only increased miscarriage<<https://www.nature.com/articles/s41598-017-16623-8>> and but also increased ADHD<<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2763232>><<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2763232>>>, obesity<<https://www.nature.com/articles/srep00540>><<https://www.nature.com/articles/srep00540>>> and asthma<<https://jamanetwork.com/journals/jamapediatrics/fullarticle/1107612>><<https://jamanetwork.com/journals/jamapediatrics/fullarticle/1107612>>> in the woman's prenatally exposed children. A recent large scale study <https://www.sciencedirect.com/science/article/pii/S0013935120303662?fbclid=IwAR11X_74FIT7y_RpO9WvbkE8AmAlBHAVU67yjKW8A6ZWPnPsLRioLxGsy1o#><https://www.sciencedirect.com/science/article/pii/S0013935120303662?fbclid=IwAR11X_74FIT7y_RpO9WvbkE8AmAlBHAVU67yjKW8A6ZWPnPsLRioLxGsy1o#>> again found associations with cancer. Please clarify which US agency has jurisdiction over ELF-EMF exposures?

1. Will the FDA be initiating any research studies on 5G and health effects?

We As a health study commission on 5G/ take these duties very seriously. We are unbiased and we are seeking all answers And facts. We are requiring your answers to the above questions.

Thank you,
Denise Ricciardi
Committee Member appointed by Governor Sununu.

The Right to Know Law (RSA 91-A) provides that Town email communications regarding the business of the Town of Bedford are governmental records which may be available to the public upon request. Therefore, this email communication may be subject to public disclosure.

V. Next meeting via Zoom: July 24th 9-11

Meeting Adjourned at 3:02 pm.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

7/24/20

9:00-11:00 am EST

Via Zoom (<https://unh.zoom.us/j/93912769762>)

Via telephone-US (+1 646 876 9923) ID: 939 1276 9762

In attendance: (12)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Senator Tom Sherman-president of the senate appointee

Brandon Garod-AG designee, Asst. AG Consumer Protection

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Carol Miller-NH Business & Economic Affairs Dept

Not present: (1)

David Juvet-Business and Industry Association

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Meeting called to order by Rep Abrami at 9:03 am

Abrami: For the sake of time, I am going to open the meeting. This is the New Hampshire Commission to Study the Environmental and Health effects of evolving 5G technology. I have a short version of something I have to say. Due to the Covid 19 virus and the Executive order signed by the Governor this public meeting is allowed to be conducted via Zoom. It is open to the public for viewing and was duly posted as a zoom meeting. With that said, if you are not a member of the Commission, can you please turn your cameras off and mute yourselves? That would be much appreciated.

I. Approval of minutes from 7-1-20:

The first order of business is the minutes. I sent them out about a week ago. By the way, Deb you did a great job of compiling them once again. I did get an email from Michelle asking for two corrections. I think we misunderstood for Augustus Ong, listed under attendees. Michelle was in attendance. Also, on page 29, "this was a very helpful discussion". Those are the changes that I have gotten so far. Were there any other changes? So without objection, the minutes are approved as amended.

II: Around the table member thoughts:

Abrami: The first thing we are going to do today is go around the room. The zoom room if you will. What we would like to do is talk about where we are at and the kind of recommendations, possibly that we would like to see in the report and where you stand on the whole issue. I am envisioning the room as it was at the State House and will go to my left. That means, Tom you are up first. Again, it's a general discussion and your thoughts as to where we are at and what we should be doing.

Sherman: Thank you, Patrick. I think I said it and it was in the minutes from last time. My overriding thoughts on this are that there is enough evidence to raise concern but I'm not sure there is enough evidence to show causation between exposure and specific health impacts. So, what the means to me is that there is more than ample evidence that a non-biased large scale study or studies needs to be done to demonstrate that we are not going to be implementing an entire system of communications that would put either human health or the environment at risk. I think of the Precautionary Principle. I also recognize we have several other examples where industries have said to us, this is safe. I can think of my own profession where we used to say, "Trust me. I'm a doctor".

I think we all know that phrase, trust by verify is the very least where we need to be. In this case, there is ample distrust because the Commission has already seen the amount of industry influence on the regulatory bodies. By the way, that's nothing new in Washington, DC or in some states. When I was in Virginia, our entire oversight for agriculture was from people who had formerly been in the industry. So when you think of some of the chemicals like glyphosate, people from the industry were regulating the industry and we know where that gets us.

My overriding New Hampshire response to this is, I would like to see the ability of communities to control their environment until such a time that an independent, scientifically based study or studies have been done to demonstrate the safety of this technology. I think that is consistent with Precautionary Principle of public health. I think it is consistent with the way many of us in New Hampshire view our personal freedom. And I don't believe we have ever been shown a compelling need to, right at this moment, on an urgent basis, implement 5G technology. I guess that's my summary statement.

My plea would be to have to start working on these studies and to ask our federal delegation, as they've done with PFAS, to start looking at where there has been exposure and what has been the impact. And start funding some of these studies at a federal level outside of the different regulatory agencies. I was really impressed by the consistency of response or I guess the consistent lack of response from the EPA and the FDA. It's amazing to me, that they seem to not want to respond even to a statutory state commission. So, I guess I'll close by saying the parallels to other exposures that we have, are really clear. And the lessons that we've learned from something like PFAS, where a few years ago, I started working on PFAS back in 2014. The industry knew about those dangers from the 1950s. They continued to profit with manufacture until at least 2003 when DuPont pulled out. 3m continues to and at this point, we have over a 100 communities and/or water systems in the state impacted and those are just public systems. Now we're playing catch up. But at the exact same time this week coming

out and Lancet are two, scientific articles looking at the data on PFAS and broadening the concern to diabetes, obesity, breast cancer. None of which, we have talked about on our way through this. So here we have an opportunity before the industry has an ability to expose us. To say, let's put the brakes on, let's get the data. You show us that it's safe in independent studies, not funded by you, but funded by an independent body and overseen by an independent body. And then we can move forward together to implement this new technology. That's my feeling I and thank you for the opportunity.

Abrami: Thanks Tom. I forgot to mention that once we're done with the round table, I'm going to ask Denise to just briefly discuss our non-response from the FDA in relation to the FCC. That is a discussion that we need to have. The other thing is that this meeting is being recorded, so everybody knows, It's pretty much for the ease of doing our minutes at the end for Deb. And that, any chat room discussions that are going on will become part of the minutes. We did make them part of the minutes from last meeting. Ok. Let's continue around the room here.

Wells: Yes. Thank you. In looking over the materials that we were previewing for this meeting, I came up with a number of recommendations, about seven of them. And it seems to me, that there are three levels of issues here. One is *general RF* radiation from Wi-Fi, 5G and all that. Then there *specifically 5G* and then on top of that, and I would give it the highest priority is the 5G *small cell antenna network*, which I think poses particular hazards. And I think that we should explore ways that New Hampshire can take unilateral action to protect our population, our environment, our forestry industry, and also supply the fastest broadband and communications to our population. I have a couple of things that I think would be worthwhile here. If this type of technology is to be developed, the state of New Hampshire could require that installers and owners of these systems carry enough insurance to cover the potential claims of New Hampshire residents who are exposed. We should require also insurance to compensate based on potential losses in the forestry industry, agriculture, hive losses, etc. Here's another separate issue. It occurs to me there's a parallel here with 5G and the mining rights in coal country where farmers found that they didn't own the rights to the mineral below them and their farms were turned into strips of gravel. I think it's a private property and liberty issue.

Broadcasters must be specifically granted rights for their signal to intrude on private property. And if they don't have those rights, they must not do that. Senator Sherman mentioned the problem that many of the studies, clearly there are conflicts of interest. I think that, that following the example of Jersey City and some others where they there's been a moratorium placed until, say, a UNH study is completed when that is not funded by industry, but where there's a demonstrable freedom from conflicts of interest.

Abrami: I guess there is some debate on whether Jersey City moratorium is in place or not.

Wells: Yes. I understand. I saw the petition that was circulated as a possible model. Then I wonder if the state of New Hampshire can impose its own maximum intensity limits and require that equipment have an accessible off switch if they're found to be out of compliance. And with that, I think I'll conclude my remarks and listen to what others have to say.

Abrami: Okay. That's very good, Ken. Thank you. There are some good points from both you and Tom so far.

Chamberlin: So as I listen to the previous two speakers, I'm in agreement. I echo their concerns. And essentially Sherman in particular, what you had to say is very much along the lines of what I feel both what you said just now and what's in the minutes. My belief is that we have a serious issue with exposure. The scientific data is pretty overwhelming. Although those data, the data is, is being completely ignored by the regulatory bodies. And that's kind of the elephant in the room here is we have a regulatory body that says that these standards set 30 to 50 years ago are acceptable. Yet the evidence, scientific evidence suggests that it's not. So that clearly is something that we have to address, explicitly in whatever report we have. Other issues, is the yes, we can ask for things like insurance. We can mandate that the providers have insurance to cover any issues that may come about as a result of this. The property rights, is also a good angle also.

But at this point, I don't feel like I need to see any more scientific evidence. I'm pretty convinced. Since I got on this, I'd been reading article after article and that's pretty convincing that yes, there's a problem. The one thing that we don't know that would be nice to know is the degree of risk. How much risk do you encounter by having a cell phone? being near a cell phone tower? We need to, to get that. And I think that we can and we should pursue something like a moratorium until we figure out and get answers to some of these very important questions.

As was pointed out earlier, this is not new. We have seen these types of issues. That is where industry just says it's no problem. This won't hurt you. We've seen that from smoking doctors, from the tobacco industry. We've seen from the fossil fuel industry dealing with things like climate change, which they knew 50 years ago that this would have an impact. So we keep seeing this pattern again and again. And what happens is that the industry makes an investment before we're able to find out or to demonstrate that whatever they're investing in, causes problems. And once they've made the investment, it's kind of hard to turn back, but I think that we have this opportunity now to just move forward to come up with moratorium so that they won't invest they won't get too much of an investment, won't get ahead of the curve as it were, before we figure out how much of a risk this imposes. Thank you.

Abrami: Thank you, Kent. Good points.

Ricciardi: I, too concur with everyone who has spoken. I think the one thing we can agree on all of us is that whether some of us believe it's unsafe and maybe some of us are uncertain. I think the biggest thing we can agree on is that there's a lot of disagreement in the scientific community. I feel that the science that we have seen and the evidence that has been brought before us and all of the materials we've been reading and speakers we've been listening to. I am convinced have a serious issue. And I really believe that it will harmful to just put this out. And I think we have to put stipulation on how things should be. I feel that the state could impose mandatory hard wiring for technology. In the meantime, continuing studies that are real studies. We're having a problem with the FCC. They haven't changed anything after all these years. It's a captive agency. They are a non- health agency. I made some

notes. We could as a suggestion, call for a halt to 5G and its infrastructure until RF limit has been set by federal health and safety agencies. There is no health agency overseeing any of this.

Again, state could call for wired infrastructure which is safe, and actually is faster. Not only that, it's safer in the ability to not be hacked. So, there are many measures there. We can call a halt until the scientists determine how the adequate methods of measuring should be. We can also pass bills that support further research for transparency and education on 5G and wireless devices to be used in the Internet of Things. In my opinion, it would be completely irresponsible for this commission to just blindly roll this out with all the compelling evidence. I don't want us to be like the PFAS or the tobacco industry. And there are some huge differences with this than anything else. If this is put in front of every other home, you are now robbed of your choice. You know, if you don't want to use a cellphone, you don't have to use a cellphone. If you don't want to live near a tower, you can look to where you want to live. This robs you of your choice. And that goes against our New Hampshire constitution. I have a full report on all of this, but that's sort of the gist of it. Do you want me to go right into segue into the questions that I've sent to the FCC and the FDA, or do that at the end?

Abrami: Why don't we do that at the end? I've got Carol Miller next.

Miller: Morning everyone. Here are my thoughts on this... I mean, the science is the science whether it's true or false, it's overwhelming. Every article that I've read, it's just overwhelming. But having said all of that, RF is RF. We've RF with 4G, 3G, Wi-Fi, whatever you name we have RF in our lives. And there are people who are sensitive to RF. And depending on the degree of RF they're getting it could cause the health issues or whatnot. We have some big challenges ahead of us. Cell services not regulated at the state level. It's regulated at the federal level. So I'm not sure that towns in the state can dictate anything to the Cell carriers. There are strict rules in place and we could be setting ourselves up for major lawsuits. So that's where some of my concern goes.

My recommendations really are more practical. And I agree with everyone else's recommendations that have been said so far. What can the industry itself, due to its devices and to its antennas and its system, to reduce the effects of RF to the public? Is there a technology that can do that shielding in phones that that creates less RF to the individual? And, and I think, it could be a costly solution for the industry. But if we're going to have any effect by, I think that that's where we really need to focus our efforts, along with all the other recommendations. Yes. Let's study it. I mean, it has been studied. We need to study it. Can towns literally put a moratorium on it? I don't know. Can the state say that everybody has to have a wired connection? I don't think so. So what we need to do is look at things that can be accomplished and through this committee, get that information out there. And I'll close my comments.

Abrami: Somewhere along the line over the over the years a left turn was taken. We were heading on the journey to fiber optics. And then then now we got, you know, the evolution of 5G. And we know fiber optics is actually more robust. They carry more information and they're less likely to be hacked if you will.

Miller: yeah, but that doesn't solve mobility problems. That's the lore that cell cellular coverage is. It's the ability to have your phone on you and your data anywhere any time. But that does not mean to say

that fiber isn't important. Fiber is the infrastructure of the future and where New Hampshire should be funneling any investments, or all investments, right? (I like the thumbs up) to fiber connectivity and stop putting band-aids on a sagging telecommunications infrastructure. I have very strong feelings about that. But cellular is a different creature altogether. It actually needs fiber to be able to transport data. Everything comes into the wired network, even by cellular. So it's the mobility, the ease of use, it's the instant connection, instant reach ability that the mobile industry has captured. And so therefore, there needs to be some work on their part to abate all of this RF bubbling to the surface. And, you know, I agree with everyone else, but I just wanted to offer a practical solution or I guess sound check to what we're actually doing here.

Abrami: Thank you Carol. Beth Cooley, you are up.

Cooley: Alright, can you see me? Hear me? I am having some issues.

Abrami: I like those things behind you. Looks like Star Trek.

Cooley: Yes. I am in outer-space. Well, good morning everyone. I appreciate the opportunity to provide our thoughts at this point in time. You know, in terms of recommendations at this point, my thoughts are, I think we need more experts because everyone has been anti 5G at this point. And in fact, some of the "experts", their research on this topic has been called "junk science", quote-unquote. So my first recommendation and Rep. Abrami, you and I talked about this before the pandemic is Dr. Swanson didn't get to finish his presentation back in November. So I'm sure he'd be happy to answer questions because he ran out of time. I understand some folks may not agree with his point of view. But I think Rep Abrami, you and I discussed offline that we want a balanced approach to this commission. So that's sort of point one in terms of the experts in the science. I think the other side has some questionable credentials. Second, I think it would be helpful. We sent around, I think maybe three weeks ago, a recent study from the radiation safety journal on 5G a new study. I think it would be helpful to hear from the authors of that as well. And Rep Abrami, if you're open to it, I'd be happy to see if we can do some outreach to those authors. And that's sort of my first recommendation on the on the expert side.

I'm the first to admit I'm not an expert. CTIA is not an expert. We defer to those that are. We think we need to hear from the people that are smarter than us.

Abrami: Beth, I've always said to you, I'm open to hearing from all sides. And you gave us Dr. Swanson and he was sort of out of time, but we could probably dedicate some time more or any other experts that you may have.

Cooley: Yeah, that would be great Rep Abrami. And I want to say they're not, you know, industry experts. They're speaking their thoughts, their research. So I'd be happy to do that outreach.

The only other item I'd like to raise that I'm not sure that we've talked about. I think it's been distributed. But it's important to note that other states have done this. They've done the research and even your neighbors in Vermont and Connecticut have done this. And I think it's important to look at those recommendations. Other states like Louisiana, Oregon, Hawaii have also done reports on this as

well. So I believe some of those have been distributed, but I don't think we've talked about them. I know there have been a lot of things distributed into this group in terms of articles and studies. So I'd just like to highlight that other states are doing this too. And rather than re-invent the wheel, I think it would be helpful to look at what they looked at.

Those are sort of my two recommendations at this point in time. I appreciate a given me the opportunity.

Abrami: Well, Beth, if you have any documents from these other states that you could share with us, that would be fine.

Cooley: Absolutely.

Abrami: Okay. Well, thank you.

Ricciardi: Can I interject to make a comment?

Abrami: Yes.

Ricciardi: Okay. Since Beth did bring that up, I actually have in front of me what other states have done. And she referenced Hawaii. I can send this link out to everyone. Hawaii county planning board passed a resolution to halt 5G. Farragut, Tennessee has a resolution calling on state and federal governments to halt 5G until health risks are evaluated. The Washington DC advisory 3G/ 4G committee resolution opposing small cell wireless and 5G technology, wants studies confirming safety. I have a whole list here that does speak to what Beth just said. I'll make sure that committee gets that.

Cooley: Yeah, Denise, I think that's a good point to look at what other states have done, but I think it's important to understand the context. For example, in Hawaii county, the council passed the resolution this week. It's a nonbinding resolution. As you well know, it is illegal to stop infrastructure at the state and local level on the basis of RF, as that is regulated at the federal level. So the Hawaii county resolution that was passed is non-binding, and I believe Rep Abrami sent out our comments when it was before the planning board a few weeks ago.

Abrami: Yes I sent it out and I also want to know if theses have teeth or not. That's the question, you know, in the legislature we do resolutions to Congress and to the federal government but they're not binding to anybody other than it's a statement of a position. In this case, we have a commission that that's looked at this very closely. And that is a bit different than some of these other commissions from other states. I would say we have more technically minded people on this commission and then some of these other states may have, you may know more than I do about that Beth. Tom has his hand up.

Sherman: But I just have a quick question for Beth, you used the term "junk science". I was wondering which science you were referring to when you called some science "junk science".

Cooley: So this wasn't a quote from me. Another scientist called one of our previous speakers, research on cell phone RF issues, "junk science".

Abrami: Okay. Thank you. Okay, we will move on now. Brandon Garod.

Garod: It's Brandon, that's ok. It's a very common mistake. So I am a little bit leery at this point of continuing to hear from experts on either side because I think that we could call experts for the rest of the Commission. I think there is a difference of opinion. Some people think it's safe. Some people think it's not safe. I think there is enough evidence to suggest that it might not be safe that we should as a commission, have an obligation to flag that for the state. And you I don't think that hearing from more experts is going to move us in one direction or the other in terms of a commission deciding definitively yes, this is safe or no, this isn't safe. I think that there is some evidence it is not safe.

It is not, in my opinion, a foregone conclusion that this is definitely not safe, but if there is evidence to suggest that it might not be safe, I think that it is important that it is thoroughly vetted and tested before there's an enormous roll out in the state. And I think that's even more important, echoing what Senator Sherman said at the beginning, which is that there really in my opinion, does not seem to be immediate compelling need to have 5G in the state of New Hampshire at this point. My cell phone works great, almost anywhere I am. I can get on Wi-Fi, almost anywhere I am. We're able to meet as a commission remotely. We're able to do our jobs remotely. I'm not sure what the benefit is of having 5G if it's not thoroughly vetted and tested and confirmed, definitively, to be safe before it's rolled out. It would be great. You know, the faster things are, the better things work. Obviously, it's better for us moving forward technologically as a society. But at this current juncture, I don't see an immediate compelling need. I think that it's clear as a commission that we have some evidence that it's safe and some evidence that it's not. And now it turns to, you know, what are we as a Commission going to do in order to fulfill the task that we've been given as a commission, which is to make a recommendation.

And that's where I really struggle. Because like others have said, you know, I'm I think I'm the only lawyer on this commission. I spent some time doing some legal research yesterday and in anticipation of today's meeting. The Telecommunications Act of 1996 is very clear. The state cannot pass a law or regulation that prohibits the telecommunications infrastructure from coming into the state. It is preempted. It's completely regulated by the federal government. There's a carve-out for public health and safety but that is limited because there's a lot of litigation that has come from that in terms of whether that only applies to the state, or whether that can be attributed to local government as well, towns and municipalities. And overwhelmingly, for the most part, it's only the state that can pass a resolution that directly correlates to protecting the health and public safety. I don't think that the science is there in order for us to pass any sort of law that would prohibit or inhibit 5G, in order to say that it is in a direct correlation to protecting the health and wellness of citizens of New Hampshire. Any sort of recommendation that is passing a law or passing a regulation or a barrier to entry is going to be heavily, heavily litigated. And you know, whether it's successful or not, as, you know, is always an open question. But I think that to the extent that we decide to recommend any sort of legal barrier, we need to be prepared for that. That's going to result in a very long drawn-out legal battle.

I do certainly support any recommendations that we can make that are not likely to lead to extensive litigation that we may not have a leg to stand on. I think that the public needs to be made aware of the findings of this commission. I think that there needs to be more public awareness about the issues. And I

think the people in New Hampshire have a right to know about the science and about the studies that have been done. Anything we can do as a commission to increase public awareness even if it is like the Hawaii resolution. Yes, it's non-binding. But it's something. It's at least the community saying, yes, we have concerns about this. And this is what we're going to do to take the steps that we can in order to make people aware and to do our part to say that we as a community have concerns. And I think that is probably the sort of recommendations that we need to be looking at moving forward as a commission.

Abrami: Ok Brandon, that's great. When I speak at the end, I want you to react to one of the things I am going to say whether we even think it has potential of being a legal issue. So thank you. Michelle Roberge.

Roberge: I represent the department of Health and Human Services on this commission. We feel, where this is regulated at the federal level, that certainly more work needs to be done at the federal level to ensure that the standards are protective of public health. We know that the standard haven't been reviewed for a number of years. We know that there are a lot of studies that have come out and certainly more studies that we've heard, and what we're learning from this commission. More robust studies need to be done to ensure that they are protective of public health.

So we really need to make sure that at the federal level those agencies that include FCC, FDA, EPA really need to look at the science. I know there was a recent publication put out by FDA, I think it was in February 2020. They did look at number studies but didn't move forward with a standard review but again, more support of looking at those studies where they are not just looking at heat, but they're looking at other biological effect as well. The department at that point is supportive of that. And that's where we stand at this point. And I know there's other recommendations that are coming forth and that would be something we'd have to reevaluate as we pull the report together.

And I know Representative Abrami and I shared in an email that where we are, our role in this commission depending upon what recommendations that come out, being an executive agency put us in a conflict of interest situation if the legislature tries to implement any of the these, we essentially could be the body or agency that regulating it. We have to be careful of conflicts of interest. We definitely agree that more needs to be done at the federal level where it is regulated.

Abrami: I did respond back to Michelle's request or query about specific recommendations. And given that Michelle's representing the Department of Health and Human Services, there's concern whether that's an official position of Health and Human Services. When I chaired the marijuana Commission, we had a disclaimer that the recommendations in the report don't necessarily reflect the position of certain state agencies. So, I'll share that language with everybody down the road. We can take a look at that. And that's a problem with a commission when you have State agencies on them. They're between a rock and a hard place. That will go for the AG's office as well. They have to be careful. Their input is very valuable but it gets a little bit sticky once there are recommendations being made. Okay. Dr. Heroux.

Heroux: Yes. Thank you very much for the opportunity. I am going to propose some strong measures, but I realized that we have to avoid conflict with the FCC. I also realize that the measures have to be low cost and potentially reversible as well. So I think of this in terms of protecting various populations. So

first, to protect people from radiation from portable phones, I think that we should make it a law that cell phones do not work when they are held against the head, in other words using the proximity sensor. This is a simple alteration in software that when you put your phone against the head, it stops radiating. That means that you'd have to use your phone in front of you. So it doesn't change at all the functionality of the phone, but it practically eliminates the strong radiation to the brain. When you consider that the cost of assessing this SAR is from \$50 to \$200 thousand per phone. You eliminate a whole area of conflict. Of course, industry is not very eager for this because it reduces emphasis on the issue of heat from cell phones. But you maintain functionality. It's a very simple alteration. These sensors are already there and you eliminate connections with glioblastoma or auditory tumors. So that's one thing.

Now, to protect people from radiation from base stations, without making any comment on levels of radiation, I think that a 500 meter hold back and there was a distance should be should be that much. If you can deploy 5G with that kind of hold back, you know, fine. But we have data that shows that proximity to these towers is a health risk.

Thirdly, to protect young children, I think we should adopt the same measures that were adopted just a week ago in Russia in relation to wiring schools, limiting strongly the use of wireless, and forbidding the installation of base stations near schools. This is something that they have concluded to be a good idea on the basis of their most recent evidence.

Then to protect electro sensitive people, I think that we have to take measures that give them recourse, in terms of protecting themselves. I think that we should maybe train a few physicians in New Hampshire to become expert in this area so that they can confirm that some people are electro sensitive. And when they are confirmed, they would be entitled to some form of protection.

Lastly, it would be a good idea to protect citizens and businessmen because if in the future radiation becomes a stronger issue than before, some people who buy property might not be aware of the radiation levels on the property that they are buying. And they may face big losses as a result of this ignorance. So probably in New Hampshire, you already have specialists who are capable of assessing radiation. Maybe there should be some sort of framework that would make it practical for these people to give information on the levels of radiation in various places when there are transactions occurring. And in this way, you could build a picture of exposure in the state, as well as give these businessmen some form of protection. Thank you very much.

Abrami: Thank you, Paul. And Senator Gray.

Gray: morning. I am old enough to remember back in the late fifties when there was a big to do about high tension power line and cows that would be grazing underneath the high-tension lines. Since then, you know, we've done lots of studies on lots of different things dealing with the electro- magnetic radiation. Part of what's going on here, in my opinion, is that we have created a fear. People don't like change. And certainly if you have a fear of getting cancer, that is going to create strong emotion in various people.

I'm not saying that there are not people out there who are hypersensitive to RF. I am not saying there is no problem with RF. I'm saying that most of the data out there that we see needs a good peer review. And in some cases, those peer reviews that have been conducted, have pointed out flaws in that data.

There is a big problem when I hear, well, gee, the industry paid for a particular study and therefore that study should be discounted. I don't believe that to be, you know, what should happen. Like any other study, whether the industry pays for it or does not pay for it, it, you'd be peer-reviewed. And the results of those peer reviews would tell you whether or not there is validity in the study, whether this study should be questioned further on that. We don't have, and the studies that I've seen, and there's not that many good scientific studies out there. That is, a lot of these articles that we've seen go back and reference either the same studies or they are redone.

Let's go back. It's the fear of change that tends to make us believe that there is a bigger problem out there than I believe that there is. Having the ability, if I own a piece of property and say, you can't generate any RF signal that's going to come across my property, that's just never going to happen. Okay? That's like saying you can't use perfume when the wind is blowing across my property because of the smell the perfume. I mean, this borders on the absurd.

The photo that we saw with the tree and half of the foliage being gone and the cell tower there, I want to tell you that that there was a new cell tower put up and there were two trees next to each other. One of those trees had to be removed for the cell tower to operate properly. And you know what? It looked very much like the picture that we saw. So, you know, a lot of this information I would claim is anecdotal at best. The information needs a good peer review.

Right now, I don't know of any studies that are out there that have been using any of the technology that 5G employs with the beam forming and all that, which would in my opinion, tend to decrease the radiation that's normally being put out there. But we're not there. We're not in a place where we can make a recommendation. And when you have somebody have insurance for this or that, I don't particularly see that one either. I don't see that we have a good scientific basis to make much of a recommendation at all.

Abrami: Thank you, Jim. Here's what we got before us. I think municipalities would be looking for us to give them some guidance. That's at a level that this really plays out at. It's really cell companies coming into a city or a town and saying we want permitting rights to put on top of telephone poles or install new polls or small cells. I think the majority report really has got to focus back on the small cell towers because that's the issue, that's the 5G. And as I've said over and over again, 5G mean something to every cellular company. It is just a concept. Each interacts with 3G and 4G differently. And a lot of its proprietary, so we have no idea what's inside those antennas and how those antennas are configured. What we do know and we can measure once installed, is the power intensity coming out of those towers. But we should say that a town should be able to say yes, we'll allow you to put in a cell tower but want to be able to periodically measure the intensity coming out of those small cell towers. Gary, did you just sign on?

Woods: Yes, I did. I'm in Nashville and I don't know what happened. I saw the notice that Kent put out to start at nine. Then, I got a notice that it was cancelled. My apologies.

Abrami: OK. Well, let me follow through and we will give you a chance to weigh in. Okay?

So, right now the, the standard's at, let's call it ten watts per meter squared is the US standard. But some of the other countries have set the standard much lower than that. Australia is two watts per meter squared. Canada is three watts per meter squared, but we're way up to ten watts per meter squared. So, I would think at the very least, and I don't see why this would be a problem for us to say to the cellular companies yeah, if you install these, a municipality has the right to monitor the intensity coming out. And I don't know why cellular companies would have a problem with that. There's going to be a working group where we'll put it in a recommendation from for the next meeting that we could go one by one and have a discussion around each of these. All of the things that were mentioned today will be grouped and, and then we will have to as a group at our next meeting really have that discussion around each. But for today, we're just talking about ideas.

So again, this comment is for Beth. I don't know, why the cellular company would object to a town being able to measure what's coming out of those towers and having us have that part of the agreement with the town. If those towers are on our end are out of sync with what the standard is, then those towers have to be turned off, something to that effect. So that's just one thought.

And one that Brandon, I'm going to have you weigh in on too is I looked at the documents that came out from other municipalities of what they've tried to do. One states requiring permittees to defend and indemnify the municipalities from any liabilities arising from installation, operation and maintenance of small cell installations. But why would the cellular industry, if they feel this is safe, not be willing to sign off on a permit that that allows this? Because it's the town that's bringing in the cellular companies and the towns are going to be, why should we have our municipalities be unprotected if there is indeed damage? We, as a commission are hearing both sides of this. And there could be. It's hard to say definitively. We've all heard and I think everybody's kind of agreeing that there's evidence of potential harm. But cellular companies are saying, no, there's no harm. And the FCC saying, no, there's no harm. The FDA says, no, there's no harm. Well good. If there's no harm, then why hold our communities liable for damages? So that's, that's one that I think we should we should be talking about.

I think we should be pressing the FCC. That's my third point. As a statutory commission, as Tom points out, I would just stress with them why are standards set so high? We know there are no biological effects that play into this standard. How can Australia or New Zealand be at .5 watts per meter squared and successfully roll out 5G? They are going to roll it out, I would imagine, with a lot less power intensity. Remember, those towers are going to be at the height of the telephone pole. Most of them are going to be stuck on top of the telephone poles. We also know, as commissioners, that we see the push back going on around the country. You know the industry likes it or not, there are a lot of people looking at this getting the message out that there's this potential danger. So the public is aware of this and there's going to be push back for communities on town selectmen and other boards to deal with this. My fourth point, I agree with some of those that said that we should as one of the recommendations, which is kind

of a neutral recommendation that we would share this with the federal government agencies that a more robust study should be done on 5G. That should be pretty neutral.

Other communities have looked at simple ordinances and loopholes. How many streets are off limits? Now, I don't know how enforceable that one really is. But some communities have that, are trying to do that. Others have mentioned setbacks. I think Dr. Heroux mentioned that. There are towns that are talking about setbacks, a 500 feet from residences, businesses, schools. Again, that's something that that we could talk about. But if it's on top of a telephone pole in front of your house, you walk under the telephone pole and that's where the greatest intensity is going to be right by the pole. That's something that we will address.

Something that came up from the last speaker we had is requiring power density disclosures for renters and buyers, public buildings, locations where general public may go. That's something that I think we should discuss to see if we can make that into a recommendation of some kind. Another community was trying to say, let's have all poles with 5G antenna have warning signs that RF radiation is being emitted above. That's a simple thing. Again, I don't know why the industry would object to that. Some people would want to know that there's RF radiation being emitted above. So those are some of the things that we can look at as a group.

Brandon, in terms of the liability issue, do you have any comment on that?

Garod: What specific liability issue here you're asking about?

Abrami: Well, I'll read it again that some communities are requiring, permittees, meaning the cellular companies, to defend and indemnify the municipality for any liabilities arising from permits and installation, operation and maintenance of small cell installations. The point is to hold the municipality harmless if someone could prove that they were damaged from the small cell towers.

Garod: I think that to the extent that municipalities are making that a condition of receiving a permit, it would be a law or regulation that's specifically preempted by federal law. This is really where the rub is. The communities, the municipalities, the towns, the cities... they're the ones that control the permitting. You have to go through a permitting process and you have to be approved and any law that's passed, that is a barrier to telecommunications coming in that's passed by state, is specifically preempted unless you can meet one of a few carve outs. The carve outs create another barrier. Unless the state has specifically delegated to the towns and municipalities, the ability to regulate telecommunications in any capacity, that doesn't even apply. It's only the state that has the ability to use those carve outs as like a safe haven for a law that serves as a barrier for telecom. And I'm not clear as whether New Hampshire has delegated any of that authority to the municipalities. But there's a lot of litigation since this thing was enacted in 1996 and it's usually a municipality trying to pass something. And the way that the telecom companies are able to beat it is by saying that they're trying to say that it's for public health and safety or for consumer protection, or to protect right of ways. Those are the specific carve-outs. But unless this state has specifically delegated to those communities, you can't even use those carve outs as a defense. I think there's a good chance that it would be preempted. Really, I'm not an expert. That's basically what I've come up with so far.

Abrami: I agree that the state legislature would have to enable the municipalities to do that. Is that what you're saying?

Garod: If there was a specific delegation from the state of New Hampshire to the municipalities to be able to regulate telecommunications coming in, in any capacity, then the municipalities would have to show that any regulation that they passed, which served as a barrier to telecommunications coming in, fits one of the few carve outs under the Telecommunications Act of 1996. And in trying to find a good case to use as a standard, it's almost never been done.

Abrami: Ok, well, so that's why we have the AG's office is represented to give us those insights.

Sherman: Brandon, I have a question for you from what you said. Why do the telecommunications industries have to come in and get a permit if everything is federal? On what basis could a town deny a permit? So in other words, is the permitting process just a rubber stamp? If you don't permit, they're going to take you to court. You know, they can come in any way with or without a permit with or without municipal law, with or without state law. Is there anything that a municipality can do to stop the installation of these antennae and 5G technology?

Garod: To answer your first question, which I believe was, why would they need a permit? They might not under every circumstance. But imagine what the companies are trying to do is come into a town and build several new towers, to build several new receiver or to build infrastructure they would have to apply to the town for, you know, building permits or in order to do construction within the town. There are laws that determine what sort of process you have to go through in order to be able to come into the town and build something. If there is a specific limitation on telecommunications, being able to do that, that is passed by the town...that's specifically what is preempted by federal law. Because federal law determines when telecommunications can come in and what they can do. So it's frustrating because you would think that at the municipal level that would be who is in the best position to determine what's best for your individual town. I think what I can say for certain, I don't know if there's anything that can be done, but what definitely can't be done is any sort of regulation that amounts to any sort of barrier to telecom coming into the town and installing new infrastructure.

Sherman: So the follow-up would be if a town doesn't want 5G, they just deny the permit.

Garod: Well, I think you have to have a basis to do it. I'm not a local government guy, so I don't know.

Ricciardi: I can answer the question what Senator Sherman was asking. So the reason there is a permitting process is each town has zoning laws in place. And the telecommunications company, when they come into your town and they want to put a cellphone tower, they do have to show that there is a need and that this is the only location and that they checked everywhere else. So it does go before our zoning board here in Bedford. Everybody's zoning has different regulation. The zoning we have in place is not a barrier to the telecommunications, but it is definitive things that we have put in place that are allowable by law. So for example, we have the 750 foot setback from any residential neighborhood in our town now and was put before the voters and voted on. So there are things like that that you can do. The other thing that you can do that is legal, that we have just completed is a "wires and poles" town

ordinance. So we did not single out the telecommunications. We did not say this is just to keep the rules in place for them, but it is all utilities, wires, and poles. And in that section, there are some very strict but allowable bylaw criteria. If 5G were to come and it's beyond our control because the FCC, so we put allowable things in place. And when you do this, you're protecting the residents of your town. But you're making it more difficult, but it's across the board for all utilities. So by not singling out, then it can't be done. Anyone on our commission, and your towns, I'd be happy to provide a copy of what we just completed.

Abrami: Okay. Well, that that's something that I think would be helpful and that, you know, I think you have some specific recommendations that we're going to vet as a group in the next couple of weeks. Ken, do you have another leading question? I think Beth wants to respond. Would you mind if Beth responds?

Cooley: Yeah, I think the only thing I'd add to Denise's comments in terms of what a locality can do, technically, every locality should be complying with the FCC order that went into effect in January of 19. There could also be state laws as well. We've got 29 states and Puerto Rico that have passed laws that also need to be in compliance with their state law. But in terms of what Denise already outlined, localities also have say over aesthetics. In the FCC order, so long as aesthetics are reasonable, objective, and non-discriminatory. And that's what Denise was talking about when she was saying all utilities in the right away. That's the nondiscriminatory part. So in terms of an ordinance, that's also what you can outline is if everything in the right away is green, then we needed to be green and things like that. So just to piggyback off of what Denise outlined, that's how the process works. You do need to get a building permit. You can't just go in and build. Local governments also have the ability to deny a permit on the basis of public safety issues. So for example, if you're doing sidewalk work and the sidewalk is no longer wide enough for wheelchair that can be denied under ADA compliance. Public safety can also circumstance can also be where if a small cell would impede the vision of a driver around learner or a traffic light, things like that. So there's a process passing ordinances helpful to outline where control is retained in terms of the build out, but we'd also be happy to work with you. There are other communities in New Hampshire that have also passed small cell ordinances that we'd be happy to share. So thank you Rep. Abrami for allowing me to comment.

Wells: Looking at this as a physicist, it seems to me that there is an artificial distinction made between different types of RF emitters when in fact RF differs only in intensity and frequency and polarization and so forth. I'd like to see if we could get someone to look into why telecom is subjected one set of standards where say in FCC Class D, broadcast transmitter is limited to a certain number of megawatts per square meter at the property line. And so I think that this is something to look into. Why is there an inconsistency in what the power levels are allowed to be because the power levels on 5G are astronomically higher than they are for broadcast.

Abrami: We will see what we can do there. Ken, thanks. Gary, what we've been doing is everybody's been chiming in with some thoughts and potential recommendations to get the juices flowing here.

Woods: I have some thoughts thinking more as a physicist and where we are and our understanding of some of the basic processes or lack of understanding of the basic processes are, to me still troublesome. I tried to think of this in a number of dimensions. One of which is what I call the sort of the “arc of understanding”. This is a little bit of sidebar, but hopefully it'll all come together in a second. When we looked about the human body, we had gross anatomy, the dissected anatomy, microscopic anatomy, cellular anatomy, chemical anatomy, synthetic biology. Then we focus down and then we've got the genetic code with at all we got all the answers now. Well now we don't have all the answers even though you have the genetic code. We know there's now epigenetics and we're learning more as we go along. To me, we're at the sort of the almost gross anatomy levels with microwaves. We're still talking about the impact from what we call a bulk material, irradiate a mouse total and see what happens. And it doesn't give us an understanding of the potential mechanisms.

You say, well, why do we need to understand the mechanisms? Well, let's give an example of a tornado. Sort of normal atmospheric conditions exist and all of a sudden a tornado appears because you've got a very confluence of a lot of factors that come into play that can create an isolated event. And we see that in a variety of things where seemingly normal processes result in a very abnormal event. And we know how to look at that. Chaos theory from a mathematical perspective has done that. And I'm sure Dr. Chamberlain probably teaches courses on for what are called Fourier transforms, where you'd take seemingly very, very benign smooth waves, you put them together and you get this big spike. So these things that occur and we're at that point, from my perspective, of beginning to understand the confluence of these things at the molecular level. And so this arc of understanding has not come down far enough for my perspective, for me to feel comfortable.

And I think there is a line in the Cyprus thing that I thought sort of synthesized my thoughts. And it said “that the potential aggregation and dynamic interaction with other signals”. I think that's really crucial for us to understand. It's not just 5G coming in. And our last speaker talked about precursors, which is sort of the same sort of thing. You have a signal coming in and then it turns out it interacts and creates a different signal. And we'd make use of this in biology already in orthopedics. Being a retired orthopedic surgeon, we use magnetic pulsed impulses to enhance bone healing. And that's you're creating a field at the molecular level. Because we know our bone is basically what's called a piezoelectric material and it depends on electrical currents to do its job and stay strong. That's why you go up in space. You don't have gravity, that piezoelectric phenomenon doesn't exist. And you'd have bone loss. But that's an example of the kinds of interactions.

Epigenomic part is another example. And a lot of these processes, and we touched on this very briefly when the issue of proton tunneling came up. That's at an extraordinarily low energy level and secondary internal processes make that occur and change all the time. And we know that things, simple, things like the configuration of an enzyme is a configuration of proteins in general. It is highly dependent on these hydrogen bonds, which are susceptible to proton tunneling. And as a consequence, all these processes we have, we really don't have an idea of how these work and some of the secondary processes. We're back up the “arc of understanding” at the bulk material level. And until we can get further down. And we will eventually, but to me, we're not there yet. So I just wanted to offer that as a concern, At least from my perspective, a concern of where we are in terms of the science. And I'll leave it at that.

Abrami: That said. We don't know what we don't know. Thank you for dialing in from your vacation. Everybody's had a chance to weigh in. And what let's talk about next steps here. What I mentioned, the last meeting, I think we should form a work group to take these ideas. I asked for volunteers. I got Representative Wells, Dr. Chamberlin, Denise Ricciardi, Carol Miller, Dr. Heroux, and myself that will meet as a work group, to at least put some ideas on paper. We threw a lot of the ideas around here today. We have to do, as a group is take each one of those ideas and see if it will pass muster as a recommendation in our report. And so that's what I think what we'll do. I will work with those people and set up a meeting to do that and then maybe have to meet once or twice before our next meeting. We're running out of time now. We have three months left. I did say I was going to try to follow up to see if we get an extension on the date, but because we go to the next Legislature, I think they really want us to have our report out by November first. So that's what we'll continue to shoot for. So any objection to what I just said? I think that we've got a small work group that will work on this and put recommendations on paper and will get that out to everybody.

And at the next meeting we'll go through each one of those and have a discussion around each one of those to see if there's support for it or not support for it. And having the discussion, some of the discussions we just had, the science discussions, but also the legal discussions as to what we can make work for municipalities. What message we want to send to the federal government about this delegation or other ways.

Sherman: I just wanted to remind everybody, you know many of us have served on many commissions and committees. And I believe if there is a dissenting view to whatever the majority wants, there is the capacity for Minority Report. Is that not correct?

Abrami: That's correct.

Sherman: So I'm just saying that not because I'm encouraging a Minority Report, but because for people who haven't served on commissions or members of the public, the goal is to reach some level of consensus, but perhaps not unanimity. And, and so we may end up with two reports and that's just the way Commissions work.

Abrami: Yes. I think I mentioned that the past. Yes. That's the way commissions work. Okay. Which brings us to Denise. I want you to just weigh in a little bit on the lack of the response to nonresponse response we got from the FDA.

Ricciardi: So I sent several questions to the FDA and the National Cancer Institute regarding answers that are very important to this commission and our decision making. The questions were ignored at first. After I kept at it, I got a response that was not an answer to the question. I point blank, asked and numbered the questions and said we need an answer to each question not linked to their website that we already know that we already have. That's very frustrating. And that was the situation on both counts with the FDA and the National Cancer Institute. So I tried to reach our United States senators offices and finally yesterday I spoke with a staff member in constituent services. And I have forwarded our questions to that office. And I feel at this point, it's going to take our U.S. senator to insist they answer the questions. And I find it very telling that they don't want to answer them. We are a

commission with a very important task and I don't understand why they want to answer these questions. I'll give you an example. I'll read one of my questions. The FDA is aware that cell phones violate the FCC SAR limits at body contact on high power. The FDA has written that because it's safety factor and that's what they do. What is the safety factor for SAR the FDA relies on and at what SAR level above the FCC limits will the FDA intervene? So they have written that that it is not safe on body contact, but then they don't do anything about it. And why will they answer one simple question? That's just an example. So that's where we're at. I'm still waiting.

Abrami: Tom, I'm going to ask you to help us out with that and try to get maybe Senator Shaheen or someone to help us out with that.

Sherman: I am happy to.

Ricciardi: It's her office that I spoke with. It wouldn't hurt to have you follow up as well.

Sherman: I can call their state directors. I reached out to them about the FCC and we didn't get anywhere. It's not because they didn't try but because they didn't get a response. It's frustrating.

Abrami: So if, if the commission doesn't mind, you all remember Theodora from Environmental Health Trust. She had reached out to me about the FCC and if you don't mind if we give it a few minutes and then Beth, if there's anybody on this that from the industry that wants to respond, we will give them that opportunity as well. So if you don't mind, we'll have Theodora spend a few minutes. We have about a half hour left.

Scarato: Thank you so much. I had sent over and just wanted to make everyone aware of the documentation that I received from the EPA with a lot of questions. Their response to my questions was that the EPA's last review was in 1984 in terms of biological effects and they gave they cited that you should all have a copy of the questions and the answers. Just to go over what the EPA said. I said what's the research? Has EPA reviewed the research on damaged memory? They say they don't have a funded mandate for radio frequency matters. And in regards to the birds, bees, and trees, what's really important is that the limits were not set of course for birds, bees or trees and the EPA seem to confirm that in the answers that they sent. Also in regards to the safety factor, I would note that I think this is a really important question, so I'm glad it's being asked because it said that there's a 50 time safety factor. But when it comes to phones against the body, is certainly couldn't possibly be a 50 times safety factor for that in terms of the heating effect. So want to make sure you have that as well as the scientific letters that were sent to the FDA in regards to their report, their literature review on only cancer. They didn't look at other end points comprehensively. And you'll notice that Dr. Albert Manville, the former fish and wildlife lead, who is now retired, wrote stating that the current FDA statement is irresponsible, unfounded, and sets a dangerous precedent and so on. But please take a look at those letters that were sent by the scientists regard to the FDA. So thank you.

Abrami: Thank you. I think I did send that out to everybody. And if I recall, each response to each one of those was "that's not our mandate"Something like that. Is that correct? Right. So we have got it because Congress has mandated us look at this, something to that effect. Again, next steps are going to

be getting the working together a couple of times. In terms of the next meeting, we could try to put a stake in the ground and come up with a date while everybody's on the Zoom meeting here. Are people on vacation? Are they staying local? August 28th? Who cannot make August 28th at 09:00 AM? Brandon can't. I want to make sure the Working Committee has enough time to do what they have got to do.

Sherman: I'm on vacation on the 28th, but I can do it anyway. I could do Monday, the 31st if that worked. I don't mind dialing in. It's no problem.

Okay. Okay. How about Monday the 31st? Anybody can't make money to 31st? Okay, why don't we save that date, the 31st at 9 am. I'm going to reach out to the folks who volunteered and we'll come up with some dates for us to get together in between. So well, we've got about 25 minutes. Is there any other general discussion we would like to engage in? If not, I'd like to open this up to any other folks on the on the Zoom meeting that our guests, if they'd like to weigh in. I would allow that now because we have time. Does anybody else want to weigh in? Questions? Comments? suggestions?

Bloede: Yes. Oh, can I speak? I am Paul Bloede from Coloradans for Safe Technology. We had a meeting recently, Zoom meeting with an attorney that I wonder if your organization is familiar with this national level Attorney. His name is Julian Gresser. And he had a lot of comments about the legal state around the country of this whole issue and I thought he was very incisive and we have a transcript now with his presentation to us, we have that transcript just from last week as a PDF file. I didn't know if that would be of interest. How I could get that file to any of you, should that be of interest?

Abrami: Can you get that to me?

Bloede: Yes. Do you have an email address?

Abrami: Yes. Use abrami.nhrep@gmail.com.

Bloede: Yes, definitely. I will get that out to you. I think you will find it interesting hopefully.

Abrami: I'll get it out the others. Okay, thank you. Cece?

Doucette: Thank you Rep Abrami. When I first started investigating the wireless radiation issue, I thought as soon as we saw that it's especially harmful to children, that my school would have jumped up immediately and shut off the wifi in schools.

Abrami: Cece, why don't you back up and explain your involvement in this.

Doucette: Okay. I spent several years at Ashland Public Schools in Massachusetts doing fundraising for what we kept hearing our kids would need to succeed in the world. And that was basically the 21st century classroom, which is an industry campaign to introduce wireless into our school systems. And I had spent many years doing fundraising because our town didn't have the budget for that. I started looking and an engineer friend of mine tipped me off that there could be harm. So I started my investigation and I came up with a few studies that were saying no harm. I didn't understand at that point that "no harm" is not the same thing as "safe", right? So I started looking a little bit deeper and

then I start finding peer-reviewed studies all over the world showing great biological effects. And the set of studies that got me on my feet were the sperm studies, where they've taken male human sperm and expose it to a laptop with the antennas on. And it changed the DNA, it slowed the motility in it cause far fewer sperm to be viable in just four hours of exposure.

We had just bought my youngest daughter a laptop going into high school. And of course she's using it right on top of her reproductive organs. So that was the day that I got involved in this. I have helped introduce legislation here in Massachusetts and I wish we were as swift as New Hampshire is. My bill has been in play for six years. There are others on the utility smart meters that had been in play for eight years. But even during this pandemic and the racial justice movement that's happening, our legislature is finally advancing three of our bills, so we're hopeful that that will happen here.

Early on in my journey, others who talked to me about legal action and I don't know anything about that. I didn't want to see lawsuits come into play. I just wanted us to do the right thing and especially protect our children. But then I got to listen to a conversation with somebody who was referencing Martin Luther King Jr. And what MLK was teaching us is that in order for important societal changes to happen, it happens through three channels. 1. The public gets educated and speaks up and thank you to Deb Hodgdon for being the catalyst in New Hampshire who then spoke to Rep Abrami, who then drove down to my kitchen table here in Massachusetts. We had a long conversation about wireless. 2. There is legal action that happens to hold those who have infringed upon our rights, accountable. 3. Public policy ultimately catches up with the science or whatever else the issue is. So as much as it makes me uncomfortable to think about legal action, it's part of how change happens.

So to our Attorneys General, I hope you will look at this as seriously as you looked at tobacco and do the right thing, reach out to your colleagues and other states, get this conversation going. My understanding is the industry has already set aside billions for the lawsuits that are going to happen. But we cannot afford to continue to expose our children even during this pandemic, handing out hot spots without any information on how to use technology safely. So I implore you as a mother, as a woman who fell down this rabbit hole which I never wished to be in. But once you know the harm, you can't "un-know" it. And we have to use every resource that is available to us to start protecting our children, especially right now. So thank you for your time. I hope the commission will report out favorably something that we can hold up with pride and say, thank you to New Hampshire for being our nation's leader. And then we can follow suit in our states too.

Abrami: Thank you, Cece. Is there anybody else that would like to weigh in at all? Okay. I don't see any. I guess we will be adjourning. We will see everybody on August 31st at 9. And then, in the meantime the subgroup will be meeting. Did I mention that we're recording the meeting? I thank everybody for your time. Thank you to those who have tuned in from afar. Those on the Working Group, I will get an email later today with some dates that we can get together. Okay. Is there a Motion to adjourn?

Woods: I was the latest but I will make a motion to adjourn.

Abrami: motion to second by Carol. Without objection, we're adjourned.

V. Next meeting via Zoom: August 31st 9-11

Meeting Adjourned at 10:43 am

Text chat during Zoom meeting:

00:30:12 Bruce L. Cragin: ???

00:30:45 Bruce L. Cragin: ???

00:41:30 Bruce L. Cragin: Yes bring back Swanson!

00:43:58 Cece Doucette: Hawaii County Council just passed their 5G ban

00:45:51 Bruce L. Cragin: Ha

00:50:10 EH Trust: There have been attempts to overturn the Telecom Act section 704. Some links her e<https://ehtrust.org/policy/the-telecommunications-act-of-1996/>

00:51:17 christine.melkonian: YES, to public awareness

00:54:54 Cece Doucette: It was our state attorneys general banding together and suing the tobacco industry that finally brought the toxic effects mainstream. Perhaps the Commission can recommend that NH lead an effort for attorneys general to band together on wireless too, which if successful, would help to provide the funding to put safe, fast, sustainable technology in place. I believe NH still receives funding from the tobacco industry lawsuit today.

01:01:20 EH Trust: Also the Telecom Act Research continues to show effects from power lines. See studies here <https://ehtrust.org/science/research-on-magnetic-fields-extremely-low-frequency-electromagnetic-fields-cancer-and-miscarriage/>

01:02:08 EH Trust: Many countries have protective limits in regards to power lines, over a dozen. They set limits at the level linked to cancer in children. But the US has no limit at all. <https://ehtrust.org/policy/international-policy-actions-on-wireless/>

01:02:29 Bruce L. Cragin: Exactly, Sen. Gray. So much fearmongering.

01:03:56 EH Trust: Two published studies by the Ramazzini Institute “Carcinogenic Synergism of S-50 Hz MF Plus Formaldehyde in Rats” (2016) and “Life-span exposure to sinusoidal-50 Hz magnetic field and acute low-dose γ radiation induce carcinogenic effects in Sprague-Dawley rats” (2016) found that ELF exposed rats had statistically significant increased incidence of several type of malignant tumors when combined with a known carcinogen.<http://onlinelibrary.wiley.com/doi/10.1002/ajim.22598/full>

01:04:44 Bruce L. Cragin: And here comes some more ^^^

01:12:17 Bruce L. Cragin: Re. A., you're hearing ONE sde, not both.

01:33:08 Bruce L. Cragin: Physicians are not physicists.

01:33:27 Ken Wells: Bruce: This one is

01:33:48 Bruce L. Cragin: You, Ken? or Gary?

01:34:08 Ken Wells: Dr. Woods

01:34:35 Bruce L. Cragin: Thabk you. I will contact him.

01:37:54 Bruce L. Cragin: <http://bobpark.physics.umd.edu/WN10/wn121010.html>

01:39:17 Bruce L. Cragin: Sorry, I meant <https://quackwatch.org/related/signs/>

01:44:10 Bruce L. Cragin: <https://americanbeejournal.com/why-we-shouldnt-fear-5g/>

01:45:48 EH Trust: The FDA scientists letters are found here <https://ehtrust.org/doctors-slam-fda-report-on-cell-phones-cancer-and-health-effects/>

01:46:04 EH Trust: Dr. Manville <https://ehtrust.org/press-statement-from-dr-albert-manville-on-the-fda-report-on-cell-phone-radiation-2/>

01:46:38 EH Trust: The EPA letter can be found here <https://ehtrust.org/epa-birds-bees-trees-5g-wireless-effects/>

01:47:05 Bruce L. Cragin: "FDA scientists" or activist scientists?

01:47:24 EH Trust: The letter from scientists to the FDA.

01:47:42 Bruce L. Cragin: Yes that's more honest.

01:47:49 EH Trust: NIH scientists, experts internally signed, several on the world health organization emf group

01:50:20 EH Trust: Several of the scientists are expert advisors to the World Health organization who are asking the FDA to retract their flawed report on the studies.

01:54:13 christine.melkonian: YES

01:54:20 Bruce L. Cragin: I give up. You people are just lost. The idea that a commission of legislators has the scientific capability to meaningfully question the standards is ridiculous.

01:54:26 EH Trust: Resources on Wi-Fi in School <https://ehtrust.org/wifi-in-schools-tool-kit/>

01:55:14 Ken Wells: Aug 31 at 9am

01:55:47 christine.melkonian: Thank you so much

01:56:28 Cece Doucette: Thank you to the commission members and others, please feel free to reach out if there is anything I may help with. c2douce@gmail.com

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

8/31/20

9:00-11:00 am EST

Via Zoom (<https://unh.zoom.us/j/95489344931>)

Via telephone-US (1 312 626 6799 (US Toll) ID: 954 8934 4931)

In attendance: (12)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Senator Tom Sherman-president of the senate appointee

Brandon Garod-AG designee, Asst. AG Consumer Protection

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Carol Miller-NH Business & Economic Affairs Dept

Not present: (1)

David Juvet-Business and Industry Association

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Meeting called to order by Rep Abrami at 9:05 am

Abrami: Due to the Covid 19 virus and the Executive order signed by the Governor this public meeting is allowed to be conducted via Zoom. It is open to the public for viewing and was duly posted as a zoom meeting. With that said, if you are not a member of the Commission, can you please turn your cameras off and mute yourselves? That would be much appreciated. In addition the meeting is being recorded as an aid to doing the minutes. All chat room discussions will be included in the minutes.

I. Approval of minutes from 7-24-20:

I have not received any comments or changes to the minutes. Are there any changes? Without objection, we approve the minutes from that meeting.

II: Proposed report format/ Procedural Discussion:

Abrami: We also sent out a copy of the agenda and the proposed final report format and recommendations the work group has been working on. That's the primary reason for the meeting is to talk about those and if there are any other recommendations. This is what I am thinking about the report: Preamble, Definition of Terms, Physics, Study process (who we heard from, etc.), then a section of the questions posed by the Commission in the legislation and the answers, our recommendations.

What we consider firm recommendations for lack of a better word and also listing some other things that we decided not to make recommendations. There will also be appendices and supporting documentation for the recommendations and of course the minutes will be attached to the report. This is what I am thinking but I am open to any changes. Are there any questions on that?

Cooley: Rep Abrami, just one question on that. In the outline, where would a minority report or dissenting opinion fit it?

Abrami: I will double check this but it's a separate report that gets attached to this report. I know there will likely be a minority report which is fine. I will get clarification on that. It was easier when we were at the state house and I could just walk over and ask but I will get clarification on that. OK?

Cooley: Yes, thank you.

Abrami: There is a work group that consists of seven members: Carol, Denise, Gary, Ken, Kent, Paul and myself. There are seven of the twelve members that have been active. The working group met three times. We started with a baseline of ten recommendations and we have done several iterations on these. Obviously, these are open to discussion today whether you think they should or should not be in the report, etc. Since I sent these to you I have gotten two updated versions that I sent to you this morning. Sorry it was late. One is from Paul with some minor changes. One is from Jim with some major changes. Hopefully, you have seen them.

Sherman: Pat, I also sent some minor edits to Paul's version this morning.

Abrami: ok. I didn't see those. So can you chime in when we get there? What we will do is take them one at a time and have a discussion around each one. I had a communication with Beth about, do we really want to take a vote on these today given that you have just received them this weekend. What we can do is take a straw poll to see where we are on each one of them and not be an official vote. When we do a final vote on these, if the majority votes yes, it will be in the report as a firm recommendation. If not, then it's not. After that, we will have a vote on the report with everything in it. There are twelve members that are active, so if it ends up 6-6, I will have to figure out what that means.

What I would like to hear from you today possibly three things. 1. I like it the way it's written. 2. I would like to make some changes then I could support it. 3. No matter what, I don't think this recommendation is needed. Certain members of the working group took charge of certain recommendations so I will ask them to describe the recommendation and what the motivation was behind it. If there are any other recommendations please let us know in this meeting and we can deal with those.

Sherman: Before we go to Recommendation 1, can I just make a comment on the first paragraph?

Abrami: Sure

Sherman: This is a great sentence but it's very long. On the last one it says ", thus the commission ..." I think it would be clearer if you had a period and the words, "given these considerations, the commission yields". My feeling is that it's fine but I would have the last sentence be independent. That's in my edits for what it's worth.

Abrami: I get it. That's a good one.

Wells: I submitted an edited version of this one and changed it into a bullet list.

Abrami: ok. Boy, I am behind in my email. I missed that one too.

Miller: Which document should we be looking at? The original and everyone can chime in with their changes? I have multiple versions open and I don't know which one I am looking at any more. I think the one that you sent was Revision 3. Correct?

Abrami: Yes. If you see red in there, that means there were changes.

Sherman: which one did you send?

Miller: It was Revision_3 5G Recommendations.docx

Gray: since we are commenting on the first paragraph, I took out a couple of different things in my revision. I think that whoever puts this thing together at the end should consider removing and only presenting facts and not things that aren't facts.

Abrami: What you are saying is that the things that you crossed out aren't factual.

Gray: Right. You talk about the whole insurance industry, well that's not true, ok? The insurance industry if you leave it like that is more accurate. In the next sentence down you say "because of" instead of "due to potential harm". Thank you.

Abrami: I agree with those. These are good ones.

Gray: The word "determined" is used many places. In my edits part of my suggestion is that we take that out and replace it with the word "believe". The definition of determined is that it's found to be a fact or conclusive. In the first paragraph of the report we say that none of this is found to be a fact so again... take that word out and replace it with believe or a word of your choice. That would be a good revision.

Sherman: If you are anticipating a Minority Report, then wherever you have "the Commission has concluded" should be changed to the Majority or this Majority of the Commission has concluded... because you are going to have a Minority Report that has not concluded that necessarily. I think you will be a little more accurate using that phrase in the Majority report. That's only if there is going to be a Minority Report to recognize that the entire commission does not agree with this report.

Abrami: That's a good point, Tom. I anticipate there is going to be a Minority Report.

Gray: I will write it.

Abrami: Ok. So we are going to have a Minority report. Anyone who wants input into it can send me their comments.

Roberge: I haven't had a chance to talk with my leadership from DHHS on any of these recommendations so I may have additional comments from a resource perspective once I have had a chance to look these over with leadership. Also, I know we talked about this at the last meeting about not formally taking a position on the recommendations just due to the role of the department. I think we would just want to have a statement in the report reflective of that.

Abrami: right. It will say effectively that the recommendations do not necessarily reflect the position of any agency, Attorney General's office or Dept of Health and Human Services.

III: Work group recommendations and discussion:

RECOMMENDATION 1- Propose a joint resolution of the NH Senate and House to the US Congress and Executive Branch to require a review of the current radiofrequency (RF) standards of the electromagnetic radiation in the 300MHz to 300GHz microwave spectrum, used to measure exposure and health study to mitigate the health risks associated with the use of cellular communications and data transmittal, promulgated by the Federal Communications Commission (FCC).

Cooley: With the whole caveat that I received these Saturday morning and have not spoken with my members or with legal dept. so that will be my disclaimer throughout all of this discussion. My one question about this recommendation.... The first sentence of the last paragraph that says, " this commission believes that EMR is on the path to be confirmed as a class I carcinogen, where does that information come from? Is there a footnote? How is that assumption being presumed?

Miller: Recommendation 1 is a merger of something that I had written and Paul had written. That particular phrase came from Paul. Can you speak to that?

Heroux: Essentially that would refer to an article by an epidemiologist Anthony Miller who is very active with IARC. In other words, IARC has agreed to review the situation and in the last report what was missing was animal evidence and its likely there will be an upgrade to the classification because you have two major studies NTP and Ramazzini that now provide animal evidence.

Abrami: We need to refer to the papers either as a footnote or in the appendix.

Cooley: I think a footnote, Mr. Chair might be helpful because this is someone who has not presented before the Commission. I don't know who they are and it's the opinion of one person. I think backing up that claim or allegation would be helpful.

Abrami: The gist of recommendation 1 and I don't know Beth, why your organization would not think it's a good idea saying that we do have more to study. That's basically the thrust of this. There are a lot of organizations asking for this. Carol, why don't you spend a few minutes on this.

Miller: This is a joint resolution of the New Hampshire Senate and House to the US Congress and Executive Branch just requiring a review of the current RF standards and asking for a health study. The un-highlighted text is just back up and could probably be moved to the appendix. I don't know if anyone has any questions about that particular recommendation. I think it's pretty straight forward.

Sherman: I thought the recommendation was fine. It was straightforward but I thought there was a clearer way to describe what we are trying to get done. The edit that I suggested would read: "Propose a joint resolution of the NH Senate and House to US Congress and Executive Branch to require the FCC to conduct or commission a review of the current RF standard of EMR in the 300Mz-300GHz microwave spectrum as well as a health study to assess and recommend mitigation for the health risks associated with the use of cellular communications and data transmittal". I just think it's the active which makes it clearer than passive.

Miller: So you are suggestion after the word "require" to put the "FCC" right there.

Sherman: yes and after the word, "spectrum" I would use the words "as well as a health study to assess and recommend mitigation for the health risks associated with the use of cellular communications and data transmittal".

Miller: I am ok with that. Anybody else have an opinion about that?

Abrami: That's fine with me. Does anybody have a problem with that?

Gray: Again, I have made many changes in my edits and I don't object to many of the words that Dr. Sherman has put forward but I still think the rest of those paragraphs need to be looked at. When I read this report for the first time, it was very clear to me that someone who was a very big proponent of eliminating 5G or wifi, entirely, wrote this thing. That's not our job as a commission. I encourage you to take a look at my edits. I tried not to gut your proposals but to make it more neutral while still putting forth your proposals. Thank you.

Abrami: The work group will be meeting again on Friday. We have got our work cut out to try to pull all of these together. I am sure some of your words are going to make it into the report, Jim. The bigger question right now is who is opposed to having a joint resolution where we say that more study is needed on this topic? Who is opposed to that? We can tinker with the words.

Gray: I am not opposed to having a study but I want you guys to know that the reality of having a joint House/Senate Resolution is practically nil. The Senate has these resolutions and has determined that it's

better for the citizens to go out individually contact their Congressmen than to do one of these resolutions.

Abrami: It is our understanding on the House side that the Senate doesn't like joint resolutions. We were trying to give it a little more umph. No matter what we do, it will be a sell to whether it's just the House, where we will have to get 201 members to agree to it. We thought it was important that as a commission that at very least, we make a statement that further study is needed, bottom line. Having the full House and Senate would give it more umph than just the commission.

Ricciardi: I want to make two statements if I could with all due respect to everyone. I am going to speak for the seven of us on the working group. I don't believe any of the six of you are against technology by any means. We are for it and we presented solutions that are safer, quicker, better latency. I don't appreciate that we are called out as saying we are against it. That's simply not true. I've got my cellphone right here ok? I want to clear that up right now. We are not against it. We are against the way it is now and we have shown a better solution as you get down into the recommendations.

The second thing is, we are tasked with a job based on the findings that we found. We don't sit here and not put them forward because the Senate or the House won't go for it or we didn't do our job. Our job is to present the truth. You don't, not present the truth because you are afraid of the outcome. The truth is the truth. You place it there and see where it goes. The seven of us with the testimony, the evidence and the science came to these conclusions. Anyone else who disagrees is allowed to and I respect their opinion and they can follow up in a report. But I do think we should get through it so we all have a good sense of where we are at. I am going to reiterate this. It is unconscionable to not tell the findings because you are afraid it won't sit well with someone or won't pass. That's my two cents.

Abrami: Thank you, Denise.

Sherman: Pat, I have a few edits on the paragraphs following recommendation one if this is the right time to mention them and they are minor. The words "living things" at the end of the second paragraph. I would replace that with "organisms" which is a slightly more scientific term for living things. The Obama-Biden plan to combat cancer, I am concerned about including that if it was never adopted by any elected body. If it was 2008, was that a campaign plan they had in 2008 because certainly the FCC would not be held to any campaign plan. My recommendation would be if it was adopted, then include it but if it was a campaign platform, I would delete it and just have the first one which was the National Cancer Act.

Miller: I am ok with that. I didn't write that particular piece.

Abrami: I think Tom has a good point, Paul. Was that ever enacted?

Heroux: I am trying to find out what type of formal approval this had but I think I should do it later.

Abrami: yes. Please do it later.

Gray: Sometimes these things are done by Executive Orders. But the paragraph ahead of that, where you talk about the FCC, all needs to be restructured also. Rewording that so it flows much better is something that you should consider.

Sherman: I agree with Jim on that wording because rather than have the word “favorable” in that paragraph with the Ninth Circuit Court, I would use what Jim said which was what the ruling was and what it will result in. I haven’t seen Jim’s version of this but I would favor being as clear as possible. The word “favorable” leaves a question as to who is it favorable to? Is it favorable to the FCC or the plaintiff?

Abrami: Carol, I am looking at you.

Miller: I am ok with removing that and I am not that invested in the surrounding documentation and it should probably be moved to the appendix. With regard to this, there is a lot of information in there and I think it just muddies the water.

Abrami: Ok, you heard all the comments Carol to modify.

Miller: If people send their recommendations directly to me, I am happy to do that or its going to get lost in the shuffle. I have Senator Gray and Senator Sherman, who else had comments?

Cooley: I just had a footnote on the article by Anthony Miller.

RECOMMENDATION 2- Establish a State position that protects the State and all its Municipalities from any liability from harm caused by small cell antennae placed on the public rights-of-way. Specifically liability of the State of New Hampshire and its municipalities connected to harm caused by claims of personal damage or harm from the deployment of 5G small cell towers or the attachment of 5G antennae on telephone poles, electric poles, lamp poles, or other structures on the public right-of-way is by state statute transferred to the Federal Government. The Federal Government shall be required to defend and indemnify the municipality from any liabilities arising from permits and the installation, operation, and maintenance of small cell installations.

Abrami: We had some discussion about this. This had to do with protecting our municipalities from harm. Do we really want this recommendation or not because the feeling is that it will put citizens in a bad position. I actually originally wrote this and Paul took it from there. Our communities are being forced to deploy small cells at telephone height and I thought about holding them harmless. This was an attempt to protect our municipalities, but what about people?

Heroux: Well, this is a rather legal question. I think we all recognize the motive of Rep. Abrami's original statement. But, if the federal government cannot be sued and if this recommendation goes nowhere, what is the means by which we can support municipalities and individuals who might feel helpless in relation to this problem in the sense of congealing their actions together and make sense of it and rationalize it.

Woods: It seems as a discussion, we went over this very point and the complexities of having a liability element in there as a recommendation. We wanted to include it but perhaps put it at the end as an observation. And couch it in terms that we understand that this very well may be an issue that will come to the fore that we did not have a recommendation but wanted to recognize that this is an issue that will perhaps need to be addressed in the future.

Abrami: right. I put in my notes...discussing whether to demote to something less than a recommendation.

Sherman: Brandon is with the AG's office. Could we get an opinion whether this is even possible? What's happening is states and municipalities are being asked to approve these but based on FCC rulings, they don't really have a choice. As a result, if the people of the town are harmed, and go after the municipalities because they can't go after the federal government (FCC) then they are stuck. I am concerned that municipalities will bear the brunt of liability without being able to say no to the request from the cellular company. Do we have any wiggle room on this? Or is it something that is not worth mentioning because there is nothing we can do about it? Can Brandon weigh in?

Garod: I'll do my best with the caveat that gets into the question of what is civil negligence and what establishes the liability for civil negligence. That is pretty far outside the realm of what I typically do in the consumer protection world. But, I had two initial thoughts when I looked at this. Because municipalities are being forced to this and don't have a choice. To bring a suit for negligence there has to be some sort of negligent action like setting aside the standard of care. If they are being forced, I don't know how a community could be held liable for that. If they did have an option and did not do their due diligence and allowed this to happen, that's a different story. It's very clear that other than aesthetic regulation, the placement, design, size of something in a public space, municipalities have no authority to say no to 5G technology being moved into their town. I don't think there is a huge risk of liability for municipalities.

When I went back to the legislation, and looked at what the commission is supposed to do, I think this is a bit of an outlier. I think it may be worth mentioning that there are concerns about who would be liable. I don't see anything in the commission's tasks as to what steps we need to take legally protect municipalities or the state from possible liability. It's more getting the information out there, developing strategies to limit exposure, public policy statements rather than developing a plan to protect municipalities from liabilities.

I think that likely if there are lawsuits in the future, that they will be directed at cellphone companies who are pushing these things out aggressively without doing their research and they have acknowledged the risk of harm as they recommend not putting it near your head but if they are then

going to implement towers everywhere and not give anybody a choice, that's really their choice. I am not sure that their choice and actions can be imparted onto municipalities that don't have an option and trust the FCC that they are doing what they are supposed to be doing about safety. Those are my takes.

Ricciardi: The seven of you know that I have been against recommendation 2. I feel it's a dangerous recommendation and we should omit it. State government needs to make these antenna safe not indemnify or protect government from liability or responsibility when they allow them to be deployed unsafely. We need state government to say no to these transmitters and challenge legal cases around Section 704 of the 1996 Telecommunications Act that prevent them from even considering health and safety. I don't think we should have Recommendation 2 in there at all.

Abrami: My original thought on this one is...the new twist is that these antennas are going to be in the public Right Of Way. In the back of my head I'm thinking there is something different about these being in the public Rights of Way. We have two, the municipal and the state ROW. We have town roads and state roads. So, that's the game changer for me. That's what's different about this. We have no control of those antennae and what's coming out of them. I am okay with eliminating #2 or demoting it.

Sherman: The real problem here, as Brandon said is that the municipality and the state can only object on the basis of aesthetics. We should be asking our federal delegation to bring legislation that would allow or expand the ability of municipalities and states to challenge the placement of 5G/small cell technology based on concerns about health risk. That is getting to the meat of the problem here. The reason that #2 exists is because municipalities and states have no ability to challenge FCC ruling on the basis of health risk. To me, that's the crux of the problem. What needs to happen is we need to allow local control with regard to health concerns for this technology. Local and state governments should have some regulatory impact on whether or not this is rolled out.

I can't believe that the FCC can do this without any consideration of health impact. I would change #2 or I would change the concern to: the Commission will write a letter to our federal delegation urging them to bring federal legislation that would expand the ability of states and municipalities to object to implementation or placement of 5G/small cell technology based on their concern for health risk. That's the way I would take this, rather than going down the liability corridor which gets us into the issues that Brandon was talking about.

Abrami: Right, the courts are not reviewing whether it's good or bad. They are just following 1996 statute.

Sherman: Frankly, if the industry wants to bring Xenon ray guns out that transmit data quickly, they can do it if the FCC says they can do it. The FCC has the power to say, you have no right to object to whatever technology that the telecommunications industry brings forward based on health risk. That's it. That's the problem.

Heroux: what the FCC says is that certain levels of electromagnetic radiation and power density are not harmful. It has a stranglehold on that because this was a main preoccupation of the engineering community. It also says that you have to provide telecommunications service. But these two

requirements leave a lot of ground for other arguments. I think aesthetics is a very weak word to describe the leeway that you actually have. Without confronting the FCC, you can probably do lots of things.

Chamberlin: My point is that we might want to wrap #2 into #1 since they are pushing for basically the same thing having our federal delegation become involved in changing the policies for objecting to cell tower placement.

Abrami: that's a possibility. Also, I should have mentioned this earlier. We had a discussion in the working group about even using the term 5G but broadening that to a certain bandwidth of RF because 5G may be passe in a year or two with 6G. 5G is just a marketing concept. It's being rolled out differently by all of the cell companies. Some are using small cell towers and others aren't. I don't want to burden this here but we are looking for words to use in the report that would be broader than 5G.

Sherman: I would fully support that.

Wells: I agree and I can write some language about that.

Abrami: #2 won't stand the way it is and we will take a crack at it by either incorporating it in #1 or coming up with some additional language here. Basically, the change that would have the most impact is for the U.S. Congress to act. We all know that. That's a tough one. There are bills filed every once in a while but they tend to go nowhere at the federal level but as New Hampshire we will throw our two cents in. Or at least the Commission will.

RECOMMENDATION 3- Require the New Hampshire Department of Health and Human Services or other New Hampshire agency to include links on its website that contain information and warnings about RF-Radiation from all sources, but specifically from 5G small cells deployed on public rights-of-way as well as showing the proper use of cell phones to minimize exposure to RF-Radiation. In addition, public service announcements on radio, television print media, and internet should periodically appear, warning of the health risks associated with radiation exposure. Of significant importance are warnings concerning the newborn and young as well as pregnant women.

Chamberlin: the part that we were most recently looking at in our subcommittee is an establishment of a registry that would be on a website. The reason for that registry would be for people to log their concerns. How I became aware of this being at the University in electromagnetics, a number of calls from concerned citizens get routed to me. I tell them what I know about exposure to electromagnetic fields and they are sometimes concerned that they don't have an avenue for reporting their concerns. I tell them that there is not much they can do about exposure at this point because of the 1996 Telecommunications Act and so they are stuck. Where do they go? Do they go to the FCC? That doesn't seem to be a very productive avenue. I feel by having a registry, we can get a sense of how many people

are concerned in the state of New Hampshire and to build essentially ammunition if there are a lot of concerned people so we can go to the federal delegation and have them do something.

That's the second part that I really addressed and that is have a registry where citizens can report concerns so we can get a sense of how many people do have concerns. If it's only one or two then maybe the point is moot but if we are getting hundreds that's something that we should know. Paul, did you want to address the other aspect of this?

Heroux: You are right. We wanted to give an access point to monitor this situation and the access point could be for either individuals or organizations or a separate access point for both of these.

Gray: This is Jim. This recommendation first of all should not be for the Dept of Health and Human Services. It should be for the state because we don't care what department it is as there may be a better place to put it. It's more realistic if you have the state collect data. What we are talking about here is a man year of effort and supervision and if the volume is high, maybe more than that. That would be a budget issue and again, do we really want that and will the legislature approve it?

Abrami: we know most of these will have to go to the legislature for approval but first someone has to file the bill. Those discussions will happen there. We decided that we want to make the recommendations and let that process work through.

Chamberlin: I have done websites like this and to provide information and add links as we have done with the website associated with the Commission. In terms of a registry, it could be something as simple as a survey. I have created those in an afternoon. We could create a survey that is appended to the website. I think we are talking about a man week as opposed to a man year worth of effort.

Heroux: I echo that comment because with automation today, it's fairly easy to create a link and a person from within the state can access this link and file a pdf document automatically. If you have many requests then you might face the labor of assessing these requests but as Kent pointed out, you wait until you have many and then you know it's worth it. Thank you.

Roberge: As I said earlier, I have not had the opportunity to talk with leadership about this so I may have some additional comments. One thing that I thought of and it's been talked about a little bit here is funding for this. If the department is required to do a registry, there are obviously database requirements and an evaluation component. One thing that concerns me is that if we are collecting this information, at this point, we don't have any authority to do anything with it. That's somewhat concerning to me because if we are collecting all of this information, what is the dept doing with it? I know DES has been mentioned, I am not sure if they are appropriate either.

I know DHHS has a radiological program. It's a small program that is focused on ionizing radiation. We license and inspect sources of ionizing radiation including x-ray machines in dental offices or hospitals or industrial radiography in industry or a radioactive materials program. Again, that is focused on ionizing radiation. The department also participates with Homeland Security Emergency Management and an emergency response program specifically for Seabrook Station. Again, it's ionizing radiation. I'm not sure

that DES is the correct agency. That being said, any additional requirements to do inspections, monitoring or in this case PSAs and things like that, there is a funding mechanism that would be an issue. If you had a registry, what are you doing with that data? Is it confidential? Will there be private health information if people are talking about radiation sickness? How involved are we going to be with these activities?

Also, I am not sure where the PUC falls in any of this. They do regulation of power lines so the radiological health program does not do power lines. That falls under the Public Utilities Commission. I am not sure where Telecommunications falls and if that would fall under PUC or not. I just wanted to offer up those thoughts and certainly I am going to take this back to my program and I may have additional thoughts to share at a future meeting or through email.

Abrami: It is my understanding that telecom is not really regulated like the utilities because it's not considered a utility.

Sherman: I have a few thoughts. We have a commission to study environmentally triggered disease and we have been working on this kind of database on that commission. We have been disrupted by Covid and it's a senate commission so we have not been allowed to restart but what we have learned is DES has a site where private property owners can put their well test results in. I don't believe that required legislation or if they did that through rules. Individual well owners could enter their data into the site and make it possible for DES to develop a database for private well owners.

There is also on the public health side, and Michelle knows there is an entire infrastructure of public service and the ability to generate public service announcements. One concern I would have is with well testing you have a certified report from a well tester. But with this, if you have people self-report with what is on their digital read out on their EMF monitor that has not been verified. I would be concerned about any agency being compelled to report non verifiable data. Just a few thoughts but this might be something we could take up with the environmentally triggered disease commission. There might be a softer language to recommendation 3 and I agree with Jim that we should not say which departments would do this because it could be one of several departments.

Abrami: My concern is what data? What are people reporting? It's one thing if it's data but just feelings? I don't know we have to be careful.... feelings based on what?

Chamberlin: We will talk more about data collection in another recommendation but for this one, this is just a way for citizens to say I don't like the way the current legislation exists, Section 704 of the 1996 Telecom Act. Whenever people hear about it, they get very concerned about it because there is nothing they can do because of this legislation. How many people are concerned would be helpful to us as we move forward. If only a handful of people go on this registry and register a complaint, that tells us one thing but if we have hundreds then that tells us something quite different. It would only be so people who register could have their voices heard. Right now citizens who are concerned have no place to go. They can write letters to the FCC as I have and very likely nothing will happen. This just makes it a state initiative to identify people who are concerned so we perhaps can do something.

Roberge: Is this appropriate for an advocacy group? I don't know that it's an agencies responsibility to survey the feelings in New Hampshire. I would want to go back and talk to my leadership about this. Any data that we hold, we would have to make sure that the data is safe and valid. I just wonder if it's more something that an advocacy group would take on.

Abrami: Michelle, after you talk to your leadership, can you just drop me a note so I get a sense of where they are?

Chamberlin: So, actually the registry was an add-on to the first part which is a website that contains information about exposure to electromagnetic fields. This is informational and the add-on is to assess how many people are concerned. So what about the first part does this seem to fall within the purview of your organization?

Roberge: Before I make any comment on that, I would want to talk to my leadership. Right now, we are knee deep in Covid, as you know. I would want to talk with them and I can come back and share with this group what I learn.

Abrami: We have another six to go through and we have forty five minutes so we are going to move along.

RECOMMENDATION 4- Require every pole or other structure in the public rights-of-way that holds a 5G antenna be labeled indicating RF-Radiation being emitted above. This label should be at eye level and legible from nine feet away.

Abrami: Basically, with antenna being in the public right of way, I thought it wouldn't be a bad idea to have the poles labelled to that effect as they may be on telephone poles or light poles, etc. Current towers are usually surrounded by barbed wire fence or some structure around it at the base with a sign saying....don't climb the fence. Obviously, there are different reasons for that. That's all this is, to label the pole. Beware of the device on the top of the tower. Industry would have to label the poles. Can we open that up for discussion please?

Cooley: Just more of a comment and again, I still have to talk to my membership and my legal department. There are other entities in the public right of way that also use low level non ionizing radiation. So, I question if this is discriminatory. In the public right of way, you do have utilities, electricity lines and you also do have the cable industry deploying micro-wireless facilities also using 5G. Again, I have to talk to my members and legal and I wonder if this is a discriminatory practice should the commission endorse this in the majority report.

Abrami: So what you are saying is any device in the public rights of way emitting RF should have this sign. That way, it's not discriminatory. Is that correct?

Cooley: I don't know. I will have to speak with my attorney. I flag that as a concern. There are other entities in the right of way and this is targeting one.

Abrami: Brandon, do you have any comment on this one?

Garod: It's close. I think it's dangerous to apply if it only discriminates against one type of entity then it's definitely preempted. That's actually contrary to what the Portland case said. In the Portland case, they found that different types of restrictions can be applied to different types of infrastructure. Really, the key takeaway is if the effect of whether something discriminates against a particular company of particular type of infrastructure would have the effect of prohibiting their entry into the state to provide services, then that would be preempted. But, if it's simply requiring a certain type of infrastructure to provide a warning that is consistent with the type of radiation that is emitted by that type of infrastructure and placement of that type of infrastructure, I think there is an argument that could be made that that is permissible and wouldn't be preempted.

All of this is sort of fuzzy. I think that is in line with the court when the court prohibited the FCC from regulating too broadly a state or municipality's ability to regulate aesthetics that may be discriminatory against one particular entity but as long as there is a reason for it and it's not prohibiting their entry, I think there is an argument that can be made that it may not be preempted.

Sherman: I agree with Beth in a way. If there are multiple devices emitting RF, we should not have that warning limited to the telecom. Maybe the warning should read that there is an RF emitting device on this pole, no matter what that RF is. We know that cell towers look like. Right now, we don't know what 5G or small cells look like and we may not recognize that that emission is occurring from that pole. Rather than being specific about the industry, we should be specific about that which we are trying to protect the public from which is this level of RF exposure and that would get around Beth's concern. If it's a cable company or telecommunications company or wireless company, the point is to identify that that exposure is occurring.

Gray: The first thing you need to say is who is responsible for putting the sign up there. If it's the owner of the antenna, you need to say that. Second, your problem with this recommendation is that you go back to your preamble, nothing has been proven about the health effects so you are talking about potential health effects. Do I have to put a warning on the side of my house because it has a transmitter that transmits my water usage and electric usage to people who go by? Again, this needs to be looked at carefully because it could be a whole lot of impact if it's not done right.

Abrami: That's good, Jim. Thanks. I will take a crack at modifying this one and we will talk about it again.

RECOMMENDATION 5- Require that schools and public libraries migrate from RF wireless connections for computers, laptops, pads, and other devices, to hard wired or optical connections within a five-year period starting when funding becomes available.

Wells: This is mostly about schools and public libraries where the environment has already been fitted out with wifi. There is strong evidence that the RF associated with wifi might have greater impacts on young children. The Precautionary Principle would indicate that alternatives to RF would be preferred. Two possibilities would be to go to hardwired connections to every device or use a different frequency range and go up into the optical range where there are not likely to be any health effects to that. One of the things that the state of New Hampshire could look into is that classrooms could be fitted out with a device like Lifi which is an LED lighting fixture based optical data transmission. We need to look at how we fund this but Carol recommended one possible fund may be the FCC's E-Rate program for telecommunications and IT for schools and libraries. We figured if funding was procured then five years would be a reasonable amount of time to complete a project.

One thing that I think is an important point to note is that the optical means for data transmission is much faster than RF. So, essentially you would be saying, let's just skip RF and 5G and go into the next generation directly.

Gray: Certainly the opposition report on this one would be that if you link it to funding, and implementation, you take out the word, "require" and its better and the schools will do it because you are paying for it and its better. I don't have a major thing on this except the word "require".

Abrami: So just encourage schools and libraries to look at alternatives including Lifi.

Gray: you would want to put in there that when public funds or whatever funds are available.

Abrami: right. The reason we put about the funding in there is that schools have spent a lot of money putting this infrastructure in place and it would take a lot to reverse that course. Hardwire is an option but Ken's suggestion of Lifi and our understanding at this point, is that it wouldn't be an expensive option relatively speaking.

Wells: It appears that Lifi would be plug and play. It also involves an upgrade to a more cost efficient lighting. You might actually come out ahead on this. We would have to look into what the actual costs would be and savings but there is a possibility it would offset quite a bit of the cost with energy savings.

Gray: Just as a caution when you put something in your report that you don't have to do it until the funding is available, you are already that it's not that bad. Certainly, the cheaper that you can make it would mean that a parent of a child that is sensitive to electromagnetic radiation, could fund the conversion of one classroom or whatever. Just think hard about this one if you go forward with it. What if your data from studies proves that it's not harmful, then mandating is the wrong thing to do. In my example, the funding will dry up if the radiation is not harmful.

Wells: The E-Rate funding is not tied to harm. It's tied to telecommunications and IT in schools and libraries. But it's a good point you raise about taking federal out of the description of the funding. It is possible that you could get a charitable donation to convert school buildings. That's a good idea.

RECOMMENDATION 6-Establish new protocols for performing signal strength measurements in areas around cell tower radiators to ensure compliance with regulatory radiation thresholds and to evaluate signal characteristics known to be deleterious to human health as has been documented through peer-reviewed research efforts (e.g.,[1]). Those new protocols are to take into account the impulsive nature of high-data-rate radiation that a growing body of evidence shows to have a significantly greater negative impact on human health than does continuous radiation. The measurements should be taken in regions surrounding the tower that either are occupied or are accessible to the public. Commissioning measurements are to be performed when the site is installed and at regular intervals if required by state statute or municipal ordinance such as those required by the town of Burlington, MA [2]. Measurements should also be collected when changes are made to the tower that might affect its radiation, such as changes in software controlling it. Measurements should be performed under worst-case scenario conditions when the site is transmitting at its highest levels.

Abrami: One thing as a state that I think we need to know is.... if these antenna generating RF are even generating within FCC guidelines? This recommendation talks about what the state should be doing about this.

Chamberlin: This recommendation really has two parts. The first is to come up with new protocols for performing the measurements. The way we measure RF right now is the way we have been doing it for 50-60 years. It averages signals and does not take into account the summative effect of having multiple transmitters. One thing the FCC guidelines do not take into account at all and that is, in the last thirty years think of how many transmitters have been added to the RF spectrum. Now we are not being illuminated by a single source like a local tv station. We are being radiated by cell towers, our own cell phones, wifi and the way that measurements are taken now don't take the summative effect of those radiation sources into account. The first part of recommendation six takes that into account and prescribes a different way of performing these measurements. Also, what's being found is that it's not the continuous radiation that has the greatest effect on us but it's the transient nature and impulsive nature that has the greatest deleterious effect on health. The way this is worded, takes that into account and specifies a new way of doing measurements.

The second part says, you have to make the measurements and I could find no evidence that a cell tower ever has to be measured unless maybe there is a report of someone thinking the radiation is too great. The FCC doesn't have a commissioning for cell towers. I am familiar with this from working with the FAA. Any time you install anything, you always have a commissioning measurement to make sure it's performing according to specs. The cell industry from what I have read has basically made calculations about what power should be radiated from certain antennas and they say these calculated powers are below the FCC threshold so we are good. However, I know from experience that you can get what is called terrain or building focusing of electromagnetic waves that gives you far greater signals than you would expect from simple calculations. The second part of this says whenever you commission a facility, you have to go and make measurements under worse case scenarios and you have to do it using the new protocols.

Just basically wanting to make sure that the towers are putting out the types of power that have been calculated and that those powers are below the FCC thresholds.

Wells: Thank you, Kent. That's really excellent. I would make one suggestion though. When you talk about focusing by buildings and terrain, could you also add beam forming?

Chamberlin: You mean beam forming from the antennas? I wasn't sure how much detail I should go into but I am thinking when you set up a test protocol, you specify the beam forming will be at the location of the receiver. It's actually buried in the worst case scenario statement.

Wells: right. I was just thinking that you acknowledged that the radiation can be focused by buildings and terrain but it can also be focused deliberately.

Chamberlin: I will add that in. Thank you.

Roberge: I just had a question in terms of implementation of this recommendation. How do you envision that? Is that something that the cell phone company would do after installation? Do you envision a reviewing body of that or an independent analysis? It is unclear to me how this would be implemented.

Chamberlin: I was thinking it would be a third party or some independent measurement organization, perhaps even the FCC.

Roberge: I come at this from a regulatory standpoint. If you put a requirement out there and a measurement happens. It's fine if it all works out great but what happens if the measurement comes in and it's not consistent with what requirements are or is it a true requirement? Or is this just a recommendation? It's challenging to implement something like this if you don't have a true standard and you don't have consistent measurement protocols. What happens if it's above? Who will be the authority to make corrections or enforce? If you are thinking of this from an enforcement standpoint, for instance if this cell tower measures above, what happens then? From an implementation standpoint there can be challenges with that.

If you are thinking of implementing this as a licensing or commissioning and enforcement of it then there would be a cost associated with it establishing a protocol program whether it's on the federal level or state level. Who is the regulating body for that? Just a couple of thoughts there.

Abrami: We talked about this. We can get lost in the weeds on the detail. This isn't words or legislation. For that we would have to have a lot more detail than what you see here. We are saying we need a better protocol and the state has the right to ask for an independent person to measure at the worst case scenario that it's within FCC standards. This is not trying to change FCC limits on this. I understand asking, who do we go to if it's out of compliance. It could go to the courts. Either this is a good idea or it isn't a good idea. To me, this is a good idea. I don't have a comfort level that the industry is taking into account all the other towers and RF soup in the area that they aren't really above the federal limit.

What we are saying as a commission is, we think it's a good idea to use an independent body to measure and if it doesn't pass the test, then we as a state want to say you have to turn that tower off. Now they may come back and say, it's not our tower, it's the one down the street. These are the discussions that should be done at the federal level but it's not. We need to move forward with this recommendation and then the detail comes in if someone picks this up to write a bill where we would add more detail on some of the things you are bringing up Michelle.

Chamberlin: I can make this really brief. Cece linked in the text chat with some certification requirement from Burlington, Mass. I will read that and see if I can add some of what they have done to our recommendation and move forward with that.

Heroux: Actually, this kind of a situation has been taken into account in the past in relation to the tops of buildings where you have forests of radiating structures and this is why advanced equipment that has frequency analysis capability was created. If these locations exceed, for example thermal limits, there is a requirement that says you have to have a power intensity reduction. But it has never been taken into account for the general environment outside these facilities. Essentially, because it's assumed that outside this region there is no hope that you will ever reach thermal levels. But if you are taking into account crest measurements and peak characteristics, of course the situation can change very substantially.

RECOMMENDATION 7- Require that any 5G antennae located on a public right-of-way or new cellular phone antennae of any type, be set back 1,640 feet (500 meters) from residences, businesses, and schools within a municipality enforceable by the municipality during the permitting process unless all owners of a residence or business or a school district waives this restriction.

Abrami: We went back and forth of this one in the work group. I will let Paul explain.

Heroux: Essentially, here there is no desire to challenge the FCC on power levels. There is no desire to challenge the availability of wireless services. There is just a desire to have these towers with a setback from dwellings where people live or work.

Gray: Your 500 meters is .31 of a mile. The recommendation doesn't take into consideration anything about the transmission, what the power level is at any particular point along that .31 of a mile. I went to look up the things that were listed there and found it very difficult. It took me to Google Docs. I looked also at our webpage to find them. Again, I think if you are going to include something like this then you need to start getting into more detail. But a third of a mile would eliminate cell antennas. There are an awful lot of people you can pack into a third of a mile.

Cooley: Again with the caveat that I need to discuss this with members and legal department. I do think there is an argument that can be made that this violates section 332 of the Telecom Act. That is, you are trying to tell providers where they can and cannot site facilities which could have the effect of impeding service thus increasing the cost and providing a barrier to entry. You are saying where we can and cannot go which has been ruled as a defacto moratorium and has been ruled unlawful. Again, I need to run that up the chain but that is my initial impression.

Wells: this is a section where we need to make a distinction. It is referred to as 5G and we need to have an RF definition. The thing that is unique about 5G is not the frequency or the power levels but the proximity to people. This recommendation talks about a setback which is dealing with the unique quality of 5G. It's very close to people. There are some other applications and implementations like smart meters that might also fall into this. We need to come up with a definition of what sort of transmissions we are talking about because to call it 5G is to give it a trade name rather than a physical definition.

RECOMMENDATION 8- Require power intensity disclosures for renters and buyers and for public buildings (locations where the general public may go)

Wells: This recommendation requires power density disclosure for renters and buyers and also public buildings. The idea here is that some agency of the state would also be a recipient of those readings so the public has some idea of what they are exposed to. I understand that the objection has been made many times that there is no safe threshold that has been specified. But we know that just as kitchen appliances have an energy usage scale on them showing where they fall on the range of low energy and high energy use, the same sort of scale could be understood by buyers and renters that perhaps less intense energy is more desirable than more intense energy. They can figure out where they stand in that continuum.

One other part that is important on this, in order to make this practical, the instruments used need to be affordable and available. We have identified one particular example, the GQ 390 meter and the price is under \$200. Some agency of the state could loan them or real estate agents may find it's more convenient to own their own.

On the state owned ones, it would be easy to get the manufacturer to verify they are all benchmarked and consistent in their sensitivity.

Abrami: the more thought I give to this one, there are really two pieces to this, the buyers and the sellers and then any public place. I think any public place would be really unwieldy. But the buyers and sellers, it's akin to getting a water test and a radon test. That's, basically what we are talking about.

Sherman: I have a concern. I see this running smack into the realtors. You and I have worked with them in the past and I am just thinking of a pre-recommendation compromise and one thought would be rather than requiring of a measurement and Michelle would probably tell us would require funding to have this program. In other cases, haven't we required full disclosure if you have knowledge of issues on the property. The seller would be required to disclose radon levels, lead paint, all of these other things. Couldn't we say the owner would need to disclose potential RF exposure or known RF when you sell a property?

Rather than putting in a whole new infrastructure, I think this is going to run into pushback at the fiscal level and at the regulatory level. But a lesser would be to require any known exposure to RF or RF levels.

Gray: This one is so broad reaching. What happens when I change one of my routers? Do I have to go retake the measurement and redo the posting? Again, we don't know what the safe level is. One of the things that could be done if we did know what the safe level is would be to set a limit up to this. And I know Dr. Chamberlin says it's the way we do beam forming and all that. This would be very difficult to do.

Abrami: the real estate folks have already weighed in by the way. You can imagine which direction they weighed in on.

Roberge: I was going to add in. Senator Sherman touched upon it. Depending upon how you envision this being implemented, there could be costs associated if this gets delegated to an agency to implement.

Chamberlin: we would definitely have to specify the conditions under which the measurements would be taken. I would say that when you are going to take these measurements for real estate purposes, you would turn off all internal sources so everyone would be on the same level playing field.

Abrami: Ken, you mentioned the Bio-initiative 2012 report, the 1,000 microwatts per meter squared.

Wells: There is a recommended maximum level by the Bio-initiative 2012 report of 1,000 microwatts per meter squared. This is a pretty high level. This is a peak exposure. These meters could measure peak and averages over 24 hours and could measure frequency. There is quite a bit of information that would be available and I think it would be valuable for the agency that collects this. It would allow them the basis for building a map of RF around NH and give them data for pursuing future public health investigations about say cancer clusters in relation to transmission or cancer clusters that are not related to transmission but perhaps some other environmental sources.

Abrami: This, ties back to Kent's proposal about a database but this would be real data. There could be hotspots in a neighborhood or a town. All we are saying is, maybe before you buy a house, you want to know about it. We went through this with radon and lead paint. The more we see radiation flying every

which way, I think this is prudent. It doesn't have anything to do with the industry or the federal government. It's just informing the buyer or the renter that you might be in a pretty hot zone.

Heroux: Actually, Senator Gray is right. If you install another antenna, the levels will change. Essentially, this is what you are trying to determine by a number of these measurements to see what the evolution in a particular place or state how radiation is evolving. These measurements are fundamentally fairly easy to perform if they are performed by an instrument. They are probably preformatted so compiling them could be relatively simple.

Woods: Going back to the fact that we could sort of massage this. The concept is very good and this is a recommendation that says to the public besides the legislators in this report that this is an area that we need to consider. Now, the details are going to be a morass to say the least. But I think as you pointed out earlier Pat, these are areas that we see as a commission that need attention. As Tom said, the realtors are going to have some input but I think that's for another day. To the Legislature and to the public, we are saying we feel this is an important issue.

Ricciardi: I just wanted to say that maybe an RF map would be good for people who are already microwave sick. That way they would know where the transmitters are the highest and could avoid them.

Wells: I think that's a great idea. I just wanted to point out that Cece Doucette put something in the chat that there is already an RF meter loan program in Ashland, MA through the public library. This would not be hard to do. They are not terribly expensive.

Gray: It appears what you really ought to do after listening to Dr. Chamberlin, is split it into two. If you are transferring real estate then taking measurements with wifi turned off etc. may be appropriate.

But if we are talking about posting for the public, then it's radiation when I walk into that building which would include all the sources inside the building. It is unclear what you are really trying to do with this. Are you trying to mix these two concepts together? You've got to remember that exposure for most people would be a long term thing that would affect them and not a short term thing.

Abrami: I agree. I think I said this earlier. Comingling the purchase of property vs posting measurements in public areas in the same recommendation is a tough one. If anything, we could split them out and vote separately.

Wells: How about if I take the public building part of it and make that a separate part or possibility for future consideration?

Abrami: that would probably be better.

RECOMMENDATION 9- Require all new cell phones sold in New Hampshire come equipped with a sensor that will stop the phone from radiating when positioned against the body.

Heroux: This speaks to the fact that there is an opportunity in cell phones themselves, to mute the radio emissions when the phone is held against the body. There are various ways of implementing this. Initially, I presented it as the fact that the phone should be hardwired to do this. There are many other ways to do this. The weakest way is to say we require that you can download an application that will make your phone behave that way. The most sensible one might be to have a toggle on the phone or a menu item that allows the phone to function in this manner. If you choose not to have your brain radiated, you can choose that function on the phone itself. Between these extremes of you having it hardwired or you having to do a lot of things to eliminate the radiation. Or there is another possibility the phone could come with the toggle switch installed and you could disable it if you wish. That means you choose and you agree that you believe that this risk is not substantial so you prefer to use the phone against your head rather than avoid the risk.

Abrami: I think it has to be individual preference. We want to give those who are concerned about it a chance to have something that will help them.

Wells: this is the first that I have heard of that last suggestion and I think that is a good one that the phone is delivered to the customer with the safety option on and the user has the option of disabling the safety function.

Sherman: One other option in this would be I believe this is true that they have this capacity but have opted not to install it on phones, the idea of intrinsic shielding that would protect the customer from radiation. There was a move about fifteen years ago to develop sleeves that you could put over your phone to shield against the RF that was emitted toward your head. I like the toggle idea. I would not go for the requirement that all phones shut down if you put them by your head. The toggle and personal choice is a great option. Or the other part you could put in there would be the intrinsic shielding.

Gray: Are we creating a scenario where phones are not going to be sold in NH anymore?

Abrami: this is simply a recommendation to the cell phone manufacturers to consider.

Gray: We are not as big as the state of California who has driven emission regulations by state regulation. I don't know that the cell phone industry is going to modify what is available to customers because of the state of New Hampshire.

Abrami: the cellphone industry knows that holding the phone against your head may not be the best thing because it's in their legal section. There must be a reason why they are saying that. So, if you believe that then why don't you install an option where a user could turn it off. That's all we are doing as a commission is recognizing this issue and making a recommendation. It's got to start somewhere. It's my understanding that other states are following us on these proceedings. If we take that first step, other states may also weigh in on it.

Ricciardi: I just want to add to that is that our job is to protect the residents of New Hampshire. That's what we are doing with these recommendations. Again, they are recommendations, not law. We have to do that. With all due respect to everyone, here all opinions are appreciated but as we know, the majority will write one report and those who are in disagreement are entitled to write their own. I would caution on making too many changes to the one we did if the majority agrees with it. Since the other report will be written anyway. Thank you.

Gray: The point that I was trying to make in a lot of this thing is that if we go right back to the first paragraph and we say these things aren't proven. So to make recommendations that may impact the cell phone may cost more in NH. There are reasons why we should be cautious in the recommendations that we make.

Heroux : I take Senator Gray's point that New Hampshire is not as large as California and in some instances may not have the same influence. But I have to say, I am a fan of New Hampshire and maybe you are as big as you feel.

Wells: I just want to remind everyone about New Hampshire's role in MTBE. We are not without influence.

Abrami: Let's do number ten. Eleven is still under consideration and twelve we can talk about next time.

RECOMMENDATION 10- Propose legislation that would facilitate the implementation of fiber optic cable connectivity deployment and internal wired connections to serve all commercial and residential properties statewide.

Abrami: it's just basically a statement that the state should promote fiber optic cable. Carol had to leave. I am going to let her weigh on this next time. Members of the work group, I want to work on their recommendations based on this input. Jim has some good comments in his as well as the others and should take those into consideration. We are running out of time. Unfortunately, we lost almost four months. I couldn't even get zoom time from the House. Good thing Kent has been gracious enough to let us use the University of New Hampshire's zoom account.

I think we need to have more than a meeting a month.

Sherman: We are having trouble on the Senate side with all the zoom meetings we need to have. So if we could have all the materials we need for the next meeting well in advance and preferably have a longer meeting rather than three shorter meetings and just get the work finished as best as we can.

Abrami: I'd like to do it in three weeks. How about Tues the 22nd at 9? We will make it a 2.5 hour meeting. Kent will set that up. Thank you everybody. We will make our way through this.

V. Next meeting via Zoom: Sept 22nd 9-11:30

Meeting Adjourned at 11: 15 am

Text chat during Zoom meeting:

00:51:58 Paul Heroux, PhD: Identify Health Impacts of Environmental Factors: Barack Obama and Joe Biden believe it is critical to understand the relationship between environmental factors and risk or onset of disease, particularly cancer.

They support the efforts of Senators Clinton and Hatch to expand CDC biomonitoring programs, and as president, Obama will expand the collaboration between the CDC and state public health agencies across the country to increase understanding and improve treatment of individuals negatively affected by environmental factors.

01:19:35 Cece Doucette: For Recommendation 2: Might NH consider taking a leadership role with peers in all other states, share the Commission's final report, and encourage them to make a similar request to their federal delegations? This approach might help to get meaningful action to protect the public sooner rather than later since the 4G/5G small cells are going up in real time, and children are being given wireless devices to access their education with no safety instructions.

01:29:43 Cece Doucette: Thank you, Dr. Sherman. It would be helpful to the public to label every RF-emitting device, including utility smart meters and the collection devices mounted on poles outside of residents' homes.

01:36:19 Cece Doucette: For Recommendation 5: Please vet all new technology through non-industry funded scientific investigation before exposing our collective children. LEDs and Li-Fi may have risks, but hard-wired technology to the premises with Ethernet cables and adapters is proven safe.

01:43:13 Cece Doucette: For Recommendation 6: Please see Burlington, MA Small Cell Policy, which requires an annual recertification by an independent expert, and the wireless vendor pays the town to complete the annual recertification.
http://www.burlington.org/town_government/small_cell_information.php

01:48:36 carol.a.miller: I apologize but I have a hard stop at 11am this morning. I will just disconnect when that happens.

01:48:53 Beth Cooley: Same here

01:56:29 Cece Doucette: For Recommendation 8: We have modeled an RF meter lending program at Ashland Public Library, MA. Others are emulating this too. It was based on kill-o-watt meters put on loan in our libraries by the energy industry.

02:04:35 carol.a.miller: Again I apologize that I must leave the meeting now.

02:06:10 Cece Doucette: Thank you, Ken.

02:09:00 Brandon.H.Garod: I apologize but I have to leave for another meeting.

02:09:26 Cece Doucette: Please consider adding a new recommendation to educate the public. I drafted a fact sheet with the MA Department of Public Health, and have built a non-profit with quick on-line courses that the public could take today and have the right to choose how they wish to use the devices within their control. Please see <https://www.wirelesseducation.org/store/l2/> and <https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbX1bmRlcnN0YW5kaW5nZW1mc3xneDo2OWYxMmNhY2ViNDcwMmQx>

02:15:05 Cece Doucette: For Recommendation 9: Shielding can be helpful, but unless the shield absorbs the radiation, it will deflect it back into the hand, other body parts, and other people/children in the vicinity. We have seen hand cancers from cell phones too. See attorney Jimmy Gonzalez testimony in Florida: <https://www.youtube.com/watch?v=XitM4lkpvgo>

02:17:31 Marty Feffer: Unfortunately, only humans will be able to make the choice to limit their exposure to cell phone radiation with the ideas you are discussing. The natural world who are also being irradiated, and have been, are suffering just as much, if not more, from exposure. Our responsibilities run deep and wide if we honestly look at the complete picture.

02:21:09 denise ricciardi: to sign off

02:22:51 Paul Bloede: My apologies for asking if I was being spoken to, earlier; I hadn't studied my notes from last time, closely enough, apparently, to realize there is a Paul who is truly a member of the commission: Dr. Paul Heroux. Again, my apologies.

02:23:51 Marty Feffer: Thank you for your work. Inspiring to other states.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

9/22/20

9:00-11:30 am EST

Via Zoom (<https://unh.zoom.us/j/95115866784>)

Via telephone-US (1 301 715 8592 (US Toll) ID: 951 1586 6784)

In attendance: (13)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Senator Tom Sherman-president of the senate appointee

Brandon Garod-AG designee, Asst. AG Consumer Protection

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Carol Miller-NH Business & Economic Affairs Dept * *(joined meeting in progress)*

David Juvet-Business and Industry Association

Not present: (0)

Meeting called to order by Rep Abrami at 9:03 am

Abrami: Due to the Covid 19 virus and the Executive order signed by the Governor this public meeting is allowed to be conducted via Zoom. It is open to the public for viewing and was duly posted as a Zoom meeting. With that said, if you are not a member of the Commission, can you please turn your cameras off and mute yourselves? That would be much appreciated. In addition the meeting is being recorded as an aid to doing the minutes. All chat room discussions will be included in the minutes.

Since we are going to be taking some votes today, I am going to have to do a roll call. That is also a requirement. The votes today will be in the order going to my left as we were seated in Concord for our meetings. Please say where you are and if anyone else is in the room.

Tom Sherman- I am here alone, Rye NH

Ken Wells- I am in East Andover with my dog.

Kent Chamberlin- I am in Durham, NH and I am alone.

Carol Miller- absent for roll call. *(Joined meeting while in progress later)*

Denise Ricciardi- I am in Bedford and I am alone.

David Juvet- I am at the BIA office in Concord. Others in the building but I am alone in my office.

Beth Cooley- I am in Sarasota,FL and I am alone with the exception of my dog.

Brandon Garod- I am at the AG's office, Concord. Others are in the building but I am alone in my office.

Michelle Roberge- I am alone in my office at DHHS, Hazen Dr. Concord.

Paul Heroux- I am in Montreal and am home alone in my office.

Gary Woods- I am in Bow, NH and am in my study at home alone.

Jim Gray- I am alone here in Rochester alone in the kitchen having breakfast.

Pat Abrami- The Chair is here in Stratham, NH and I am home alone.

Ok. Thank you. So we have 12/13 present at the moment.

I. Approval of minutes from 8-31-20:

I have not received any changes to the minutes. Are there any changes that anyone wants to make? Seeing none, I will say ...without objection, we approve the minutes from that meeting.

II: What remains for the Commission:

Abrami: I spoke to the Speaker this week to see if there was any wiggle room with the November 1st date. He said it would be very difficult to change. So, my intuition is we strive to get to the November 1st date to get the report done. Just keep that in the back of your mind. We have had a work group of seven working on recommendations and we are going to vote up and down on those.

There will be a Minority Report. My goal is to give those involved with the Minority Report proper time to react to the Majority Report in their report. My goal is to have the total report done by the middle of October, if we can. We have a lot of pieces of it. Joel Anderson, staff member appointed to the Commission will be helping put those pieces together.

So, that's where we are at. My goal is to have one or two more meetings. The Majority work group will have to meet to put finishing touches on the report and get it to Jim and whoever wants to work with Jim on the Minority report to give them a week or two. I am thinking the full Commission needs to meet the third week in October just in case we need another week to do some adjusting.

III: Minority Report and Agency Disclaimer:

I sent out to everybody some sample reports of Minority reports. In this case, I think what we will do is make the Minority report part of the report and it will be the last section where the Minority can say what it's going to say. It will have a header that it's the Minority report. So it will be one report that will include both.

As far as the agency disclaimer, Joel dug out my old marijuana Commission report. At the end, the agencies had trouble saying they agree or disagree. Brandon, Carol and Michelle are the three that work for the state. This is what I think it's going to sound like: Members of the Commission of the study of the environmental and health effects of evolving 5G technology agree to the filing of the report by the chairman. This action should not be construed in any way as an adoption of any particular position of a commission member or the state agency or organization they represent on the underlying issue of the deployment of 5G technology. It's as simple as that. I think this may make the members who feel

uncomfortable more comfortable with their position on the report. Brandon and Michelle, any reaction to what I just read?

Garod: I think at first glance, that language probably will work for DOJ but I would like the opportunity to run it by the Attorney General to make sure that he is comfortable with it.

Roberge: I agree, same thing. I would like to run it by our folks here.

Abrami: I will retype it and send it so you have a hard copy to share with them.

I am going to move this along. We had a meeting and talked about most of these recommendations and a few new ones did come up. It would take a lot to change a recommendation. If someone says, if you change it this way or that way and I can vote for it, understand that the work group pretty much agreed to the language here. Obviously, grammatical things will be accepted and if you have a real issue with a particular recommendation, my sense is you would probably be in the minority report. I apologize in advance, but I am going to move this fast. I just want to make sure we get this all in today so we can move on to finalizing the report.

IV. Work Group Recommendations and Vote:

The rule is, we need to have a roll call vote on each of these per Joel and the folks that know about these things. We are going to talk quickly about each of these and take a vote. When you vote, you will vote ... yes, no or abstain. The majority of those who vote yes or no will make it into the majority report. That's what the ground rule is. Is there any objection to that ground rule? I don't see any. Thank you.

If you read the intro to it, what the work group concluded is that (in my words) the science is conflicting in some regards but there is enough science out there that's showing more study needs to be done on this topic. Given that we tried to reach out to federal agencies and they didn't really answer our questions and all the other things I mention in this intro, the conclusion of the majority is that we have to use the Precautionary Principle here. You will find that we have softened some of the recommendations from the last meeting. I am assuming that there may be enough that these are the majority position but it may not be. It may be the minority. I kept the numbering the way it was so we didn't confuse anyone even though we will be taking #2 off the table. After we are done voting, we will reorder these for the report in a logical way.

Juvet: Mr. Chair, could I ask a process question before we start on each of the recommendations?

Abrami: Absolutely, Dave.

Juvet: As a part of voting, are you looking for just an up or down vote? Or can we, as members of the commission explain why we are voting the way we are for the permanent record? I don't want to make this process any longer than it needs to be. I just need some clarification.

Abrami: You can do that during the discussion.

Sherman: I know we are going on the recommendations, but before we do, in the version I have which says 5G commission recommendations at the top of it. I think it's the Sept 17th version. Is that the latest?

Abrami: yes.

Sherman: There is a sentence that to me does not make sense. Would this be an appropriate time for me to point that out?

Abrami: Yes. Please.

Sherman: It's in the introduction, midway through. You will see the words, "the effect of the soup". Then it says, "today, which will only be growing in the world of if the roll out continues is not known" That phrase grammatically does not make sense to me. I don't know what the intent of that phrase was.

Abrami: if anything, the amount of RF will be expanding over time.

Gray: I took it as "the soup" is going to be growing, the amount of RF. That's what I took from it.

Sherman: But if I could just wordsmith that just to keep it simple.

Abrami: Yes. Absolutely.

Sherman: The effect of the soup of RF waves surrounding us today, which is likely to increase over time. Perhaps, you could do something like that, because it was unclear.

Cooley: We will be providing comments to Senator Gray's Minority Report (CTIA). Second, I would just like to publicly object to the entire introduction, most notably the first sentence. The Commission has indeed not heard from many experts on both sides of the issue. As you recall, the Commission heard from one pro-5G Physicist on November 20, 2019 who ran out of time. I do understand that the pandemic did lose us many months. However, upon learning of new research during the summer regarding the safety of 5G, I offered to reach out to the authors of that study and I was told in no uncertain terms that there were to be no more experts. However, funny enough, I then hear of a so called expert presenting before the working group at their Sept 11th meeting. We would just like as an industry and CTIA to highlight that this biased approach and preordained outcome of the Commission has not gone unnoticed, and we will be making these facts very clear to the General Court. Thank you, Mr. Chair for the opportunity to speak.

Abrami: right and how many times did I say to you even before the virus, give me your best shot and any time you want another speaker, let me know. It isn't like I didn't do that. We lost about four months with the virus. The group argued that we really didn't have much time to hear additional testimony. Yes, Paul suggested we hear from this lawyer, who wasn't a technical guy to possibly help us with some of the language.

Ricciardi: I just want to address something since Beth has brought up the word "biased". I think you represent the CTIA and having been in a lawsuit in Berkley, not wanting to have the fact that the information about the proximity of the phone to the body that is hidden inside the information for the

phone, not brought out, which was the lawsuit. That could be considered biased too, seeing that you are on the Commission. Thank you.

Abrami: I understand. I had many emails about this, Beth. I batted them away. There were people out there who wanted you off the Commission and I said absolutely not.

Cooley: Yes. I heard both the allegations and personal attacks against myself, CTIA and the industry. Again, the facts will be made clear to the general court.

Abrami: That's fine.

Gray: This is Senator Gray. We need not to be defensive about comments that are made today and try to rebut them. We just need to accept them as a comment and move on or we are not going to finish anywhere near eleven.

Abrami: I agree, Senator. Again, that's what the Minority Report is for.

RECOMMENDATION 1- Propose a resolution of the House to the US Congress and Executive Branch to require the Federal Communication Commission (FCC) to commission a review of the current radiofrequency (RF) standards of the electromagnetic radiation in the 300MHz to 300GHz microwave spectrum as well as a health study to assess and recommend mitigation for the health risks associated with the use of cellular communications and data transmittal.

The Telecommunications Act (TTA) of 1996 was adopted before the health risks and biological effects of RF-radiation to the human body were fully known to the scientific community as well as the public. The Commission believes that the FCC has not exercised due diligence in its mission to manage the electromagnetic environment, failing to support technical means and investigations aimed at reducing human exposures to electromagnetic radiation (EMR) in telecommunications systems, and optimize wireless modulations to reduce biological and health impacts. Commissioned research should study the health effects and should be conducted by an independent research organization with standards which have been mutually agreed to by all the stakeholders. The FCC shall then ensure that the findings and recommendations are adequately disseminated to the public.

Abrami: First we had #1 as a joint resolution and I agree with Senator Gray, that the Senate does not like joint resolutions and they would never do one. So, we put a resolution of the House. Basically, what #1 says is more health studies are needed. We broadened the range to include anything in that range, not just 5G. Discussion?

Chamberlin: This is just wordsmithing. The section that says, "investigations aimed at reducing human exposures to EMR". Well, we are not really trying to reduce radiation, necessarily. The wording that I suggest is: "we want to set exposure limits that protect against negative health impacts". I would suggest making that change.

Sherman: I have a change as well. It reads, "require the Federal Communication Commission (FCC) to commission a review of the current radiofrequency (RF) standards". I would say, "an independent

review". It's already been determined that the bulk of the FCC is comprised of Commissioners who have spent a significant component of their career in the telecommunications business. So, for them to have an in-house review of this, is like having the fox watch the hen house. That's true of any federal agency. They would typically do an independent review.

Heroux: Is it necessary to point to the FCC? We know historically what the FCC does and they just performed a review that they will just repeat. So, why not say the federal government?

Ricciardi: I agree with Paul. Also, the industry says that the biological effects are not health effects. We know that it is so I think the wording has to be in there that you have to have clarification about the impacts of biological effects.

Abrami: It's interesting that most of these changes are coming from the work group. So we are saying the federal government.

Ricciardi: and add protect against the biological adverse effects.

Heroux: Yes. This is what I was suggesting.

Sherman: She is referring to the non bolded section. I would leave it because it's more inclusive the way it is. It's in there twice already.

Sherman: Mine was independent review and Paul's was federal government. I kind of like leaving the FCC.

Abrami: I didn't have a problem with the FCC either.

Woods: I would leave it as the FCC and I think the important part would be to have fabricated that it's independent.

Sherman: Why don't we go ahead and vote on this one?

Abrami: So, keeping the FCC, adding independent review and changing to exposure limits to protect against health impacts, any other discussion?

Juvet: Mr. Chair, before you call the roll I just want to let the Commission members know that I am going to be voting against this recommendation. It states in the non bolded area that the commission believes that the FCC has not exercised due diligence in its mission and my organization just doesn't believe that is true. So, I will be voting against this recommendation.

Abrami: Ok. Thank you, Dave.

Gray: What I would put into the Minority Report on this one is that we don't have a problem with further research. You could even fund the research from the federal government. The way you conduct that research though and some of the other in here is what we would object to. In principle, the research I am good with but the rest of it...no.

Abrami: Thank you Jim.

Heroux: Just to be clear, I would vote for this recommendation whether it's FCC or federal government. It's just with the federal government somebody would have to make the decision to ask the FCC, which will be a further decision. But, both carry the same idea.

Abrami: Ok. Thanks, Paul. Ok. Here we go. I will call the roll: Tom Sherman (yes), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (absent), Denise Ricciardi (yes), Dave Juvet (no), Beth Cooley (abstain), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no), Patrick Abami-Chair (yes). There are 7 (yes); 2(no); 3 (abstain) and 1 absent. The motion passes.

RECOMMENDATION 2- Establish a State position that protects the State and all its Municipalities from any liability from harm caused by small cell antennae placed on the public rights-of-way. Specifically, liability of the State of New Hampshire and its municipalities connected to harm caused by claims of personal damage or harm from the deployment of 5G small cell towers or the attachment of 5G antennae on telephone poles, electric poles, lamp poles, or other structures on the public right-of-way is by state statute transferred to the Federal Government. The Federal Government shall be required to defend and indemnify the municipality from any liabilities arising from permits and the installation, operation, and maintenance of small cell installations. Since the State of New Hampshire and its municipalities are being forced by Federal Law to deploy 5G small cell towers and antennae on public rights-of-way, the Commission has concluded that that the State and its municipalities should be held harmless from any litigation claiming harm for any reason, including damage to health. The Committee feels that this recommendation should not be of any burden to the Federal Government or to the cellular industry and related industries who support the cellular industry, since they believe that 5G technology is safe and thus there will be no harm caused by having these antennae so closely deployed to the public on the public right-of-way. **DEMOTED TO SOMETHING THE COMMISSION DISCUSSED**

Abrami: The workgroup has decided to take this off the table. We kept it here for numbering purposes. It will be demoted to a topic of discussion in the report saying the commission discussed this issue. The position of the workgroup was to not include this recommendation. So are we ok just skipping this? If you want to say something, raise your hand or just speak out. It's quicker. There is no one monitoring this other than myself. Ok.

RECOMMENDATION 3- Require that the most appropriate agency (agencies) of the State of New Hampshire include links on its (there) website(s) that contain information and warnings about RF-Radiation from all sources, but specifically from 5G small cells deployed on public rights-of-way as well as showing the proper use of cell phones to minimize exposure to RF-Radiation. In addition, public service announcements on radio, television print media, and internet should periodically appear, warning of the health risks associated with radiation exposure. Of significant importance are warnings concerning the newborn and young as well as pregnant women. Even without further study, there is compelling evidence that the public should be warned of the potential dangers of RF-radiation and be told simple steps to lessen the risks of unnecessary exposure. Attachment XX shows an example of a simple cell phone warning.

The website must provide an option for visitors to register their concerns about current FCC exposure guidelines. In particular, this registry should provide a convenient and formal mechanism for New Hampshire municipalities and residents to weigh in concerning the contentious 1996 Telecommunications Act Section 704 that disallows using radiation-related health concerns as a reason to challenge cell phone tower siting. The primary use for the data collected on this registry will be to gauge the level of concern about RF-radiation exposure there is on the part of New Hampshire citizens.

Abrami: This has to do with public information related to RF radiation in general and public service announcements and postings of certain warnings. Kent, I think you and Carol worked on this.

Chamberlin: This is part of informing people about potential problems associated with exposure to fields. Now a lot of people do not realize that there are any negative effects. This would be an opportunity to provide warnings both on the signs and on the webpage indicating what those potential hazards are. The other aspect of this is to allow people to provide an opportunity for New Hampshire citizens to register their concerns about the current legislation, for example the Telecommunications Act of 1996. It would be just a way for them to air their concerns. The data would be used to inform us or the state about what the level of concern is. As I mentioned the last time, if only a handful of people are concerned, then perhaps it's not that big of an issue. But my own experience having people call me at the University to have me come out and make measurements and ask what they can do about cell tower exposure. I haven't been able to send them any place where they got satisfaction. This would be an opportunity to provide a registry for people to log concerns about exposure to RF fields.

Abrami: Kent, I think a lot of what you are saying relates to another recommendation. This was really Carol's. This was more about public service announcements and things on the website.

Chamberlin: I am sorry. I did mention that but my apologies that does relate to another one.

Sherman: there is a typo in the second line: "their" is what it should be.

Juvet: I just have a question about the first sentence in the bold where we are suggesting that the most appropriate agency or agencies of the state include links. As a commission that's been studying this, are we unable to name which agencies we think should be responsible for this?

Abrami: Originally, we had DHHS but we decided that it could be more than one. It could be others like environmental. So, we just kept it broad.

Heroux: In the version I have, the last paragraph, it does mention that the website must provide an option for visitors, as Kent had indicated. Does this mean that this paragraph has been transferred elsewhere? It means that there are links for people and perhaps by filling out a form.

Sherman: He is saying it reads that the website must provide an option for visitors to register their concerns about current FCC exposure guidelines.

Chamberlin: The intent was not to go to the FCC but would be a registry for the state of New Hampshire.

Heroux: What Kent is saying is that there is no way for any citizen who is concerned to voice that concern and their situation and it is not wise for New Hampshire to be totally deaf to such a situation. It could be fairly simple. There might be a standard form that can be uploaded and simply kept on file until for some reason it is decided that this needs to be analyzed.

Juvet: Mr. Chair, can I make a comment on this point? Two things: If we are only allowing a vehicle to only register concerns, you will get a very one sided point of view and I am wondering if that could be changed to say register their opinions.

Abrami: I think you are correct.

Juvet: the second thing is more of a procedural thing. I am unclear if this is established, what happens then? I am not quite clear on how this information will be used.

Abrami: The data could be accumulated and then interested parties would have a place to go to look for opinions of the public.

Juvet: One final comment about midway through that paragraph, you are labelling the 1996 Telecommunications Act as “contentious”. I think that is a little pejorative also and I would remove the word “contentious”.

Sherman: I would go one step further and take out that middle sentence because it is judgmental.

Abrami: you are suggesting that we take out the section that says: this registry should provide a convenient and formal mechanism for the New Hampshire municipalities and residents to weigh in concerning the contentious 1996 Telecommunication s Act.

Sherman: I would get rid of the word “contentious” no matter what. I agree with Dave. I would change it as a way of people logging opinions rather than telling people what they should be discussing.

Abrami: Most of the public has no idea what the 1996 Telecommunications Act is. Municipalities would because they are doing these sitings all the time.

Sherman: I would just get rid of” contentiou”.

Gray: The first objection I have is the word “compelling” in the first non-bold sentence. If we look back to the preamble, we say the science isn’t all in and throughout this report I don’t believe we should set up a new division in the state anywhere that summarizes all this stuff and has action etc. But, we will put all that into the Minority Report.

Sherman: I agree with Jim. We are saying we are going with the Precautionary Principle because we don’t know. So, saying “compelling” says we know. There is evidence that the public should be warned. There is evidence but there is some editorial comment in this report that is stronger than what I am comfortable with. Get rid of the word “compelling” and “contentious”. I think it sounds a little less judgmental and a little more acceptable to your audience.

Juvet: Mr. Chairman, along those lines, in the very last sentence of the non bolded section says “the primary use of this data collected on this registry will be to gauge the level of concern. I would be more comfortable with “opinion” in place of “concern”.

Abrami: I am ok with that as well. Are there any other changes?

Roberge: I request some qualifying language around “appropriate funding” if this was to go to a state agency and the agency was required to do PSAs or whatever. There might be a funding issue that may come up.

Sherman: Michelle, you make me smile.

Abrami: ... this cannot occur unless the legislature provides proper funding. Is that ok?

Sherman: you could say that the legislature fund the most appropriate agency in the state of New Hampshire. The first step as Michelle is saying and those of us in the legislature know the first step is you need the funding. You could put “supported by funding granted by the legislature”.

Gray: When this goes to the legislature for adoption, it will get reviewed and if there is funding required, it will be part of it. So, I don’t even think you need to talk to the funding specifically. Thank you.

Wells: Back on the last item where we talked about the level of “opinion”. I think it would be more appropriate to say level of “interest” about RF radiation exposure on the part of the public.

Juvet: I don’t have a problem with that. I agree.

Abrami: I think I got all the correct changes. We have the funding piece. We have the correction on the “there” to “their”. We got rid of “compelling”. We got rid of “contentious”. We replaced “concerns” with “interest”.

Juvet: Mr. Chair I am going to be voting against this recommendation and the reason why is related to the budget and potential fiscal issues. I am not ready to commit the BIA to supporting that before we have a chance to review the context of the entire budget.

Abrami: Remember, with any of these recommendations, it would take someone to put some of these in bill form to propose to the legislature and make it through a difficult legislative process.

Juvet: I appreciate that but if I vote for this, it could be construed that the BIA is in favor of that as a part of the overall budget. I’m not there yet.

Sherman: Could I just ask Dave a question? You do have the option of abstaining. If you are voting against it, my interpretation is that you are opposed to this moving forward as a recommendation....that the recommendation is something that the BIA could not agree to.

Juvet: Thank you, Senator. I agree with you. So, I will be planning to abstain on this one.

Cooley: I will be opposing this because of the implied risk of wireless radiation.

Abrami: Any other discussion? I will make a motion that we accept this.

Sherman: I will second.

Abrami: I will call the roll: Tom Sherman (yes), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (absent), Denise Ricciardi (yes), Dave Juvet (abstain), Beth Cooley (no), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no), Patrick Abami-Chair (yes). There are 7 (yes); 2(no); 3 (abstain) and 1 absent. The motion passes.

RECOMMENDATION 4- Require every pole or other structure in the public rights-of-way that holds a 5G antenna be labeled indicating RF-Radiation being emitted above. This label should be at eye level and legible from nine feet away. In the view of the Commission, the State of New Hampshire has the right to warn the public of potential harm of 5G antennae deployed in the public rights-of-way. Large cell towers all currently have fencing around them at their base to protect the public. This will not be the case with small cell towers or any pole with an antenna on top in the public-right-of-way. These public rights-of-way are the jurisdiction of our municipalities and not of the Federal Government. The Telecommunication Act of 1996 did not contemplate antennae being placed on the public rights-of way of municipalities. Thus, the State of New Hampshire has the right to warn the public harm by requiring the owners of these antennae to inform the public of potential from RF-radiation harm. See Appendix XX for an example symbol.

Abrami: We talked about this last time. The game changing with 5G, not all cell companies are rolling out small cells in the right of way but some may be. For many, that's a game changer. All this is saying is that if that is the case, there should be some sort of labelling that there is an antenna on top emitting RF radiation. Beth, I know you had some concerns about this as there is RF related to power lines and all that. The subgroup decided to keep this recommendation.

Juvet: Mr. Chair, I'm going to be voting against this recommendation. I think it sends a conflicting message. I think it potentially makes NH different than every other state in terms of 5G rollout. I think if this is an issue then it's something that should happen at the federal level as part of federal legislation so the requirement is the same for all states. I can't support this recommendation.

Ricciardi: I just have a question. Is there any rule for participation in these groups? When someone misses a lot of the meetings, I don't think they have all the information they need to make an informed decision. It's just a question, Mr. Chair.

Abrami: Let's go way back. Dave and I chatted early on and certain days of meetings Dave could not attend because of a conflict with his board meetings with the BIA. Plus we were into the science and I know Dave was pretty eye rolling. So after the virus hit and we finally came back, I just assumed that Dave didn't really want to participate. That was a false assumption on my part. Dave reached out to me and said he is officially appointed to this commission. I cannot take him off this commission. None of us can other than the person who appointed him. So, he is still a formal member of this commission and yet he missed a lot of the meetings. The minutes are out there on our site. I don't want to make a big deal about this.

Sherman: Denise, I just want to point out the minutes and presentations are on the site. If you miss commission hearings, you do have the ability to catch up. And I am assuming that anyone who is participating in voting is up to date. That's what we do in commissions as we have that capacity. I am on more than 20 commissions and committees right now. There is no way I can make every single hearing. I agree with the Chair. We should move on and assume that Dave has done his due diligence and has every right to vote as an appointed member.

Ricciardi: It was just a question. I wanted clarification. Thank you Senator.

Abrami: Just for the record, our minutes are basically almost verbatim of what's being said. They are very extensive minutes. I move to call recommendation four for a vote. Tom?

Sherman: on the discussion side, I just have to say I have a concern about this one. First of all the labelling, I agree with the industry that there are many sources of RF and I think the public should be warned but I'm not completely comfortable with this one. I am going to hold off on seconding it and give myself a few more minutes to think about it before we vote.

Woods: I will second it.

Gray: my problem with this one is we have regulations and if the emissions from the cell tower meets the current and if we are saying that the future ones of our recommendation number one if it exceeds those then a warning label might be appropriate but again, we haven't done the research from number one. It meets current regulations and therefore the added expense of putting that sign on there and if there is still anybody who climbs poles without a hydraulic lift then that sign could be hazardous to them climbing that pole. For those reasons, I will not be supporting it.

Sherman: Patrick, the more I think about this one, the legibility of the sign, I have to agree. Right now under current law, we have already said there needs to be more study. I really am uncomfortable with this one. I think I am going to have to vote against it.

Wells: We have had quite a bit of discussion on this because the current standards don't talk about energy density in watts per square meter. When you have antenna in the public right of way, there are orders of magnitude closer to people than existing antennas. So, the RF exposure is very high.

Heroux: The other thing is that if you require it to have a full survey of all RF sources other than 5G, I realize that this may seem discriminatory. Essentially, it's because there is densification that this has provided and it would be a substantial task to inventory all sources of radiation and make sure that all of them are labelled. But at the threshold of densification, I feel this is justified.

Abrami: any other discussion? Alright. I am going to call the roll: Tom Sherman (no), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (absent), Denise Ricciardi (yes), Dave Juvet (no), Beth Cooley (no), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no), Patrick Abami-Chair (yes). There are 6 (yes); 4 (no); 2 (abstain) and 1 absent. The motion passes.

Abrami: Carol, were you here when I called for the vote?

Miller: I am abstaining anyway.

Cooley: I'm sorry, a clarification on that last vote. So was it 6 (yes) 4(no) and 2(abstain) because Carol was not here before the roll was called?

Abrami: yes.

Cooley: so was it 6-6 and does not pass?

Abrami: no. It's the majority of those who did not abstain.

Cooley: got it.

RECOMMENDATION 5- Schools and public libraries should migrate from RF wireless connections for computers, laptops, pads, and other devices, to hard wired or optical connections within a five-year period starting when funding becomes available. There is strong evidence that the younger the child the more susceptible they are to the negative impacts of RF-Radiation. Hard-wired connections or optical wireless do not subject children to RF radiation. The Commission is aware that school districts and public libraries have invested much in wireless infra-structure and that a movement to radiation-less connections would require additional investment of resources.

New optical networking solutions for the classroom and office spaces (such as LiFi) offer faster, healthier, and more secure connections than RF-based WiFi. This technology utilizes visible light, which organisms can withstand without any harm at far higher intensity levels (such as direct sunlight) than required for transmission. Such optical data transmission using visible light offers giga-byte speed, as well as plug-and-play replacement of current RF WiFi routers. The optical wireless system can be incorporated in an upgrade to cost-efficient LED room lighting, which can save schools and public libraries significant energy dollars.

The hard-wiring and/or optical projects should be completed within five years from when the federal funding (via say through the FCC's E-Rate program for telecommunications and IT in schools and public libraries) is procured.

Abrami: so this one is encouraging the use of hardwire or optical connections within schools and public libraries. I will let Ken spend a minute on it.

Wells: Schools and public libraries should migrate from RF wireless connections to either hardwired or optical wireless connections within five years of when funding becomes available.

Abrami: Can you spend a second on LiFi?

Wells: yes. There has been adequate research that younger children are susceptible to RF radiation and the alternative to using RF sources would be faster optical systems like LiFi or hardwired connections which don't emit radiation. Lifi is a visible light. There is adequate evidence that living things are quite

resistant to visible lights. The speed and security of optical is better than RF based communications. This would be a step up in performance and security.

Abrami: The recommendation is also sensitive to the school districts have spent a lot of money already on WiFi. Understanding that these things have cycles and there is obsolescence. We are suggesting that when funding is available that this be looked at as an alternative to WiFi.

Sherman: Can I just wordsmith one thing? In the last paragraph of the non bolded section, there are words that say: "via say through" I would replace that with: "e.g." and commas. It's a little slangy for a commission report.

Gray: Going back up to the recommendation, I am not so sure that we need to say that they should migrate. Also in the non bolded section it says "strong evidence". There are organizations out there that sell that equipment and would be more than happy to help school districts migrate over. Should they? Shouldn't they? It goes back to your first paragraph, what is an acceptable limit? If you say schools and libraries should be assisted in migrating and you take out the word "strong" and it gets closer to something that I can support.

Sherman: I like it the way it is and if Jim is not going to support it in any event then I would leave it the way it is.

Miller: I would just notate "gigabit" not "giga-byte". It's just one word, gigabit.

Abrami: Ken, are you ok with that?

Wells: Yes, that's good.

Heroux: Mr. Chair, did you ask Carol where she was and if she was alone?

Miller: I am home alone except for the dog and he is on the deck.

Abrami: I will move for recommendation five. Tom?

Sherman: I will second.

Abrami: I am going to call the roll: Tom Sherman (yes), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (abstain), Denise Ricciardi (yes), Dave Juvet (abstain), Beth Cooley (no), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no), Patrick Abami-Chair (yes). There are 7 (yes); 2(no); 4 (abstain). The motion passes.

RECOMMENDATION 6-Establish new protocols for performing signal strength measurements in areas around cell tower radiators to ensure compliance with regulatory radiation thresholds and to evaluate signal characteristics known to be deleterious to human health as has been documented through peer-reviewed research efforts (e.g.,[1]). Those new protocols are to take into account the impulsive nature of high-data-rate radiation that a growing body of evidence shows to have a significantly greater negative impact on human health than does continuous radiation. The measurements should be taken

in regions surrounding the tower that either are occupied or are accessible to the public. Commissioning measurements are to be performed when the site is installed and at regular intervals if required by state statute or municipal ordinance such as those required by the town of Burlington, MA [2]. Measurements should also be collected when changes are made to the tower that might affect its radiation, such as changes in software controlling it. Measurements should be performed under worst-case scenario conditions when the site is transmitting at its highest levels.

It is recognized that theoretical calculations show that existing FCC guidelines will be met by standard cell tower configurations. However, there are cases where the radiation from towers can be focused by buildings, terrain, and antennas, causing signal levels to be considerably higher than would be expected in theoretical calculations unless those effects are taken into account. Further, if measurements are performed using the protocols that are advocated, they will be sensitive to the impulses and summative effects of other radiation sources such as nearby cell towers. The measurements being advocated will require wideband equipment that is typically not used in the averaged signal measurements that are currently used. Two peer-reviewed articles that address the effects of impulsive radiation on organisms are [3] and [4].

[1] Belyaev I., Dean A., Eger H. et al. EUROPAEM EMF Guideline 2016 for the prevention, diagnosis, and treatment of EMF-related health problems and illnesses. *Rev environ Health*. 2016;31(3):363-397. Doi:10.1515/reveh-2016-0011.

[2] Burlington, MA zoning Bylaw Wireless Facilities Section 8.4.6.2 "Annual RF emissions monitoring is required for all sites by an independent RF engineer to be hired with Planning Board approval and at the applicant's expense. Test results will be submitted to the Town as soon as available, and not later than the close of the calendar year. Annual testing of electromagnetic emission shall be required to ensure continual compliance with the FCC regulations.

[3] B. W. G. (2012). *Bionitiative 2012: A Rationile for Biologically-based Exposure Standards for Low-Intensity Electromagnetic Radiation*

[4] McCarty, D. E., Carrubba, S., Chesson, A. L., Frilot, C., Gonzalez-Toledo, E., & Marino, A. A. (2011). Electromagnetic hypersensitivity: P Evidence for a novel neurological syndrome. *International Journal of Neuroscience*,121(12), 670-676

Abrami: I will let Kent speak to this. It really discusses that there should be something more than the average when we look at signal strength.

Chamberlin: this also has two parts. One is that it says you have to perform measurements on a cell tower. At one point you need to do that at commissioning because there are factors that can cause signals to be greater than what you would expect from simple calculations that the cell tower manufacturers provide. Burlington, Mass has a requirement as a town ordinance saying you have to perform these measurements regularly to make sure you have not exceeded guidelines.

The next part relates to how you perform those measurements. The way that's been done for fifty years is to look at averages. It turns out that it's not just the average power you're exposed to but it has to do with the transient nature of that and the summative effects. The way the measurements are performed now, if you were looking at a particular frequency, you would get a single value. It wouldn't see the contributing effects of nearby transmitters. The way I am proposing it here is that you look at the signals differently. You look at summative, the transient nature, the peak value which as I understand it, are not being looked at right now.

Wells: I am just noticing in this version, the second sentence after the bold section talks about focusing building terrain and antennas, but does not mention beam forming, which I think we discussed in one of the earlier sessions.

Abrami: I think you are right. Where are you?

Wells: The second non bolded sentence. You can put it after building, terrain, beam forming and antenna.

Heroux: Kent, this recommendation is very long. I wonder if somehow it could be a little bit remodeled to make it crisper to understand. All the other recommendations could almost be used in a commercial. Whereas this one, needs some wind to go through.

Abrami: I think you are right. Perhaps, some should be in the discussion part not the bold.

Gray: My objection to this recommendation is that it ought to be a subset of the study that you are requiring in recommendation one. If you found there is a problem, then how do you mitigate that problem?

Sherman: I kind of agree with Jim that this may be the cart before the horse. I don't disagree with this recommendation. I will vote for it but it would be great to have some parenthetical phrase somewhere in there that says depending on results of section one, or something like that.

Abrami: Ok. Why don't we say we are voting on the essence of this? Then we will vote again. I just want a sense of this. Is that ok with everybody?

Wells: You can streamline it by taking the first and last sentence in the bold and relegating the rest to the last paragraph.

Heroux: I would like to mention that this is very critical in the sense that this question is not something that will come out of a new investigation. It has been around for fifty years. The point here is that if you only look at biological effects over a gram and over averages, you blind yourself to reality. This is essentially what this very important recommendation says.

Abrami: I think that's why we have it here actually. I am ok with trimming it down and taking the middle part and moving it down below.

Woods: Just to clarify. We are trying to work this which is fairly complicated. Are we going to have another work session before the next full session?

Abrami: Yes. The work group is going to meet one more time because we have to talk about the rest of the report and get that going. Let's get the essence of a yes or no on this. If it's a no, we won't bother reworking it. We will have another vote specifically on this recommendation at the next full meeting.

Cooley: I will be voting no on this just because the FCC has its regulations in place here and they occupy the field. That's clear in both federal statute and federal regulation. Also, this is seemingly implying that wireless radiation is unsafe. Thank you.

Juvet: Mr. Chair, I would also like to let the commission that I will also be voting no on this. Again, this is making New Hampshire and outlier. This is a regulation that should be handled at the federal level. I think it sends a bad message about New Hampshire being serious about embracing the latest technologies for economic development.

Woods: As far as the consideration for New Hampshire being an outlier, I would like to point out that New Hampshire is the only state that does not have a mandatory safety belt law resulting in the loss of about 27 lives per year because of disuse. We have no trouble being an outlier in that regard. So I think that is perhaps something to consider the argument by itself to be an outlier perhaps should be put in a broader context.

Abrami: We all have our opinions. Ok. I move recommendation 6. This is just the essence, not the final words. We will vote on it one more time.

Chamberlin: I will second it.

Abrami: I am going to call the roll: Tom Sherman (yes), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (abstain), Denise Ricciardi (yes), Dave Juvet (no), Beth Cooley (no), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no), Patrick Abami-Chair (yes). There are 7 (yes); 3(no); 3 (abstain). The motion passes.

RECOMMENDATION 7- Require that any new wireless antennae located on a state or municipal right-of-way or on private property be set back from residences, businesses, and schools. This should be enforceable by the municipality during the permitting process, unless the owners of residences/business or school districts waive this restriction. Given these are local public rights-of-way and under the jurisdiction of a municipality, the Commission feels empowering individuals impacted by these antennae to be within states' rights to legislate such standards. This statute would return personal freedoms back to the individual in being involved with decisions as to non-essential devices that are being placed in front of their property.

Siting restrictions for cell phone towers already in force in the world were intended to ensure the safety of vulnerable populations, like children and those with illnesses. India already prohibits placement of

cell phone towers near schools or hospitals, and Canada (Standing Committee on Health), as well as many European countries, are looking into similar restrictions. In California, firemen have been exempted from the forced placement of towers on their stations, because of radiation health concerns.

There are plans to use higher frequencies in the future. These higher frequency transmitters have to take into account:

1. Less signal penetration into structures
2. The atmospheres oxygen and water absorption of radiation
3. The shrinking antenna apertures
4. The noise from multiple extraneous sources

For human users, this means increased power density exposures. In addition, exposures will become more irregular and originate from multiple sources (Multiple-Input-Multiple Output Architecture). As vulnerable individuals are exposed ever day in society to RF-radiation, limits should be universally applied, and set according to the Largest Observed Adverse Effect Distance (LOADE) using the experience from the past and current uses of 2G, 3G, and 4G technology, since there is no epidemiological experience with 5G.

An engineering practice would use a set-back requirement for new base-station cellular towers, including 5G micro-towers. A conservative LOAED should include all observed health effects. From the 18 papers abstracted in Appendix XX, shown in historical order, this set-back for all new cell towers should be 500 meters which translates to 1,640 feet. The actual set-back requirement should be established by the municipality based upon a balance of the science and reasonable accommodation for these antennae.

Abrami: Recommendation seven has to do with setbacks. I will let Paul speak to this one.

Heroux: There has been a lot of evidence in epidemiology that the proximity of cell phone towers enhances cancer effects that happen at the maximum within two years of installation as well as a variety of neurological effects that have been documented and so we believe that to bring densification to New Hampshire represents by itself a risk. Cell phone towers should be distanced from where people live whether they are vulnerable or not.

The non-bold section relays this information and says that there is evidence of health effects until 500 meters. In terms of best practice, this is what should happen.

Gray: This recommendation does not take into consideration any power level that is going out, beam forming or other things. If we are going to do this, it can't be all cell towers have to be .31 miles away. These new 5G are much less power. Unless you start to talk about power density and other measurements in recommendation 6, then this really has no meaning.

Cooley: As I expressed prior, this likely runs afoul of federal law. A state and locality cannot dictate where a wireless network can or cannot be built particularly if it creates holes in coverage and that is a barrier to entry. I will be voting no for that reason. I will also point out that there is a reference to California and that firemen were exempted from “forced” placement of towers. That is actually an incorrect statement. I have the legislative analysis that shows why the California firefighters were exempt from AB 57 many years ago. I would just submit for the commission that that is an incorrect statement. Thank you.

Heroux: 5G is something that is not yet defined and it will have beam forming which although the individual towers consumes less power, it has a higher effective radiated power because of antenna gain. So in the face of a new method of transmission, that is 5G that has yet to be defined by most people who deploy it, we can only rely on the past to assess the health impacts of cellular systems. In other words, we cannot be twenty years in the future to gauge as Senator Gray does suggest the health impacts of 5G. We can only use our experience of the past and this is what this distance is based on.

Sherman: I have to agree with Beth on this one. If we are going to leave this intact and I know it’s weakening your recommendation, but I would change the word “require” to “encourage” because I don’t think you can do this kind of siting or require it. It’s just a non-starter. I know that in Rye when we talk about a new cell tower coming in, which there needs to be and will be, that is a very productive negotiation between the town and Verizon and so I think “encourage” would be a way I could vote for this. Correct me if I am wrong, but I think Beth had it right that this is federal statute and we can’t do this. So, it’s a non-starter to put a recommendation that we can’t do.

Abrami: I don’t have a problem with encourage.

Sherman: I also want to make sure that we are accurate where Beth pointed out we were inaccurate. Maybe at the next subcommittee work session, be absolutely confident that you are correct in what you are talking about with California. If it’s not clear, I would remove it.

Abrami: Beth, can you send us your documentation on that please and I will share it with the whole group?

Cooley: Absolutely. It’s directly from the California legislature.

Juvet: Mr. Chair, in light of changing that first word in the bold from “require” to “encourage”, doesn’t that make the entire second sentence unnecessary? I don’t understand how the municipality will have the ability to enforce this.

Sherman: Dave, I think they can’t anyway. I would get rid of the second sentence. I just don’t think they have the ability to do this.

Woods: I agree with the comments about what is currently available legalistically. However, I think part of the concept of this report is what we think we would like to see obtained, a sort of wish list if you like. Then the actual application or translation into legislation would take these factors into consideration. I

have no trouble with the changes in view of honoring the legal aspect. But by the same token, I don't think we should shy away from stating what we think should be the standard and let that be heard.

Sherman: One way to do that would be to state the goal in your first sentence and then state in your second sentence how you would hope to get there.

Heroux: This could be done by the municipality.

Sherman: Well, as Gary said, you would need to have a statutory change probably at the federal level. So you could encourage. That's what we are doing in my town because we are working with the industry and it's actually going to be fine. So, one way is to encourage. The other way is to ask for Congress to change the law.

Heroux: I just proposed to say that this could be done by the municipality during the permitting process.

Sherman: I don't think they can do that right now.

Abrami: We will take that last sentence out and move forward with this.

Garod: I think I have to agree with Beth and Senator Sherman. I don't think there is anything wrong with encouraging municipalities to consider these factors when they are negotiating the placement of towers and when they are having a conversation about where it makes the most sense. But I think if you do anything that is seen as encouraging them to require a certain placement, the commission would be encouraging them to do something that is preempted by federal statute. I think the commission should stay away from any type of recommendation that suggests that municipalities have the ability to simply restrict where these towers are placed because I don't think they have the ability to do that.

Wells: Perhaps, when we revisit this in the workgroup, we can see whether this recommendation should be linked to recommendation one which calls for the delegation to look at the federal law.

Sherman: I think we are tight on time. Should we move to recommendation eight and agree that this needs work?

Abrami: Ok. No vote on number seven. The workgroup will work on it and maybe integrate it with another recommendation. The next time the full commission meets, we will vote on it.

RECOMMENDATION 8- Upgrade the educational offerings by the NH Office of Professional Licensure and Certification (OPLC) for Home Inspectors to include RF intensity measurements. Home Inspectors currently operate as private contractors who may be hired by citizens or enterprises to measure such things as radon, to collect water quality samples, or search for mold or insect damage. Home inspectors routinely supply test results to both their clients and government entities.

The majority of the Commission believes the public has the right to discover the RF power intensity related to radio frequencies at a property which they will be purchasing or renting before the

transaction is closed. Also, the proprietors of publicly accessible venues may wish to reassure the public about the RF power intensity within their establishments, by posting the data collected by a state-approved inspector. In addition, such testing should be paid for by the party requesting it and the testing itself should be performed by a professional who owns or rents the test equipment and has met the state requirements for training of Home Inspectors regarding RF measurements.

The majority of the Commission proposes that Home Inspectors be offered training by NH OPLC on how to measure on-site peak and 24-hour average RF intensities. Measurements of frequencies and intensities will be performed using low-cost equipment (such as GQ-390 meters). [Description of existing Home Inspector training offered for radon, mold, etc. may be seen at <https://oplc.nh.gov/home-inspectors/index.htm>]

Wells: This recommendation puts in place training for home inspectors that is offered then by the Office of Professional Licensure and Certification. Just as homeowners can request testing for radon or mold, they should be able to request testing for RF exposure on their property or prospective property and expect that the person doing the measurement has had training on the use of the equipment.

Abrami: the point is, we are not talking about making it mandatory. It deals with training inspectors to be able to do the measurements. So if someone has concern, if they are RF sensitive or whatever and they want they can go to somebody that's trained on how to do the measurements. This is totally different than the original recommendation eight. Several people had concerns with the original recommendation, myself included. If someone bought their home decades ago and cell towers were put up, there is nothing they can do to mitigate that problem. If an inspector found lead paint or a water problem, there are things they can do before the house is sold to mitigate that problem. This addresses that if someone wanted testing done, that inspectors are trained.

Gray: With this one, I am sure that Beth is going to tell me that this assumes that radiation is bad and all that. Again, non-mandatory, a state approved way to license. I don't have a problem with. They should have a reliable place to go to get those measurements from a qualified person might be a better way to go might be better.

Chamberlin: This is mostly on wording. In the second paragraph, the majority of the commission believes the public has the right to discover etc., and it says "at a property that they will be purchasing or renting before the transaction is closed". You know, that could be read as almost being a requirement before the sale, which it isn't. Also, it implies that the time when you could get testing done is when you are buying or selling something. I would like to keep it more general and that any citizen that wants this done, can call upon this service. Can we reword this so it makes it clear that it is voluntary and it is not necessarily tied to buying and selling of properties?

Wells: It should also be an option if you want as part of a building inspection as part of an agreement on something you don't own yet. There is nothing about requirement in there. The seller could say no. I refuse to have it inspected and go away and I will find another buyer.

Heroux: I might have been the one to have suggested this and the actual intention was to avoid bursts of demand as a result of some article and make the requirements for testing more evened out over time. I recognize that it's true, if you are buying or selling something, this might be a variable of interest.

Abrami: We are running out of time. I know a few of you have to go but I would like to vote on this one. Maybe the workgroup can work on the wording to make it clear it's voluntary. Is that okay?

Chamberlin: Yes. That addresses my concern.

Abrami: Then we can come back for another vote. Any workgroup changes will come back to the group for another vote. I move to vote.

Wells: second.

Abrami: I am going to call the roll: Tom Sherman (yes), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (abstain), Denise Ricciardi (yes), Dave Juvet (abstain), Beth Cooley (abstain), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no), Patrick Abami-Chair (yes). There are 7 (yes); 1 (no); 5 (abstain). The motion passes and will be revisited.

RECOMMENDATION 8A- The State of New Hampshire should begin an effort to measure RF intensities within frequency ranges throughout the state, with the aim of developing and refining a continually updated map of RF exposure levels across the state, using data submitted by state-trained Home Inspectors. The data should be collected in such a way as to identify geographic areas of notably high RF exposure, places where RF signal for wireless communication is inadequate (dead spots), and places where RF is unusually low (white spots) sought by people who wish to minimize their RF exposure. One possible use of this data will be buyers/renters of property or the public in general using benchmark values to make comparisons and make their own decisions based on their comfort level with RF exposure. After a while, an extensive New Hampshire RF database will exist to provide useful maps and data for future public health investigations. Appendix XX outlines in more detail the technical aspects of this recommendation.

Wells: So 8A is what we would do with the data that home inspectors come up with. One of the things would be that the State of New Hampshire would begin an effort to collect that data in such a way that we can identify geographic areas of notably high RF exposure and places where RF exposure is unusually low and this would be published in a database or a map. It could be used for future health investigations or for people who are looking for places with lower RF exposure.

Abrami: We are also talking about the state taking this on to actually do some measurements, itself. Am I correct on that Ken?

Wells: Yes. That could be a part of it. We talked about the way that Vermont did it. For the most part, this recommendation talks about a low cost way of assembling the data by collecting the data from licensed home inspectors.

Abrami: I can see that being added to the data. That would probably take a long time to get a real picture. The one thing we agreed on was we didn't want the general public taking their own measurements because there is no control.

Wells: It says here that the state of New Hampshire should begin an effort to measure RF intensities throughout the state. That does not preclude the state from having someone from the proper agency go around and take measurements.

Abrami: The essence is we want the state to look at the mapping of RF radiation and if recommendation 8 goes through, that data would be collected as well. These would likely be part of the same legislation.

Gray: My objection to this goes back to the state having to go through this. We haven't proven that there is a big problem yet. I would suggest that Kent work through the University system, get some grant funding and fund this thing. They can do all the studying and data recording and all the measurements that they want to but I don't believe that the state should be required to put together the organization to go do this. Thank you.

Cooley: I will be opposing this 8A as it tries to undermine safety standards that are set by the federal government with the potential to mislead residents that somehow RF within legal limits, is dangerous. So, I will be voting no. Thank you.

Sherman: Just to respond to Beth's comments. Actually, I don't think that's the case at all. Suppose if we find RF levels within the state that are exceeding federally acceptable levels. I am Chair of the Commission on chronic illness that has been standing since 2014 or 2015, looking at the link between human health and chronic illness. This kind of map is something we've been envisioning on all sorts of things. DES and DHHS are actually looking at this in relation to arsenic and bladder cancer and we've talked about expanding this. So these ideas of maps are not new. I think right now, it's a huge unknown. If the state of New Hampshire were to do this or if somebody were to develop a map, I think it would be very helpful. We may be surprised that we may have various RF exposure that far exceeds federal limits but right now, we don't have any clue what those levels are.

So, I don't think that is correct, Beth. I think that this would be useful information making sure that people are not unwittingly being exposed to levels that are beyond what our federal industry accepted levels.

Abrami: Again, we don't say in this recommendation that we are setting different levels.

Roberge: I would just echo what I have said previously. If this intention is that this recommendation be implemented by a state agency, then funding would be necessary. I don't know if you can build language in there similar to recommendation three.

Abrami: The state of New Hampshire "should fund an effort"...how is that?

Wells: I think this could be done in conjunction with the training of the home inspectors. If it's part of their training to do half a dozen measurements in locations the state is interested in.

Juvet: Mr. Chair, starting out that statement with the state of New Hampshire clearly implies it's the state.

Abrami: "The state of New Hampshire should fund or find resources to support the beginning of an effort to measure RF..."

Wells: I am not comfortable with that. One of the advantages of having the state do it, is that the state does not have a conflict of interest. I can imagine if there were entities that would have a conflict of interest and the data collected may not be believed by everyone.

Abrami: Right. We talked about this last time Michelle. Obviously, this isn't going anywhere unless legislation is passed. And if we want the state to do this, there would have to be funding as part of the legislation. It would have to have budget dollars associated with it. Again, this is more of a statement of what we would like to see happen.

Roberge: understood.

Abrami: I am going to say, just keep it the way it is. Is there any other discussion? I move recommendation 8A.

Wells: second.

Abrami: I am going to call the roll: Tom Sherman (yes), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (abstain), Denise Ricciardi (yes), Dave Juvet (abstain), Beth Cooley (no), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no), Patrick Abami-Chair (yes). There are 7 (yes); 2 (no); 4 (abstain). The motion passes.

RECOMMENDATION 9- Require all new cell phones sold in New Hampshire come equipped with updated software that can stop the phone from radiating when positioned against the body. The Commission has been made aware that cell phones contain proximity sensors that will allow a cell phone to only radiate signals when a certain distance from the body, for example, held in the fingers, or placed on a table. This does not change the functionality of the device, only the way it is used, specifically not held against the head or body. Implementation is a software update in the cell phone, as these phones already have a proximity detector to turn off the screen and soft keys when an obstacle is present. With this change, the screen and the RF circuit are automatically turned off. This removes the problems of brain cancers (glioblastomas and acoustic neuromas) and the issue of SAR limits for the industry. See Appendix XX for more detail references to the science behind this recommendation. Cell phones should come set with this inhibition, with instructions in the manual on how to disable it. There should be a soft button on then unit to easily re-enable the radiation inhibition, for example if the unit is handed to a child. In all cases, it should be easier to enable the restriction than to disable it. Cellular phones marketed specifically for children should stop radiating when positioned against the body under all circumstances. The installation of such proximity sensors is also encouraged in laptops and tablets.

Abrami: Number nine has to do with cell phones and I will let Paul explain it.

Heroux: Essentially, there is in cell phones a system that blanks out the screen when it's close to the head. This was originally intended to prevent the soft keys from being activated and the battery from being spent unnecessarily. This software could also interrupt the radiofrequency radiation so that when you bring it against your head so that half of the radiation that was previously broadcast into your head does not exist. In other words, you could use your cellphone exactly as before but you would need to hold it a certain distance from your head as instructed in most manuals sold with the cell phone. Or you could place it in front of your face or place it on the table for example.

Abrami: So the internals of the cellphone can do this with an app, is that correct?

Heroux: Either an app or a modification in the embedded code that is in the phone.

Cooley: since I had to drop early from our last meeting, I didn't get to speak on this recommendation. We are strongly opposed to this. Not only does science not require any of this. This is not necessary. The FCC has a 50 fold safety factor and there is no safety risk. I would be remiss not to point out Berkeley. The decision from last week in terms of compelled speech and First Amendment issues and I will just leave it at that and I will be voting no on this.

Sherman: I am just concerned that when we carve out New Hampshire as a different market from the rest of the entire world. To me, it's a little concerning. I am wondering if the intent here was to have this software that could be enabled by the user rather than something that would be inflicted on them. In other words, you go into your phone and you say I want this to automatically turn off when it's a certain distance of my body. You have activated that software and that keeps it a choice issue. I think that might be a little more doable. I worry about this one. I understand the intent and agree with the intent. But I wonder if making it enabling rather than mandating might be a better way to go.

Heroux: As it is, it is a choice of the user, you have to realize. Of course if you don't have the software in there to do this, you can't do it. In other words, every individual has the choice to accept this radiation when it's against their head or to reject it. We have discussed this issue of choice before. I believe Rep. Abrami brought it up and it was decided that adults should have the choice to use the phone and irradiate their brain if they wish but that the facility to subtract themselves from this radiation should be provided because it is technically very easy to do. In a sense, it is a negligence of industry not to have provided this before.

Heroux: So, Paul what you are saying is that this would have the software not activated but present so if the consumer chooses to use it.

Heroux: That is entirely right. If I may take off the gloves here.... The first thing that will happen from industry is that when the software is included, they will instruct all their sales force to do a favor to the buyer and say I will undo this for you. That's what I expect would happen because they do not want even this capability to be known. I think this is unfair to users.

Gray: If we continue to debate all of these instead of just accepting comments, we are never going to get out of here. My comment on this one is that on recommendation three, we are already putting out information on a site and using this as a hands free device which most cellphones do.

Abrami: the real essence of this recommendation is that it is possible to do this. I kind of agree with Tom. If it's true that most phones can do this, do we encourage entrepreneurs to come up with apps that allow people to buy and do this on their own? My understanding was that this existed in the phones, sensors. The question becomes would an app be allowed by a third party to be put on a phone to turn it off? There are many apps that go on phones, so I don't know. Do we need the cell phone industry to bless this or not?

Again, we are making a statement here. I would almost say "encourage"

Sherman: How about this wording? "Encourage that all new cell phones sold, come equipped with updated software that allows the user to automatically stop the phone from radiating when positioned against the body.

Abrami: It would be a tough sell in NH now that I think about it. There are some states with different emissions limits than others. The auto industry actually does comply with those different limits. California has different fuel standards.

Sherman: But California has a slightly different market share than New Hampshire.

Abrami: you got that right. We are the rounding error. But we like to be first in stuff though. So, with those two changes, any more discussion? I move recommendation nine.

Sherman: I will second.

Abrami: I am going to call the roll: Tom Sherman (yes), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (abstain), Denise Ricciardi (yes), Dave Juvet (no), Beth Cooley (no), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no), Patrick Abami-Chair (yes). There are 7 (yes); 3 (no); 3 (abstain). The motion passes.

Abrami: I know that Denise has to leave at a quarter after. A couple of hers are coming up here at the end. I know Gary has to leave too. I think what we may do ...

Woods: Mr. Chair I have number eleven and I think that should be pretty straight forward if you want to do it that way.

Abrami: I think we will do it that way. We will do one more, number eleven. I will just have to call another meeting. I said a potential of two more meetings so before I lose everybody, can we meet in two weeks? The 8th or the 9th?

Sherman: Why don't we do 10-11:30 on Thursday, October 8th?

Abrami: Ok. Subgroup I will reach out to you

Garod: I am sorry to be the one who jams everything up but I have a prescheduled meeting on the 8th at 11. I will be available for the first hour.

Abrami: We will book 1.5 hours but let's say it's going to be an hour meeting. If we just do the recommendation votes, we should be able to get that done in an hour. Let's just do number eleven.

RECOMMENDATION 11- Further basic science studies are needed in conjunction with the medical community outlining the characteristics of expressed clinical symptoms related to radio frequency radiation exposure. Further studies are just beginning to explore the quantum mechanical mechanisms which are the fundamental basis for understanding the biological changes occurring during the interaction of radio frequency radiation and molecules. These mechanisms can affect cells, tissues and whole organs, as well as accumulate over time.

The majority of the Commission feels the medical community is in the ideal position to clarify the clinical presentation of symptoms precipitated by the exposure to radio frequency radiation consistent with the Americans with Disabilities Act (ADA) which identifies such a disability. The medical community can also help delineate appropriate protections and protocols for affected individuals.

All of these endeavors (basic science, clinical assessment, epidemiological studies) must be completely independent and outside of commercial influence.

Woods: Basically, this just addresses the issue of further studies needed and addresses the issue of transitioning from what are called in the physics world, bulk materials to the actual quantum mechanical effects. We discuss these in a little bit of a peripheral way but have addressed such as proton tunneling and other similar quantum mechanical effects which really represents the way that all radiation interacts with molecular entities. That interaction is a base for cellular activity and as a consequence, also organ and overall systems activity. Those are really needed and they are just now coming on line. I think the bulk studies that have been done in the past, point out that we do need to look at this further. They were inconclusive for a variety of reasons. That's the inherent difficulty with bulk material studies especially when they are as complex as cells and organs. We need to encourage further looking at this.

Secondly, as this comes to the fore, there is a push in the medical community to identify exposure to these frequencies as a clinical entity. The State Medical Society and National Medical Societies are looking at this to try and colleague information in a way that will identify these as a potential designation of a syndrome. Indeed, the ADA already recognizes the exposure as a disability. I think it behooves the medical community to be thoroughly and completely engaged in this process to identify that dimension. So everything from the study, from the quantum mechanical effects which we've addressed to the clinical designation is needed.

Abrami: this is calling for the medical community to work on this. This one really has to do with RF sensitivity more than anything else. Gary is already beginning to reach out to the medical community to start addressing this in a more thorough way.

Woods: This is primarily meant for the readers of this report to identify that in fact there are other things in the works and we need to pay attention to those. The person reading the report will not only understand the other dimensions outlined in the other recommendations but that we as a commission recognize that this is a direction that we need to go and this is a direction that we need to go.

Sherman: I just had one little wordsmith in the first line. Gary would you object to after the word further" basic science and clinical studies are needed" so that it captures the full spectrum of basic science up to the clinical.

Woods: you could put it that way. The second portion of that, the medical community outlined that studies are needed in conjunction with clinical studies.

Sherman: Ok.

Cooley: I will be voting no on this. Take a look at the World Health Organization statement on this. That is why I will be voting no. Thank you.

Abrami: Any more discussion? Ok. I move recommendation eleven.

Heroux: I second.

Abrami: I am going to call the roll: Tom Sherman (yes), Ken Wells (yes), Kent Chamberlin (yes), Carol Miller (abstain), Denise Ricciardi (yes), Dave Juvet (no), Beth Cooley (no), Brandon Garod (abstain), Michelle Roberge (abstain), Paul Heroux (yes), Gary Woods (yes), James Gray (no) because I think it should be a sub of recommendation one, Patrick Abami-Chair (yes). There are 7 (yes); 3 (no); 3 (abstain). The motion passes.

Abrami: thank you all. As far as the Minority Report, Jim and I traded emails back and forth about whether a subcommittee is needed on the Minority Report. Joel doesn't think it's necessary but I know you had some concerns Jim about 91A stuff.

Gray: If you form a group, then I have to follow 91A and publicize the meetings and all those other things. If we don't have a quorum of the group then it can be informal. We can email back and forth and then present it to the group as a recommendation.

Abrami: those who want to sign onto the Minority Report, you can give your suggestions to Jim and correspond back and forth but there can't be meetings.

Gray: right. Forming a group would hinder me from writing the report. As long as I don't have quorum of the whole group or any committee of the group, then we can get together and talk about it because that small group cannot make decisions that are binding on anyone. Everyone should have a copy of what I wrote to begin with. I think Beth would like me to put at least a paragraph in there about the FCC and their requirements and I have no problem doing that. If other people want to communicate with me, just use my legislative email: james.gray@leg.nh.us. We will certainly publish it out through Pat to the rest of the group.

Abrami: I am ok with that. Joel's counsel to me was it was ok if you guys interact. I just wanted to make sure that was your understanding Jim.

Thank you everyone. I know some of you had to leave early. You know these commissions we have people from industry, it's very difficult to get unanimous on any of this stuff. That's why we are doing it the way we are doing it with the Minority Report. The legislature has recognized this and I ran into similar things with the Marijuana Commission. There were differences of opinion that could not be reconciled. The resolution that the legislature has is a Minority Report built into the total report so people don't miss it in fairness. So that is where we are at. We will see everybody in a couple of weeks.

V. Next meeting via Zoom: October 8th 10-11:30 am

Meeting Adjourned at 11: 27 am

Text chat during Zoom meeting:

Chat from HB522 5G Commission Meeting, Sept 22, 2020

From Rick Maynard to Everyone: 09:02 AM Morning All.

From Deb Hodgdon to Me: (Privately) 09:04 AM thank you

From Cece Doucette to Me: (Privately) 09:08 AM Morning, Kent. If the Recommendations document has changed from the one you sent me dated 9/17 in the file name, would you mind sending it to me?
Thanks.

From Me to Cece Doucette: (Privately) 09:09 AM We will be discussing the version that I sent you.

From Cece Doucette to Me: (Privately) 09:12 AM Supah, thanks!

From Cece Doucette to Me: (Privately) 09:29 AM Rec. 1, non-bold paragraph, first line: (TTA) should be (TCA)

From Cece Doucette to Me: (Privately) 09:42 AM Rec. 2 bold section, line two, in parentheses, (there) should be (their). Also, line 5, after "cell phones" might you consider adding, "and other wireless devices"?

From Helene to Everyone: 09:47 AM We are very concerned about having a cellphone tower being installed in less than 1/4 mile from the front of our home. We are listening to this meeting today so that we can be active in this process to ensure that residents of NH have a seat at the table to ensure that we have representation to protect our health and rights

From Rick Maynard to Everyone: 09:48 AM Thank-you all. Take care, I have to go.

From EH Trust to Everyone: 09:49 AM Published research o cell towers here <https://ehtrust.org/cell-towers-and-cell-antennae/compilation-of-researchstudies-on-cell-tower-radiation-and-health/> research on 5G <https://ehtrust.org/scientific-research-on-5g-and-health/>

From Helene to Everyone: 09:49 AM considering that we are currently in the process of dealing with our Town and a Wireless Tower company that gained approval in a way that we feel was not appropriate. None of the neighbors were included in the meeting and we are being told by the Town committee that we never would have had any say in the tower being approved because of the current laws in our State, regardless of our concerns

From EH Trust to Me: (Privately) 09:51 AM Can I record please . It is a public meeting. I requested to record

From Cece Doucette to Everyone: 09:52 AM Rec. 3, at the end of the bolded section, please consider adding after "pregnant women" the other vulnerable populations, "the elderly and those with existing health compromises."

From Me to EH Trust: (Privately) 09:54 AM I'm not able to grant permission to record during an active meeting. However, verbatim minutes will be posted on our public website.

From EH Trust to Me: (Privately) 09:56 AM Thank you, I thought it was an open meeting so we could
From Helene to Everyone: 10:01 AM The biggest concern is that they are allowed to put numerous antennae on top of the towers which can increase the emf emissions greatly. Please consider this.

From Cece Doucette to Everyone: 10:13 AM Do we have long-term studies on Li-Fi? Perhaps we can modify the bold where it says, "optical connections" to "optical connections if proven biologically safe."
Rec. 5, second unbold paragraph, please be careful about recommending LEDs, many suffer negative biological effects from them today.

From Helene to Everyone: 10:17 AM Here is a caveat; we have a cell tower going up in less than one mile from 2 schools. What good is converting over to broadband or fiber optic technology (which is not only better, but less risky for security purposes) when there is a cell tower with 10 - 20 antennae located so close and children are exposed 5 days/week for 6-8 hours per day. Health concerns are not only for children, but all people are susceptible to emissions. Many towns are now electing to not install towers due to the findings from many studies and the notable increased health risks

From EH Trust to Everyone: 10:32 AM You can watch a news investigation that shows it was lobbying from firefighters here https://www.youtube.com/watch?v=61h_vuBujw0&feature=emb_title Affidavit of Susan foster <https://ecfsapi.fcc.gov/file/7022117660.pdf>

From Helene to Everyone: 10:32 AM Should we remind everyone that the FDA has approved numerous medications in the past as SAFE, but they were not. Tobacco and asbestos were considered safe and they were not. We have evidence from other countries that this technology is not safe, yet it is being

shoved down our throats and to comment that NH would be an outlier is wrong and uninformed. Thank you Dr. Heroux for pointing that information out. There should be several regulations implemented keeping towers from close proximity to residential homes, schools and businesses. There are OTHER safe options available and people should have the right to say NO to unsafe technology, especially until it is found to be made safer.

From EH Trust to Everyone: 10:35 AM Resources on firefighters here <https://ehtrust.org/firefighter-unions-opposing-cell-towers/>

antennas on forestations were carved out of the bills Fire stations AB57- Firefighters have gotten an exemption to have cell towers on or adjacent to their facilities. This was codified in California's 2015 legislation AB57 . CA AB57 (2015) Legiscan Text of Bill. " Section 65964.1. (f) Due to the unique duties and infrastructure requirements for the swift and effective deployment of firefighters, this section does not apply to a collocation or siting application for a wireless telecommunications facility where the project is proposed for placement on fire department facilities. " SB649- They also received an exemption in California's SB649 (2018), a bill which was vetoed by Governor Brown. SB 649 California (2017) Wireless Telecommunications Facilities – 65964.2. "(a) A small cell shall be a permitted use subject only to a permitting process adopted by a city or county pursuant to subdivision (b) if it satisfies the following requirements:(3) The small cell is not located on a fire department facility."

From Cece Doucette to Everyone: 10:35 AM You can replace the firefighter passage with: Please note, in 2004 the International Association of Fire Fighters adopted a formal Position on the Health Effects from Radio Frequency/Microwave (RF/MW) Radiation in Fire Department Facilities from Base Stations for Antennas and Towers for the Conduction of Cell Phone Transmissions. They oppose them, "until a study with the highest scientific merit and integrity on health effects of exposure to low-intensity RF/MW radiation is conducted and it is proven that such sitings are not hazardous to the health of our members." They reaffirmed that stance in California's 2017 Senate Bill 649 which would take away municipal home rule to place more wireless infrastructure in our communities, on poles in the public rights of way, at street level every 4 to 12 homes. They included an exemption in the bill: Section 2 "65964.2. (a)...(3) The small cell is not located on a fire department facility." Every citizen should have the same protections.

From EH Trust to Everyone: 10:36 AM The news investigation details the fire fighter position. You can watch it all here https://www.youtube.com/watch?v=61h_vuBujw0&feature=emb_title

From NR to Everyone: 10:38 AM New Hampshire does have the legal right to "require" those setbacks. According to the TCA of 1996 -- 47 U.S.C. § 332(c)(7)(B)(i)(I) is very clear: in only prohibiting discrimination between "providers of functionally equivalent services." "Functionally equivalent services" are defined as those wireless services functionally equivalent to those being provided by the "personal wireless service facilities" for which approval is sought. Therefore, a county zoning ordinance that imposed different and stricter procedural requirements (e.g., conditional use) on wireless service facilities than on facilities used for providing fiber to the home, cable TV, utilities, or other services would not be in violation of the law. Moreover, 47 U.S.C. § 253 does not prohibit the county from

imposing stricter procedural requirements on WTFs than on cable or other uses of facilities. Section 253 has three relevant parts. Section 253(a) creates the general rule that "[n]o State or local statute or regulation, or other State or local legal requirement, may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service". In turn, subsections (b) and (c) are "savings clauses" that provide safe harbors to protect the ability of states and localities to regulate zoning and construction of wireless facilities:

From NR to Everyone: 10:38 AM (b) State Regulatory Authority

Nothing in this section shall affect the ability of a State to impose, on a competitively neutral basis and consistent with section 254 of this title, requirements necessary to preserve and advance universal service, protect the public safety and welfare, ensure the continued quality of telecommunications services, and safeguard the rights of consumers. (c) State and Local Government Authority Nothing in this section affects the authority of a State or local government to manage the public rights-of-way or to require fair and reasonable compensation from telecommunications providers, on a competitively neutral and nondiscriminatory basis, for use of public rights-of-way on a nondiscriminatory basis, if the compensation required is publicly disclosed by such government. From Helene to Everyone: 10:41 AM Yes, Rep Abrami. Exactly what we are going through right now. From GARY WOODS to Me: (Privately) 10:41 AM will you be able to forward the "chat" to us? From Helene to Everyone: 10:42 AM Cell tower will be erected within the hot zone of our home and we are being told that we have NO rights

From Deb Hodgdon to Me: (Privately) 10:46 AM kent see chat on state rights

From EH Trust to Everyone: 10:49 AM You can see how Switzerland measures RF and posts it fr all to see here

<https://map.geo.admin.ch/?topic=funksender&lang=en&bgLayer=ch.swisstopo.pixelkartefarbe&layers=ch.bakom.mobil-antennenstandorte-5g,ch.bakom.radio-fernsehsender,ch.bakom.mobilantennenstandorte-gsm,ch.bakom.mobil-antennenstandorte-umts,ch.bakom.mobil-antennenstandortelte&catalogNodes=403,408>

From Me to GARY WOODS: (Privately) 10:51 AM Yes, I'll forward the chat after the meeting.

From Cece Doucette to Everyone: 11:03 AM

Most kids don't use cell phones against head, but they do have their cell phones, tablets and laptops on their bodies. Please expand this to all wireless devices, not just cell phones.

From EH Trust to Everyone: 11:05 AM Phones exceed RF limits at body contact My daughter uses the phone to her head. I think it should be for al wireless devices as well. Many lawyers and politicians and coaches use cell phones to their head. and most people carry phones touching their body and in bras

From Cece Doucette to Everyone: 11:17 AM Doctors, nurses and others can be trained January 28-31 at the EMF Medical Conference. There are IDC codes already established and in use today. There is an EMF primer offered October 23-24. Health care providers and the general public are invited to register for both. <https://emfconference2021.com/>

WHO has reopened their investigation into in 2020 based on recent science showing cancers, reproductive issues and other effects: https://www.who.int/peh-emf/research/rf_ehc_page/en/index1.html

From EH Trust to Everyone: 11:20 AM The Who EMF Project has no transparency as published research shows here <https://www.spandidospublications.com/10.3892/ijo.2017.4046> Whereas The Who IARC is independent and scientists are vetted for conflicts of interest Our scientists letter to the EHO about the “factsheets” they post online was never answered <https://ehtrust.org/scientists-call-for-transparency-at-the-world-health-organization-emf-project/> The Who refuses to answer these questions

From Cece Doucette to Everyone: 11:22 AM Yes, just like the FCC refuses to answer this Commission's questions.

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

10/8/20

10:00 am-12:00 pm EST

Via Zoom (<https://unh.zoom.us/j/8760768986>)

Via telephone-US (1 312 626 6799 (US Toll) ID: 876 076 8986)

In attendance: (13)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee

Dr. Paul Heroux- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Senator Tom Sherman-president of the senate appointee

Brandon Garod-AG designee, Asst. AG Consumer Protection

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Carol Miller-NH Business & Economic Affairs Dept

David Juvet-Business and Industry Association

Not present: (0)

Meeting called to order by Rep Abrami at 10:03 am

Abrami: Due to the Covid 19 virus and the Executive order signed by the Governor this public meeting is allowed to be conducted via Zoom. It is open to the public for viewing and was duly posted as a zoom meeting. With that said, if you are not a member of the Commission, can you please turn your cameras off and mute yourselves? That would be much appreciated. In addition the meeting is being recorded as an aid to doing the minutes. All chat room discussions will be included in the minutes.

I. Approval of minutes from 9-22-20:

I have not received any changes to the minutes that I sent out about a week ago. Are there any changes that anyone wants to make? Seeing none, I will say ...without objection, we approve the minutes from that meeting.

II: Agency Disclaimer:

I sent out the agency disclaimer that will be in the report. That is there especially for the agencies. I think I heard back from two of you. I can't recall if I heard from all three of you. My sense is that the language is okay with your leadership. I think most of you took it up the pole to your leadership. I think you are all okay with that language. I am looking at Michelle, Carol and Brandon. Yes? Ok. So, we are good there. That language will appear in the report.

III: Vote on Recommendations (6,7,8,10,12,13,14):

Some of these recommendations we voted on but said we would change some of the wording so we are going to go back to them, discuss them and take another vote. We may have to revisit #9 as well. The work group changed some of the wording.

I would like to work backwards so Brandon can at least hear the discussion on the ones we have not discussed before and be involved in that vote. I sent the updated document out. It's the document dated October 5th in the upper right hand corner. We will start with Recommendation #14. Denise, that was yours.

RECOMMENDATION 14- The State of New Hampshire should engage our Federal Delegation to legislate that under the National Environmental Policy Act (NEPA) the FCC do an environmental impact statement as to the effect on New Hampshire and the country as a whole from the expansion of RF wireless technologies. Concern comes from the fact that the FCC is projecting that 140,300 low orbit satellites, 800,000 5G small cell antennae plus many additional macro towers will be required for these networks to function.

The majority of the Commission is concerned that any new large-scale project that will densify antennae networks to this extent truly requires an environmental impact study. The NEPA statute requires that the agency consider environmental concerns in its decision-making process. NH should be provided documentation of such considerations. Until there is Federal action, NH should take the initiative to protect its environment.

Ricciardi: We had discussed doing something about the environmental impact with the expansion of wireless technology. The reason I addressed it is because we have an act: the National Environmental Policy Act (NEPA). That statute requires that the agency consider environmental concerns in their decision making process. New Hampshire should be able to request for documentation to be provided of such considerations for the impacts on our environment. That's why I wanted to use this NEPA to reflect that.

Abrami: Any discussion? I don't see anyone. Ok. Without any discussion, I will move to vote. We will take the votes as we did the other day. Is there a motion to accept the recommendation?

Cooley: Mr. Chair, before we do that. Are you guys getting feedback?

Abrami: Yes. Someone is not muted. Please mute yourselves. Thank you, Beth. I was hearing that as well. The static is gone now.

Ok. I need a motion that we accept the recommendation.

Ricciardi: I make the motion that we accept recommendation #14.

Chamberlin: I second it.

Sherman: Are we going to have discussion on this, Patrick?

Abrami: Yes. I did ask for discussion.

Sherman: I just want to clarify one word and that is "fact" in the second sentence. We have seen the citation that the FCC is projecting 140,300 low orbit satellites. Is that from an FCC publication? I just want to be sure that that is a verified fact and that the FCC has stated that.

Ricciardi: It is a fact that Ajit Pai stated that the FCC estimated 800,000 wireless facilities for 5G. That, I know for sure.

Wells: Yes, the 14,300 is the number I have heard associated with the SpaceX operations. There is a citation for the 800,000 in the chat.

Sherman: I just want to make sure that we have the documentation if someone asks, is that truly a fact? This has come up on other recommendations. If you have the documentation that the FCC has projected that, then I am fine with it the way it is.

Ricciardi: Yes and I am sending it. I am trying to make sure I don't miss anybody.

Gray: The relevance of this...are we saying that the radiation from those satellites are going to cause damage to people, DNA, heating, all of those things? Yes. There may be that many satellites but what relevance does that have to our committee? It's like the thing that you sent out the other day about Van Halen having a metal guitar pick and he attributing that to his cancer and discounting all of the smoking that he did for years and years. A lot of this stuff, although may be interesting, it is just anecdotal. It is not a fact. It is not good science. It is not worthy of being talked about and reported in the minutes of these meetings. Thank you.

Woods: I understand the Senator's comment on the relationship and how this recommendation #14 does not make that direct connection. This is basically an assessment of the degree to which the level of radiation is increasing. The rest of the report relates to the basic science. This does not address basic science and its relationship to cellular or organism impact. But, just a documentation of the prevalence and so in that sense, I think it should remain.

Abrami: The third piece of this was additional macro towers to make the networks function. I would imagine without much stretch of the imagination, there would be more macro towers. I know we got

the low orbit satellites from somewhere because originally we had 140,000 and Ken, I think it was you who said, it's 140,300.

Wells: I can look for a link on the satellite numbers.

Heroux: the point of the recommendation is that the FCC is avoiding a NEPA review, while modifying the environment substantially. It doesn't qualify the consequences, it just says that the US formality is that is normally fulfilled, has not been, by the FCC.

Abrami: Ok. While Ken is looking for that, let's hold on the motion and move to #13.

Wells: I found a news article from March of this year that the FCC has approved up to a million small cell antennae for the Starlink network.

Woods: If I could clarify that Ken said antennae but the question was about satellites.

Abrami: Ken you keep looking. We will skip this one for now. Denise, please speak to #13.

RECOMMENDATION 13- The State of New Hampshire should engage agencies with appropriate scientific expertise, including ecological knowledge, to develop RF-Radiation safety limits that will protect the natural environment; trees, plants, birds, insects, and pollinators.

The majority of the Commission understands that current Federal safety limits set twenty-four years ago with the intention of only protecting humans from short term effects, but not protecting flora or fauna from harm. The State of New Hampshire needs to ensure our natural environment and wildlife are protected by effective safety standards. Tree limbs, birds, and pollinators will be closer than humans to 5G cell antennae and associated 4G densified infrastructure. In fact, the wireless radiation from cell antennae could exceed safe limits when leaves of trees and flying birds and, since they may have higher exposure being in direct line of sight of wireless RF beams. When pollinators are impacted so are all forms of vegetation that depend on them for reproduction. Research on this issue is shown in Appendix XX.

Ricciardi: We all discussed that the State of New Hampshire should engage agencies with the appropriate scientific expertise including ecological knowledge to develop RF radiation safety limits that will protect the natural environment: trees, plants, birds, insects and pollinators. I like this recommendation.

Abrami: I prefer that we have a discussion before we move to vote in case there are some slight modifications that we can agree to. I will open this up to discussion.

Heroux: I thought we had agreed to remove the word "environment" and use the word "ecology".

Abrami: Yes. We did. What we agreed to was " including ecological knowledge".

Heroux: I think you should remove environment from there entirely and put: trees,plants, birds, insects and pollinators.

Abrami: get rid of “natural environment” is that what you are suggesting?

Heroux: yes.

Gray: One of the key things you cited is data from twenty three years ago. There is also both FDA and FCC guidance that have been promulgated on this that’s dated in ‘18, ‘19 and ‘20 where they state that they have reviewed the current science and nothing like that is even mentioned in this recommendation. Again, I think you are giving the opposing argument short shrift on this and not considering all the science that is out there.

Sherman: could I say something? Senator Gray and I and everyone in the legislature, understands that federal limits and regulations may not necessarily reflect the latest science. The most recent example of this is the EPA and their regulations on PFAS, which still is at 70 ppt. No scientist worldwide would say that is adequate protection. So, we actually had a bill that we passed asking the DES through their science and toxicology to go ahead and come up with maximum contaminant levels.

I, for one, always find it a little fascinating for us to say: well let’s just trust the federal government to do the right thing when we know they are not necessarily doing it. If we want to wordsmith the second paragraph, that’s fine but I think there is absolutely zero harm having the scientists that are part of our state already and we have great ones at DHHS and DES to take a look at the science and perhaps come up with their own recommendations for guidelines. Not only is there legislative and statutory precedent for this kind of thing, we have selective trust of the federal government when it comes to these scientific matters. We have generally erred on the side of saying: well, let’s take a look at it ourselves. I would say, let’s vote on this one and move on.

Ricciardi: Thank you, Senator Sherman.

Gray: Again, I am not saying you are not going to put this recommendation in. I am saying that you say the guidance out there is 23 years old, but you don’t mention the documents from ‘18, ‘19 and ‘20 that affirm that they have conducted reviews that are of the current data that is out there. Unless you are going to treat both sides fairly, then the report you get at the end has no meaning.

Abrami: If you read on, it says with the intention of only protecting humans from short term effects. Obviously the first studies were done on humans, not birds, plants, insects and pollinators. I am ok taking the 24 years out but as Tom said, even with that, the state doesn’t necessarily trust what the federal government has done.

Sherman: Mr. Chair, I have a fairly straightforward wordsmith that hopefully addresses Jim’s concern. It could say: “the majority of the commission understands that current federal safety limits were made with the intention of only protecting humans from short term effects” They have looked at subsequent science but they are the same so we don’t have to get into that. We can just capture that by saying the intention.

Abrami: right. Thank you for helping with that one. That was my feeling.

Sherman: If there is no further discussion, we should move. We have to keep moving.

Abrami: we are up against a time clock here. That's why it may appear that I am rushing.

Roberge: Just a recommendation. In recommendation #1, we are asking our federal delegation to require the FCC to look at the standards with respect to human health. I am wondering why we wouldn't ask for them to look at the environmental impacts as well. An example of that was in my previous job at DES, that at the EPA looking at the Clean Air Act and standards set by EPA, there is a primary health based standard and a secondary environmental standard on things like sulfur dioxide and nitrogen oxide. I am just suggesting that we add this on for recommendation #13.

Abrami: We had it separate to highlight that only human effects have been considered and I would like to keep it separate.

Cooley: Just a comment and I don't me to belabor the point but this is more so for the minutes. States do not have jurisdiction to set their own RF safety limits. That is the exclusive jurisdiction of the FCC. For that reason, I will be voting no on this recommendation.

Abrami: Again, this is only to have the state study if it so wishes. This would be just like Tom was saying; the state took the initiative to look at PFAS a little more closely. That's what we are doing here. We are trying to add to the knowledge base.

Ricciardi: in 2018 and 2019, statements by the FDA are not about the birds, trees, and bees. If you look at the FDA reports, they are only about tumors not environmental effects. As we said before, these are just recommendations by our commission. Recommendations, do not go against the law as Senator Sherman said, you would put legislation forward. With all due respect to everyone here, there is the minority report. I don't feel that we should be constantly changing the one that the majority feels when there will be a minority report. Thank you.

Gray: Again, Denise has her opinion. The thing is that this report should have the fair and equal treatment of both sides of this issue. In paragraph one, you claim to have a fair and equal treatment of both sides. Yet, on this recommendation before it was modified, you spoke to the 23 years and ignored recent documentation issued by both the FCC and FDA. The FDA as far as I know is not in the business of protecting the environment. I agree with that. But, then we didn't go look at other guidance out there to see if it was relevant. All we are asking for is fair and equal treatment. There are experts that we would like to present but we have not been able to do that because of time considerations and scheduling problems with those experts.

If you are going to just put through recommendations on this issue that I feel are far and above what should be done without looking at both sides of the science, then I might as well sign off this call and resign from the commission because it's not doing me any good and it's not doing the citizens of New Hampshire any good. You guys rail road this thing through. Fine. But we are not protecting the citizens of New Hampshire and not providing the economic opportunities that a good and useful cell phone system will provide them. It's just very frustrating.

Abrami: Again, we lost four months due to the virus. I had a lot more speakers lined up and I kept saying to Beth, come up with more speakers. There is no changing our end date on this.

Sherman: Mr. Chair, I just want to make sure the Jim knows that I hear what you are saying and the way these commissions work is we try to be very respectful to everyone's opinion. We move forward as much as we can together and the minority report is for any additional dissent or altering opinion. But Denise, I think it's very appropriate for us to modify the final recommendations to fit as many people on the commission as possible. I fully support making the change that Jim wanted which was getting rid of the years and the timeline in the comment below. I hope we can move forward and bring this to a vote.

Ricciardi: I appreciate that and I understand. It's just the subcommittee has worked over and over again all these iterations. But I do thank you for your comments.

Abrami: any other questions or comments on this? I would like to take this one to a vote.

Sherman: I am happy to move it to a vote.

Heroux: I second.

Abrami: It's going to be as shown and taking out the "natural environment" in bold and taking out "set 24 years ago" and adding "limits were made with the intention", in its place. We will go over all these changes and do a final vote before we do a vote on the report. I will call the roll:

Tom Sherman: yes

Ken Wells: yes

Kent Chamberlin: yes

Carol Miller: abstain

Denise Ricciardi: yes

David Juvet: No, and I would like to comment. This implies that the state is going to be implementing its own RF radiation safety limits which I think will invite a lawsuit. I can't support it.

Beth Cooley: no

Brandon Garod: abstain

Michelle Roberge: abstain

Paul Heroux: yes

Gary Woods: yes

Jim Gray: no

Pat Abrami: yes

Abrami: The motion passes, 7 yes, 3 no, 3 abstain.

Any information on the numbers for satellites, Ken?

Wells: Elon Musk has approval for 42 thousand but there are other satellite companies like OneWeb but I don't know what the total number is. I would be fine if you want to remove that number of satellites or just talk about the 42 thousand that SpaceX has been approved for their Starlink project.

Abrami: I remember seeing articles when we first started this that there were two or three companies, I think. If somebody could help me with that, I would appreciate it.

Heroux: You could put that the exact number will be updated by FCC documents. We know it's going to be at least forty three thousand and it may be higher but I don't think that people will vote yes or no on the basis of the exact number of satellites but rather on the impact of all these things.

Abrami: We can vote on the number as written with the intention that we find and have documentation for it and all of these in the appendix and we can modify 140,300 low orbiting satellites before the last meeting.

Sherman: I would recommend the following: I would take the sentence that starts with concern and unbold it and put it in the discussion. And change the part: concern comes from the FCC projection of numerous low orbit satellites and 5G small cell antennae plus additional macro towers that will be required for these networks to function. You still need documentation in there.

Wells: Citation 53 and 57 talk about FCC license approved.

Heroux: The satellite network is something very fluid. Some of these companies go bankrupt. Essentially, there is a large uncertainty but I think that when the FCC mentions 800 thousand, it is their number and it brings home the impact on the environment because "numerous" could be five. Five is not equal to 800 thousand. When we have a number that originates with the FCC, maybe it shouldn't be in bold because it doesn't refer to a principle but at least it should be in the text underlying, in my opinion.

Gray: Again, the purpose of this commission is to study health and environmental impact. Are we saying that every one of those satellites is affecting health or the environment? No. That's not possible. The FCC has issued further guidance about whether there is a health effect and has said that they have studied the current science out there and current reports that have been done by other people. Not including a reference in this and many of the others to the fact of what the current position of the FCC is, is one sided and not a fair and balanced part of the report. You can say whatever you want but we need to present the facts on both sides, not the facts on one side. Trying to use the number of satellites, the number of antennae, the number of this, the number of that and saying that that is going to affect your health or the environment is purely trying to do fear mongering. Present the facts on both sides.

Abrami: Let's not forget that we wrote to the FCC and the FDA questions that they did not answer. We would love to have had them testify before us as well but that was not going to happen. They would not even answer our questions.

Gray: the guidance is already there on the internet. I went and found it when I was preparing the current minority report.

Ricciardi: It's a captive agency.

Sherman: I would just point out that if you look at the recommendation, it is not drawing any conclusions, Jim. It's asking for further study. I don't think it's necessary that you have to say anything when all you are asking is for further study so I disagree with you on this one. I do agree with Paul that if you want to put a number in there that is a little more dramatic than numerous, you just need to be sure that you have the source of that number documented. I am fine with a number as long as its source is documented.

Woods: I agree that we should move forward with this. This is basically an assessment tool of identifying prevalence. It's probably no different than the technology of putting roads in a hundred or so years ago. We didn't have roads or bridges and did not have to repair them. But now, we need to assess roads and identify how many bridges we have that need repair. We are now in a different technology, wireless and like roads and bridges we are trying to identify how many we have. We are not saying bridges or roads are bad. We are trying to do an assessment of the prevalence of these items so that when we look at whether they need attention or not, we will have some idea. Again, it's like trying to assess how many bridges we have not whether they are good, bad or indifferent.

Wells: From a physics point of view, the number of antennas is relevant because if you have tens of thousands of satellites and hundreds of thousands of small cell antennas and they are all emitting energy, the energy density is increased by a factor of the number of antennas.

Abrami: Tom's suggested language moving it from the bold section to the explanation portion. Why don't we do that and between now and the next meeting, if we can verify hard numbers we can put them in the report. Is there any other discussion? Kent made motion to move the recommendation. Denise seconded it. I will call the roll:

Sherman: no vote (not on screen)

Wells: yes

Chamberlin: yes

Miller: abstain

Juvet: no

Cooley: no

Garod: abstain

Roberge: abstain

Heroux: yes

Wells: yes

Gray: no

Abrami: yes

I don't see Tom on the screen, so I will not count him. 6- yes, 3 -no, 3 -abstain. Motion passes.

RECOMMENDATION 12- Recommend the use of exposure warning signs to be posted in commercial and public buildings. In addition, encourage commercial and public buildings, especially healthcare facilities, to establish RF-radiation free zones where employees and visitors can seek refuge from the effects of wireless RF emissions.

Many NH citizens are sensitive to electromagnetic radiation emitted from devices used in the delivery of in-building cellular, and fixed wireless services. A majority of the Commission suggests owners of commercial and public buildings, especially healthcare facilities, voluntarily place signage at entrances concerning RF-levels and RF-free zones within these structures so those entering the building are aware.

Miller: It's a simple recommendation for exposure signs to be posted in commercial and public buildings especially in healthcare facilities. This is also to establish RF radiation free zones where employees and visitors can seek refuge from the effects of the emissions. It's a pretty simple recommendation. Some folks are doing it already. I can say that dentist's office tell you to shut your cell phones because it does disturb the equipment. There it is and ready for discussion.

Gray: Are we going to include the report from the World Health Organization that says exposure to this low level of radiation is not a factor and has not been scientifically tied to any syndrome? Is that going to be included at all?

Miller: I don't know. If you think that would balance off this recommendation and would like it in the appendix, I have no problem with that at all. Regardless of whether it's based in science or not, there are many citizens that are sensitive to it. It's as simple as that, for me anyway.

Gray: Again, I am just trying to be fair. There are people out there who say they are sensitive to it but there is no scientific tie in double blind studies that confirm that these people are actually suffering effects of the radiation.

Heroux: and these people don't believe that.

Miller: Right and it's just a recommendation. It's not required. We can add some NH citizens are sensitive.... Regardless of the study and add the appendix note with that. However, you think the justification for the bolded statement addresses both sides. You could put after the words: fixed wireless services.... even though not substantiated through the World Health Organization Report.

Abrami: The lead in to all these recommendations is we are following the Precautionary Principle. All of these would need NH legislative approval. The work group thought this was a reasonable recommendation to make, understanding that it's a high lift to get it through the legislature and the Governor to sign. We can add a line or two but Jim, you have the minority report. I know what you are going to say about this one. You already told us.

Juvet: Just a question for people more knowledgeable about this than me. What exactly is involved with businesses establishing RF free zones? What do they have to do in order to create that?

Miller: We had some examples where hospitals have rooms available for folks that were bothered by the electromagnetic radiation. It's not just from antennas. It comes from computers and a variety of places. I have experienced a customer coming into my business going, "whoa, I can feel everything in here". That was one of hundreds that come in.

Juvet: I am just asking for clarification. You could use hospitals as an example. What did they have to do to create that RF free zone?

Wells: From the physics point of view, you build a Faraday Cage. It's a lightweight metal lined box. It could be similar to a screened porch with metal screening or aluminum foil. Repaper the wall with aluminum foil and you are good.

Heroux: What you can do is survey the environment for the place where the fields are lowest and post signs that you don't want active sources that are controlled by individuals and you may do this at a very low cost. As Ken mentioned, you could also actively try to shield if you have some sources that are very powerful that you want to get rid of in that location.

Abrami: We have somebody who is RF sensitive who says, my oral surgeon was very happy to move me to a lower RF room and make sure no one had devices in the room.

Sherman: I think there is an easy fix on the sentence but I just want to caution Jim or others about citing any traditional or organized medical site like WHO or otherwise... that because they say it isn't so, that it isn't so. I am old enough to have been and I know others will recognize this but when I was growing up in Madison, people who had fibromyalgia syndrome or symptoms or irritable bowel symptoms were actually told by doctors, it's all in your head and come to find out, it's not. Studies were inadequate. They missed the boat. Eventually, when we got the studies together, we recognized not only that the symptoms real and reflected a true syndrome, but now they are mainstream diagnoses. The fact that RF sensitivity is not fully recognized nationally or internationally, doesn't mean a thing to me.

What I would say is "many NH citizens report sensitivity to electromagnetic radiation" and leave it at that. That's the reality. I suspect this will turn out to be a real well-documented syndrome eventually.

The science is so much in its infancy right now. I would be very cautious about saying it doesn't exist. I suspect that it does and we don't have the studies yet to prove it.

Abrami: Our recommendation #11 directs the medical community to start looking at this more rigorously. I am ok with that change.

Gray: It still does not recognize that there have been scientific experiments conducted by the WHO that was supposedly double blind and all the great things we are supposed to do when we do one of these studies that said they cannot, and not to be insensitive to people who are suffering, but they couldn't attribute it to electromagnetic radiation.

Sherman: I would just respond to that Jim, no physician in their right mind would depend upon a single study to say that something does or does not exist or that a treatment does or does not work. Would you agree with that, Gary?

Woods: Absolutely, we have seen as Tom has outlined time and again over the course of hundreds of years, theories have been thrown out on a regular basis for a variety of reasons. This is just one more in that long term step. We went through this with tobacco and we are doing the same thing again. In the chat there are some references for the WHO organization the Jim refers to. The people in the chat seem to be more familiar with it than I. There are two portions of the WHO organization. Some are associated with industry and some are not. It has been pointed out, as we have pointed out in this commission, one of the WHO organization provided the conclusion that radio frequency radiation was indeed a Class II carcinogen. So to say that a WHO organization says there are no effects, would not be inclusive of all the WHO organization findings.

Gray: Saying that it is a carcinogen, it doesn't take into consideration what the level of that radiation is. The FCC's recommendations are 50 times less than what has been demonstrated in various studies. To say that it's a carcinogen, yes at certain levels it is. When we treat cancer and have multiple doses of radiation going into a patient, we do it at different aspects so the tissue in between is not affected. To make that statement without some kind of a radiation limit, doesn't bode well for me.

Sherman: Mr. Chair, can we move the question?

Abrami: Are there any other comments? Ok, let's move the question. The only change is in the descriptor, "many NH citizens report sensitivity". Tom, are you making the motion?

Sherman: yes.

Abrami: second?

Heroux: yes.

I will call the roll:

Sherman: yes

Wells: yes

Chamberlin: yes

Miller: abstain

Ricciardi: yes

Juvet: abstain. I appreciate that this is a recommendation and not a mandate. On the other hand, I am uncomfortable with sentences like “many NH citizens”. I don’t know what “many” means in the context of the overall state population so I am on both sides of this one.

Cooley: abstain.

Garod: Brandon had to leave. He is gone.

Roberge: abstain.

Heroux: yes

Woods: yes

Gray: no

Abrami: yes

7- yes, 1-no,4- abstain. Motion passes.

We are going to go to #10.

RECOMMENDATION 10- Promote and adopt a statewide position that would strongly encourage moving forward with the deployment of fiber optic cable connectivity, internal wired connections, and optical wireless to serve all commercial and public properties statewide.

The majority of the Commission believes that fiber optic transmission is the infrastructure of the future. When compared, RF wireless transmission lacks fiber optic characteristics: speed, security, signal reliability and biological effects on humans and the environment.

The State should encourage partnerships between towns to make this happen and encourage our Federal Delegation to support grant money to assist with such deployments when it comes to funding fiber optic cable deployment especially in rural locations.

Abrami: This is really a shout out to fiber optic connectivity.

Miller: It is simply adopting a statewide position, not a body but a position that strongly encourages moving forward with deployment of fiber optic connectivity, internal wired connections and optical

wireless to serve commercial and public properties statewide. That would just mean hard wired connections or optical wireless as opposed to Wifi. Open for discussion.

Heroux: I am very in favor of this. I think in the modern world, having fast access to the internet is a human right nowadays. This should be done in the most technologically advanced way, which is optical fiber. There is both a technological aspect to this and a human aspect. I think this is very important.

Juvet: just a quick comment. I am actually prepared to vote for this recommendation because the BIA believes in an "all of the above" approach for technology and communication. My question is in the text, when you talk about comparisons with RF wireless transmissions, we are only mentioning things that don't compare well with fiber optics. I am wondering if there are any advantages to wireless and if there are, shouldn't that also be mentioned?

Abrami: The advantage would be mobility.

Miller: Well, not only mobility but cost. Being able to distribute wireless connections is a lot cheaper than hardwiring connections.

Wells: The recommendation talks about fiber optic cable and in other recommendations, we talk about wireless optical transmission. The major advantage RF has is its not tethered. It is possible to do optical without being tethered. But that's not built into this recommendation but appears elsewhere.

Abrami: Well, yes it is in here.

Wells: oh yes. Now I see it. You are right.

Heroux: Lifi (optical wireless) has advantages of privacy over radio frequency or microwave (Wifi) which is very leaky from the privacy point of view.

Cooley: I just want to note for the record that I will be voting no on this. We see this as discriminatory and it doesn't take into account the realities of geography, topography and economic realities that may limit the ability to provide fiber. By removing one type of technology altogether like wireless, you could be exacerbating the digital divide and removing options for consumers to connect. Thank you.

Sherman: I just found one tiny point. I feel like the grammar police here but in the sentence with "biologic effects in the human environment, doesn't make sense to me. The way I would say that is, "RF wireless transmission lacks fiber optic characteristics including speed, security and signal reliability while avoiding potential biologic effects on humans and the environment.

Abrami: Yes, you are right. I agree with you.

Gray: I have less of a problem with this recommendation with that change but it still assumes there is an effect on humans and the environment. We are picking one technology over another that I am not sure I am comfortable with.

Sherman: I would just add Jim, you are not picking it, but the majority of the commission feels this way.

Gray: and as Senator Sherman knows, the people who elected me elected me to voice my opinion and speak strongly in their defense.

Abrami: we respect that Jim.

Woods: This doesn't say anything about the biological being good or bad. It just says avoids it. Because when you have radiation in the environment, there will be an effect on humans. It's like measuring the bridges. We are just being cognizant that in fact, this is an exposure.

Juvet: Just a request from the commission. In my reading of this, the promotion of fiber is not meant to exclude the development of Wifi but Beth makes a good point. Is there some way in the recommendation that we could add the words, "where practical"? This would recognize that a lot of areas of this state, we recognize the benefits of that but it's just not a practical option.

Abrami: I have no problem with that.

Juvet: I would insert "where practical" and delete, "to serve all commercial and public properties statewide".

Wells: I just want to note, is it practical to put electricity I commercial and public properties? You are talking about exactly the same type of installation for fiber optic.

Abrami: I think the practical consideration David was talking about was cost.

Wells: I am thinking of the Rural Electrification Act. You know it's surely more expensive to supply service in low density areas, yet broadband is as necessary these days as electricity and running water. I don't see that adding "where practical" in here is a necessary or a desirable qualifier.

Miller: Even though I will abstain from the vote on this and have written this, I think the idea behind this... as far as cell service and all of that, everything has its place. This particular recommendation really starts to get at the infrastructure of the future which regardless of mobile technology and everything else is where New Hampshire needs to go. However you decide to wordsmith it, I would not like to see the essence of that recommendation be diluted by it. That's my thought even though I will be abstaining.

Heroux: I agree with Carol and I would like to point out that in some recommendations we talk about the majority of the commission. We start the recommendation this way. I wonder if this wording is appropriate. Why is it in some recommendations and not others when we will probably report how many people voted for it and how many voted against? I don't see any recommendation in this report that will be unanimous.

Sherman: I am just reflecting. As Ken was saying, maybe rather than using "where practical", and say "wherever possible" captures what Carol was saying. It also captures the idea that if you can get electric in there, you can get fiber optic in there. Even the top of Cannon Mountain has it. If you are on top of Mount Washington and all you have is cell service and there is no electric and you are living on kerosene

lamps, then maybe it's not possible. Practical can mean if it is \$10 more to put in fiber optic, maybe it's not practical because you already have cell. I think putting in "possible" captures the spirit of what Carol was saying and also captures what Ken was saying. I am just putting it out there.

Abrami: I guess the one I have to ask is Dave.

Juvet: I would prefer practical. The senator says possible and what if it's ten thousand dollars more? Anything is possible if you want to devote enough financial resources to it.

Miller: I wanted to go back and respond to Paul's comment about the majority of the commission. I think we coined that phrase because of Senator Gray and the fact that we don't have 100% consensus on a lot of these recommendations. It's nothing more than that.

Abrami: we have three options. Either don't change it; possible; or practical.

Juvet: Mr. Chair maybe I can make it easier on the commission and perhaps we should just be voting on the original wording because I think it's going to get difficult if we are trying to find out which wordsmithing we are more comfortable with. I am not sure it will change people's votes, ultimately. I would like to withdraw my recommendation and we can just vote on the original wording.

Abrami: Ok. Thank you for that. What we are changing is, "while avoiding potential effects".

Wells: I would like to move that.

Woods: second.

We are voting on recommendation #10.

Sherman: yes

Wells: yes

Chamberlin: yes

Miller: abstain

Ricciardi: yes

Juvet: no

Cooley: no

Garod: absent

Roberge: abstain.

Heroux: yes

Woods: yes

Gray: no

Abrami: yes

7- yes, 3-no, 2- abstain. Motion passes.

Juvet: Mr. Chair, I do need to drop off the zoom meeting now because I am leading one that starts in about two minutes. Thanks everyone for all their work on this but I do need to leave at this point.

Abrami: Before you go, we are thinking of a meeting on Tuesday, the 27th one o'clock for at least two hours.

Juvet: I am available on the 27th.

Abrami: Can anyone not make that? I will check with Brandon.

Ok moving backwards now to #8.

RECOMMENDATION 8- Upgrade the educational offerings by the NH Office of Professional Licensure and Certification (OPLC) for Home Inspectors to include RF intensity measurements.

Home Inspectors currently operate as private contractors who may be hired by citizens or enterprises to measure such things as radon, to collect water quality samples, or search for mold or insect damage. Home inspectors routinely supply test results to both their clients and government entities.

The majority of the Commission believes the public has the right to discover, on a voluntary basis, the RF power intensity related to radio frequencies at a property which they will be purchasing or renting before the transaction is closed. Also, the proprietors of publicly accessible venues may wish to reassure the public about the RF power intensity within their establishments, by posting the data collected by a state-approved inspector. In addition, such testing should be paid for by the party requesting it and the testing itself should be performed by a professional who owns or rents the test equipment and has met the state requirements for training of Home Inspectors regarding RF measurements.

The majority of the Commission proposes that Home Inspectors be offered training by NH OPLC on how to measure on-site peak and 24-hour average RF intensities. Measurements of frequencies and intensities will be performed using low-cost equipment (such as GQ-390 meters). [Description of existing Home Inspector training offered for radon, mold, etc. may be seen at <https://oplcnh.gov/home-inspectors/index.htm>]

Cooley: Mr. Chair, my notes say that language was supposed to be inserted making this voluntary.

Gray: My objection to this one is that we are putting it on the Office of Professional Licensure and Certification to go and do something. I don't think we need the State of New Hampshire to do that at all.

Abrami: Beth, we did add that if you go to the second paragraph..."on a voluntary basis".

Gray : if it's a voluntary program then OPLC shouldn't have to do that, take some advocacy group and develop the thing and get certified through the advocacy group. I don't think it needs to be a function of the state.

Sherman: Mr. Chair, I move that we adopt this recommendation as written.

Ricciardi: I second it.

Abrami: Ok. Let's go to the vote:

Sherman: yes

Wells: yes

Chamberlin: yes

Miller: abstain

Ricciardi: yes

Juvet: absent

Cooley: abstain

Garod: absent

Roberge: abstain.

Heroux: yes

Woods: yes

Gray: no

Abrami: yes

7- yes, 1-no, 3- abstain. Motion passes.

RECOMMENDATION 7- Require that any new wireless antennae located on a state or municipal right-of-way or on private property be set back from residences, businesses, and schools. This should be enforceable by the municipality during the permitting process, unless the owners of residences/business or school districts waive this restriction.

Local public rights-of-way are under the jurisdiction of municipalities, and the Commission feels that municipalities should uphold the rights of individuals impacted by antennae. The Commission also supports the right property owners to manage decisions on non-essential devices being placed in front of their property.

The Commission believes that it is important to prioritize citizen safety, particularly as 5G is an upgrade, rather than the provision of wireless service to unserved areas. Additional rationale for this recommendation shown in Appendix XX.

Abrami: #7 was rewritten after objections by Beth on the California firefighters. That was in the write up.

You sent us all the California Senate amendments. They say that “due to the unique duties and infrastructure requirements for swift and effective deployment of firefighters, those provisions do not apply to co- location or siting application for telecommunication facility where the project is proposed for placement of fire department facilities.” This is my read on this, they are carving out the fire stations and the reason that they give is totally different from all the background history that says health effects.

They said it had to do with them interfering with their duties, not that it’s health effects. They basically said having towers on top of the building is going to interfere with the swift and effective deployment of firefighters. To me, that’s a sleight of hand what they are saying here. They are trying to skirt the federal law with this. To me, it’s a wink and a nod. Is that the way you read this, Beth?

Cooley: You can just read the statute itself. You can imply intention or read into it all you want but the statute itself says it’s got the FCC language in there that you know that states and localities cannot consider RF emissions or the alleged health effect as a reason to deny a facility. You have to read the statute as is. You can rely on innuendo or fake news coverage all you want but that’s really all I have to say.

Abrami: What I don’t understand is how does the cell tower on the roof impact the duties for swift and effective deployment of firefighters? I don’t understand the logic.

Cooley: you have to read the statute in conjunction with the fact they are honoring federal law,

Abrami: That’s the only way they can honor federal law. They are not going to say what the real issue was. The real reason was fire fighters fought hard because of health effects. We don’t have the time digging into the logic of California legislature on this other than to get around the federal law and appease the firefighters. I would ask that question.

Ricciardi: If you want, I can send you documents on how they lobbied on health effects.

Abrami: we know there are documents on health effects but this is the only way they could skirt federal law. If the FCC really wanted to take this on, they could. How does a cell tower on your roof impact the swift deployment of firefighters?

Cooley: Mr. Chair, I don't think it changes the essence of the recommendation. I will be voting no and you guys all know that. Your setback requirements are unlawful and essentially a prohibition of service. Even if you conceded the California topic, which I am not, you read the statute as it's written. You still have the underlying recommendation which is incredibly problematic.

Gray: The bottom line of this is that there is a federal preemption. Whether or not there is a California law to do something, it doesn't matter. There is a federal prohibition against us doing that. That's the bottom line and this recommendation should not be in the report.

Abrami: California proves that you can do a carve-around. That's what I am seeing here. They have carved out a certain set of people. That's the way I view it.

Sherman: I just want to move to accept the recommendation as written.

Chamberlin: I will second it.

Sherman: yes

Wells: yes

Chamberlin: yes

Miller: abstain

Ricciardi: yes

Juvet: absent

Cooley: no

Garod: absent

Roberge: abstain

Heroux: yes

Woods: yes

Gray: no

Abrami: yes

7- yes, 2-no, 2- abstain. Motion passes.

Abrami: Ok. We took number six and split it into 6A and 6B.

RECOMMENDATION 6A- Signal strength measurements must be collected at all wireless facilities as part of the commissioning process and as mandated by state or municipal ordinances. Measurements are also to be collected when changes are made to the system that might affect its radiation, such as changes in the software controlling it. Signal strength is to be assessed under worst-case conditions in regions surrounding the tower that either are occupied or are accessible to the public, and the results of the data collection effort is to be made available to the public via a website. In the event that the measured power for a wireless facility exceeds radiation thresholds, the municipality is to be empowered is to be immediately have the facility taken off line. The measurements are to be carried out by an independent contractor and the cost of the measurements will be borne by the site installer.

It is recognized that theoretical calculations show that existing FCC guidelines will be met by standard cell tower configurations. However, there are cases where the radiation from towers can be focused by buildings, terrain, and beamforming antennas, causing signal levels to be considerably higher than would be expected in theoretical calculations unless those effects are taken into account. Collecting field measurements provide the only valid approach for determining whether exposure guidelines have been met. It is to be noted that some municipalities (e.g., the town of Burlington, MA [1]) have ordinances requiring measurements at cell towers.

Federal Law and NH law grant to municipalities the power in enact zoning rules regulating the placement of personal wireless service facilities within the geographic boundaries of the municipalities. Municipalities should be proactive in this area and through the exercise of zoning power establish where, how, and a process for compliance with existing FCC guidelines for signal strength in the surrounding coverage area. Municipalities should establish a hierarchy of siting values and compliance acknowledgements so that the siting most favored by the municipality is the easiest siting for the wireless applicant to obtain and conversely the siting which is least desirable should be the most difficult siting for the applicant to obtain. The zoning ordinance should lay out the compliance requirement as part of the zoning approval.

[1] Burlington, MA zoning Bylaw Wireless Facilities Section 8.4.6.2 "Annual RF emissions monitoring is required for all sites by an independent RF engineer to be hired with Planning Board approval and at the applicant's expense. Test results will be submitted to the Town as soon as available, and not later than the close of the calendar year. Annual testing of electromagnetic emission shall be required to ensure continual compliance with the FCC regulations.

Chamberlin: We split this into two separate recommendations. The change made to 6A was to add that municipalities can take the antenna off line if it exceeds thresholds. It's one thing to take measurements but what do you do about it if it's an issue? It also mentions that these measurements will be taken by an independent contractor with the cost to be borne by the site installers. This only addresses requirements that measurements be performed on the facility. We might want to discuss that first because there is a part that Carol put in also talking about the control of the facility by the municipality.

This part was added by Carol.

Federal Law and NH law grant to municipalities the power in enact zoning rules regulating the placement of personal wireless service facilities within the geographic boundaries of the municipalities. Municipalities should be proactive in this area and through the exercise of zoning power establish where, how, and a process for compliance with existing FCC guidelines for signal strength in the surrounding coverage area. Municipalities should establish a hierarchy of siting values and compliance acknowledgements so that the siting most favored by the municipality is the easiest siting for the wireless applicant to obtain and conversely the siting which is least desirable should be the most difficult siting for the applicant to obtain. The zoning ordinance should lay out the compliance requirement as part of the zoning approval.

Miller: This language comes from some presentations and attorney recommendations for towns. It simply says that federal law and NH law grant to municipalities the power to enact zoning rules regulating the placement of personal wireless service facilities within the geographic boundaries of their municipalities. The municipalities should be proactive in this area. Through the exercise of zoning power establish where and how and a process for compliance with existing guidelines for signal strength in the surrounding coverage area. They can establish a hierarchy of siting values and compliance acknowledgements so that the siting most favored by the municipalities is easiest siting for the wireless applicant to obtain. Conversely, deciding which is least desirable should be the most difficult siting for the applicant to obtain. The zoning ordinance should lay out those compliance requirements as part of that zoning approval. It's just legalese legal speak for what the municipalities can indeed control within their realm. Is there any discussion about that? It comes from Donahue, Tucker and Ciandella which does a lot of work for municipalities across the state with regard to cable franchises and wireless siting and all of the above.

Cooley: That new language is concerning to me because it's a clear outline of how to put up obstacles for deployment. So a municipality is saying we want this site here over this one but the municipality has no idea where coverage is needed or where there are coverage holes. That language is quite concerning to me.

Gray: the problem I have with this one is you start off by talking about signal strength and being able to shut down a site. If the facility is operating within the FCC goals, I don't think you have the ability to do anything after that site has been established. And then we moved to this paragraph which talks about siting the thing. That's very concerning. I can't think of powers here in the city of Rochester that have gone through the planning and zoning process that haven't gotten a favorable decision because of the strength of the law giving the FCC certain responsibilities.

Abrami: It assumes that the limits are above the FCC guidelines.

Heroux: Cultural acceptability of these installations and social acceptability to the people who use them is very important and critical in my opinion.

Abrami: I don't see anything wrong with us saying the municipality can measure whether sites are within federal guidelines. If they are not, we are saying action can be taken by the municipality. That's all it is saying.

Ricciardi: I just want to remind everyone that we are here to make recommendations based on what we have learned over the course of all of these months and that is what we are doing. We wrote long questions to the FCC, FDA, EPA. We did not get answers. They did not want to present. So we are using from the presenters, from the science and from what we read, to make recommendations to help residents in the state of New Hampshire. That's our job of this commission. This is just a recommendation based on our findings. It's not a law.

Abrami: my concern is that right now, we put three or four cell towers near each other, how do we know, who is the policeman on this? Maybe Beth knows this answer. Is the industry out there taking measurements making sure they are within federal limits?

Cooley: I don't have a clear picture on that so I don't want to say publicly. I have heard different things from different members of mine but I can look into that. I can follow up.

Gray: I wanted to comment on Denise's comment about the questions that were sent to the FCC. Many of the issues she raised are already available on the FCC and FDA website. For a commission member to send a letter off that did not even come from the whole commission in an approved list of questions to the FCC doesn't meet the common sense test in this instance. That information is available. Maybe they did not respond to Denise's letter...ok? Is the information that Denise asked for available on their website? Yes. I went in and found it. We are not citing a lot of that information anywhere in our report.

Ricciardi: "We" gave specific questions that are not answered on the website. They did not answer them and those are the answers to the question we were truly seeking to find.

Abrami: I did review them before she sent them out and we shared them with everyone. We can go round and round on this one. Let's bring it to a vote. I need a motion.

Heroux: yes.

Wells: second.

Abrami: Ok. We are voting on 6A.

Sherman: yes but I have five minutes and then I have to leave at noon.

Wells: yes

Chamberlin: yes

Miller: abstain

Ricciardi: yes

Juvet: absent

Cooley: no for the hierarchy siting language and I also need to leave at noon.

Garod: absent

Roberge: abstain.

Heroux: yes

Woods: yes

Gray: no

Abrami: yes

7- yes, 2-no, 2- abstain. Motion passes.

Abrami: let's try to do 6B. Were there any changes to this one?

Chamberlin: the only change that was made addresses taking new measurements that takes into account the impulsive nature of radiation and the summative effects. What was asked for in the last meeting of this group was that we take some of the references and put them in the appendix and that's all that we really did on this one. I also mentioned that the development of those funding protocols should be funded by the appropriate federal agency like NIH, FCC etc. We are in the process of creating more references that support the statement that it's impulsive radiation more than continuous radiation that has the deleterious effect on humans. That's the change and is in compliance with what was asked in our previous meeting.

Gray: again the FCC I believe in the spring of 2019 addresses a lot of these topics in there. They reviewed the science and found these effects are not true. You don't have any of that information in this report that is anti to the opinion of the majority of the group.

Abrami: if no more discussion, I would like to get a motion on this one and vote before the two leave.

Chamberlin: So moved.

Heroux: Second.

Sherman: yes

Wells: yes

Chamberlin: yes

Miller: abstain

Ricciardi: yes

Juvet: absent

Cooley: no because of the alleged assumption of negative health effects.

Garod: absent

Roberge: abstain.

Heroux: yes

Woods: yes

Gray: no

Abrami: yes

7- yes, 2-no, 2- abstain. Motion passes.

Abrami: I think that's it. I am going to have to pull this all together. I will rely on Joel to help me pull pieces from one place to another and I will get it to you as soon as I can. I asked the work group to pull together the appendices that go with these recommendations. The work group will meet once before the final meeting and possibly reorder these in some logical way without losing the numbering.

Jim: as soon as I know the order, I will tell you and give you a map.

Gray: It doesn't appear we will have time if you aren't meeting until the 27th. We only have a few days to do the minority report.

Abrami: I was assuming you would be working on the minority report in parallel based on the recommendations.

Gray: we have been trying to do that but every time we get changes getting it back through the people on the minority report is becoming a problem. Again, we will do our best.

Abrami: ok. The date is November 1st. If we need a little wiggle room we might be able to get it. Just because we are meeting on that date does not mean we won't have the report out to everybody before that date. Ok Jim? A lot of this is going to fall on me and Joel to get it pulled together. I will try to get it to you a week ahead of that date so you can see what it looks like before then.

Gray: and I will do my best to get the thing to you as soon as I can.

Abrami: I know Jim. We are all under pressure having to campaign at the same time.

Workgroup next meeting: Monday, the 12th 10am-12 pm. Kent, will you set that up and the other one as well?

Chamberlin: yes.

Abrami: ok very good. Thank you.

IV. Next meeting via Zoom: October 27th 1-3pm

Meeting Adjourned at 12:03 pm

Chat from HB522 Commission October 8, 2020 Meeting

From EH Trust to Everyone: 10:15 AM

800,000. We'll need an estimated 800,000 new cell sites by 2025.

<https://docs.fcc.gov/public/attachments/DOC-354323A1.pdf>

REMARKS OF FCC CHAIRMAN AJIT PAI
WHITE HOUSE 5G SUMMIT
WASHINGTON, DC
SEPTEMBER 28, 2018

Research showing impacts to trees sent to fcc here Testimony of Albert M. Manville, II, Ph.D., C.W. B., and Principal, Wildlife and Habitat Conservation Solutions, LLC, on Behalf of Friends of Amazon Creek, Before the City of Eugene City Planning Department in Opposition to AT&T/Crossfire's Application for a "Stealth" Cellular Communications Tower in the Upper Amazon Creek Corridor / Testimony-of-Albert-M.-Manville-for-Amazon-Creek.pdf Testimony of Albert M. Manville, II, Ph.D., C.W. B., and Principal, Wildlife and Habitat Conservation Solutions, LLC, on Behalf of Friends of Amazon Creek, Before the City of Eugene City Planning Department in Opposition to AT&T/Crossfire's Application for a "Stealth" Cellular Communications Tower in the Upper Amazon Creek Corridor / Testimony-of-Albert-M.-Manville-for-Amazon-Creek.pdf

From EH Trust to Everyone: 10:20 AM

<https://ecfsapi.fcc.gov/file/10718080685516/Testimony-of-Albert-M.-Manville-for-Amazon-Creek.pdf>
Trees <https://ecfsapi.fcc.gov/file/1001669617135/Trees-in-Bamberg-and-Hallstadt-Documentation-2006-2016.pdf>

more on trees damaged <https://ecfsapi.fcc.gov/file/1001669617135/RF-Radiation%20injures%20trees%202016.pdf>

Published study A review of the ecological effects of radiofrequency electromagnetic fields / A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)
<https://ecfsapi.fcc.gov/file/7520939746.pdf>

Published study Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem – a review

<https://ecfsapi.fcc.gov/file/7520943486.pdf>

Impacts to insects from higher frequencies that are to be used in 5G. Here is a paper

<https://ecfsapi.fcc.gov/file/1210030663890/Exposure%20of%20Insects%20to%20RadioFrequency%20Electromagnetic%20Fields%20from%202%20to%20120GHz%205g%20.pdf>

From Cece Doucette to Everyone: 10:21 AM

Rec 13: Line 5, need to insert the word "were" between the words "limits" and "set".

From EH Trust to Everyone: 10:26 AM

The FDA info does not include ANY review of impacts birds or bees in fact the FDA only looked at tumors and their “literature review” was only on tumors, not bees, not trees, not birds

See the details on the FDA here <https://ehtrust.org/expert-physicians-surgeons-and-scientists-call-for-fda-to-retract-biased-anonymous-report-of-cancer-impacts-of-cell-phones/>

These documents by the FDA have nothing to do with trees or birds or wildlife.

No, the EPA was defunded in 1996 AND never looked at environment

The letter I sent you from the EPA shows that pollinators and trees and plants have NEVER been looked at

From Ken Wells to Everyone: 10:28 AM

“Starlink “ wiki cites reports of FCC approvals for up to 42,000 Starlink satellite antennas:

<https://en.wikipedia.org/wiki/Starlink>

From EH Trust to Everyone: 10:29 AM

Statement from Dr. Albert Manville on the FDA Report on Cell Phone Radiation

<https://ehtrust.org/press-statement-from-dr-albert-manville-on-the-fda-report-on-cell-phone-radiation-2/>

From Cece Doucette to Everyone: 10:30 AM

The FCC is being sued for not addressing the scientific literature submitted to them showing biological affects: The Environmental Health Trust and a coalition of other commentators in 2020 also filed a court appeal challenging the FCC’s order terminating its evaluation of the adequacy of FCC RF radiation limits.

<https://ehtrust.org/action-alert-lawsuit-against-the-fcc/>

Robert F. Kennedy, Jr.'s Children's Health Defense is also suing the FCC for negligence:

<https://childrenshealthdefense.org/news/robert-f-kennedy-jr-s-childrens-health-defense-submitted-historic-case>. Additionally, Dr. Jeffrey Shuren of the FDA has serious conflicts of interest, his wife is a partner in a law firm that represents the wireless industry: <https://www.5gcrisis.com/shuren-petition>

From EH Trust to Everyone: 10:40 AM

The EPA letter that is on your record shows there is no standard for the environment. See it here the EPA letter <https://ehtrust.org/epa-birds-bees-trees-5g-wireless-effects/>

Environmental Health Trust is suing the FCC . Read the brief here <https://ehtrust.org/eh-takes-the-fcc-to-court/>

Please be sure to read the NRDC brief that showcases the lack of review regarding environmental impacts here <https://ehtrust.org/wp-content/uploads/20-1025-NRDC-amicus-brief.pdf>

This Amicus brief also has the letter from the EPA that says What US agency has reviewed the research on damage to trees from cell phone radiation? If so, when was it issued and send a link to the review. Note this study showing damage from long term exposure to cell antennas. EPA Response: The EPA does not have a funded mandate for radiofrequency matters, and we are not aware of any EPA reviews that have been conducted on this topic. We do not know if any other US agencies have reviewed it. Published research can be found here <https://ehtrust.org/environmental-effects-of-wireless-radiation-and-electromagnetic-fields/>

From Cece Doucette to Everyone: 10:41 AM

Senator Gray and others, you may wish to review the Mobile Communications and Health study commissioned in 2000 by T-Mobil, the German parent company of T-Mobile. It concluded there are many non-thermal biological effects well below public radiation exposure limit levels. They recommended specific precautionary measures should have been taken, but they were not and the industry continued to market hazardous products:
<https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnx1bmRlcnN0YW5kaW5nZW1mc3xneDo3MTE4NThkYmY3NmUzMzc0>

From EH Trust to Everyone: 10:43 AM

Theodora Scarato of EHT asked “What US agency has reviewed the research on impacts to birds and bees? If so, when and send a link to the review. I will note the latest research showing possible impacts to bees from higher frequencies to be used in 5G.” July 8, 2020, Lee Ann B. Veal Director, Radiation Protection Division Office of Radiation and Indoor Air, Environmental Protection Agency of the United States of America responded “EPA Response: The EPA does not have a funded mandate for radiofrequency matters, and we are not aware of any EPA reviews that have been conducted on this topic. We do not know if any other US agencies have reviewed it.” Link to letter here <https://ehtrust.org/epa-birds-bees-trees-5g-wireless-effects/>

Statement by Wildlife Biologist Alfonso Balmori, BSc on the FDA Review of Cell Phone Radiation and Cancer

The FDA review omits an evaluation of the science on wireless radiation impacts to trees and wildlife. Electromagnetic radiation is a form of environmental pollution which may hurt wildlife. I am providing examples of my published research below as examples of this scientific evidence. Read the letter with studies at <https://ehtrust.org/26684-2/>

From EH Trust to Everyone: 10:47 AM

The FCC has NOT studied the issue. In fact they are using the lack of response by agencies to “prove” there are not effects.

From Jen White to Everyone: 10:47 AM

I second the comment above!!

From Cece Doucette to Everyone: 10:48 AM

Senator Gray and others, please read Harvard Law School's Center for Ethics report, "Captured Agency: How the FCC is Dominated by the Industries it Presumably Regulates." It likens FCC and industry approach to the tobacco industry tactics: <https://ethics.harvard.edu/news/new-e-books-edmond-j-safra-research-lab>

From EH Trust to Everyone: 10:53 AM

Research shows that the levels of RF will be increased with 5G infrastructure 4G densification . As an example of how rapidly RF is increasing from wireless antennas, a 2014 published study looked at RF in three European cities and found in just one year (between April 2011 and March 2012) that the total RF-EMF exposure levels in all outdoor areas in combination increased by 57.1% in Basel by 20.1% in Ghent and by 38.2% in Brussels (Urbinello 2014). “Exposure increase was most consistently observed in outdoor areas due to emissions from mobile phone base stations.”

<https://www.sciencedirect.com/science/article/pii/S0013935114002254>

2018 study published in Annals of Telecommunications found increased RF-EMF exposure from small cell LTE networks in two urban cities in France and the Netherlands. Researchers measured the RF-EMF from LTE (Long-Term Evolution) MC (macro cells meaning large cell towers) and SC networks (low-powered small cell base stations) and found that the small cell networks increased the radio emissions from base stations (called downlink) by a factor of 7–46 while decreasing the radio emissions from user equipment exposure (called) by a factor of 5–17. So while the devices themselves could emit less radiation, the cell antennas will increase the levels from cell antennas (Mazloun et al., 2019). This study shows the increased exposures would be involuntary. We can turn our phones off, but we cannot turn off the antennas in the neighborhood. <https://link.springer.com/article/10.1007%2Fs12243-018-0680-1>

From EH Trust to Everyone: 10:54 AM

An Australian study published in the Journal of Exposure Science & Environmental Epidemiology also found that children in kindergartens with nearby antenna installations had nearly three-and-a-half times higher RF exposures than children with installations further away by more than 300 meters (Bhatt et al., 2016). <https://www.ncbi.nlm.nih.gov/pubmed/27759027>

From Cece Doucette to Everyone: 10:57 AM

Rec. 12: Can we include other essential services? These have been well defined for COVID-19, and the public should be able to access those services too.

Senator Gray and others, the WHO determined RF is a Group 2B Possible Human Carcinogen in 2011. Now that the animal studies have been completed and show cancerous tumors and DNA damage, the WHO has re-opened its investigation in 2020: https://www.who.int/peh-emf/research/rf_ehc_page/en/index1.html

From EH Trust to Everyone: 10:58 AM

Research shows low level RF is tied to harm such as promoting tumors. And more

From Cece Doucette to Everyone: 10:58 AM

Please also note there are two WHO groups for EMFs, one is populated with those with industry ties, the other has independent scientists: <https://ehtrust.org/scientists-call-for-transparency-at-the-world-health-organization-emf-project/>

From EH Trust to Everyone: 11:00 AM

The science shows it IS substantiated

https://www.researchgate.net/publication/305689940_EUROPAEM_EMF_Guideline_2016_for_the_prevention_diagnosis_and_treatment_of_EMF-related_health_problems_and_illnesses

<https://www.sciencedirect.com/science/article/abs/pii/S0013935120303388?via%3Dihub>

Electromagnetic hypersensitivity (EHS, microwave syndrome) – Review of mechanisms
Peterborough, Canada

The City has an information sheet to help organizations accommodate individuals who have electromagnetic hypersensitivity. They recommend – among other things:

Temporarily disable City owned WAP devices.

Turn off or minimize fluorescent and LED.

Notify attendees to set mobile phones to airplane mode. <https://ehtrust.org/wp-content/uploads/EHS-Tip-Sheet-Peterborough-5-8-2018.pdf>

From Brandon.H.Garod to Everyone: 11:00 AM

I apologize but I have to leave for another meeting starting at 11:00

From Deb Hodgdon to Everyone: 11:00 AM

my oral surgeon was very happy to move me to a low rf room and make sure no one had devices in the room.

From EH Trust to Everyone: 11:03 AM

International

France: 13 Plaintiffs Win: The Tribunal de Grand Instance of Bordeaux ordered in favor of 13 of the 206 plaintiffs who had initiated a lawsuit against the installation of the electric meter created by Enedis.

<https://www.femmeactuelle.fr/sante/news-sante/compteur-linky-la-justice-donne-raison-a-13-plaignants-electrosensibles-2077743>

The word “unsubstantiated” should not be used.

Plus The WHO site being referenced is industry loyal and that is well documented in published research

<https://www.spandidos-publications.com/10.3892/ijo.2017.4046>

Actually it IS recognized and has been in several ada cases

From Jen White to Everyone: 11:03 AM

Both myself and 10 year old son are RF sensitive. It's very real and not to be discredited. Thank you. - Thank you Tom for saying that, much appreciated!

From EH Trust to Everyone: 11:04 AM

Austrian Medical Association

The Austrian Medical Association has developed a guideline for differential diagnosis and treatment of health problems associated with outdoor and indoor electrosmog.

Guidelines of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses (EMF syndrome) <https://ehtrust.org/wp-content/uploads/The-Austrian-Medical-Association-Guidelines-for-Diagnosis-and-Treatment-of-EMF-related-Health-Problems.pdf>

Exposure to Nonionizing Radiation ICD 10 Medical Codes for Exposure to nonionizing radiation – ICD-10-CM W90

“The ICD-10 code is the standard diagnostic tool for epidemiology, health management & clinical purposes. It is used for medical code lookups by physicians, nurses, researchers, health information managers, medical billing coders, health information technology workers, insurers & patient organizations to classify diseases and other health problems recorded on many types of health records, including death certificates. ICD 10 codes are also used by medical billers & payers for reimbursement purposes.”

Medicare Accepted ICD-10 codes under W90 for Exposure to other nonionizing radiation. These codes can be used for all HIPAA-covered transactions.

From Cece Doucette to Everyone: 11:04 AM

The public is welcome to join health care practitioners for the continuing medical education-accredited EMF Medical Conference in January where you will learn the science. We do have the studies already to prove wireless is harmful: <https://emfconference2021.com/>

From EH Trust to Everyone: 11:05 AM

2014:US Resident Provided Accommodations in Housing Case Regarding "Smart" Water Meters: Mechanical Meter For Resident PLUS Neighbors

Not only was a resident provided a mechanical meter after filing in court and coming to an agreement with the water authority; but in addition the neighbors of three adjacent properties also were provided free opt outs for the switch to mechanical meters.

That is correct- this switch AWAY from water meters was made with NO charges- NO FEES. The legal filing says that the Fair Housing Act prohibits discrimination based on disability.

Click here to see redacted HUD water meter agreement. <https://ehtrust.org/wp-content/uploads/HUD-meter-settlement-Redacted.pdf>

2014; Los Angeles Unified School District Accommodated a Teacher Who Fell Ill After Wireless Installation.

On September 18, 2014, LAUSD, the second largest public school district in the US, officially accommodated teacher Ms. Anura Lawson by approving her request to have the Wi-Fi turned off in her classroom during the 2014-2015 school year and alternatively approving a reassignment to a different school site where Wi-Fi has yet to be installed.

Watch the video of her testimony to the LAUSD School District Here. Read her letter of accommodation here. <https://ehtrust.org/wp-content/uploads/LA-Teacher-Accommodation.pdf>

From EH Trust to Everyone: 11:06 AM

We, physicians, acting in accordance with the Hippocratic Oath, we, scientists, acting in the name of scientific truth, we all, medical doctors and researchers working in different countries worldwide, hereby state in full independence of judgment,

that a high and growing number of persons are suffering from EHS and MCS worldwide; that EHS and MCS affect women, men and children;

that on the basis of the presently available peer-reviewed scientific evidence of adverse health effects of electromagnetic fields (EMFs) and various chemicals, and on the basis of clinical and biological investigations of patients, EHS is associated with exposure to EMFs and MCS with chemical exposure..."

Excerpt from the 2015 Brussels International Scientific Declaration on Electromagnetic Hypersensitivity and Multiple Chemical Sensitivity. Download http://www.ehs-mcs.org/fichiers/1441982143_Statement_EN_DEFINITIF.pdf

Magda Havas PhD at the National Institute of Environmental Health Sciences

"Electrosmog, the missing link as it relates to cancer, reproductive problems and electrohypersensitivity." https://www.youtube.com/watch?v=fqMCjEs9oxE&feature=emb_logo

From EH Trust to Everyone: 11:09 AM

The Who EMF project was started by industry funded scientist.

See EHT and others letter to The WHO EMF Project . They refuse to answer our letter and we have asked numerous times about that factsheet on The Who site . <https://ehtrust.org/scientists-call-for-transparency-at-the-world-health-organization-emf-project/>

There is no 50 times safety margin. This is a false statement because research on FCC record shows it. Read it here <https://ecfsapi.fcc.gov/file/7520958286.pdf>

From Cece Doucette to Everyone: 11:09 AM

The FCC limits are only based on heat exposure. The peer-reviewed non-industry funded independent science shows there is significant harm at the non-thermal level. Please see the Bioinitiative Color Charts for a summary of the science and findings of biological effects: <https://bioinitiative.org/rf-color-charts/>

From EH Trust to Everyone: 11:11 AM

The 50 times margin was based on a study of rodents with a thermometer in their rectum and it has been well disproved by science. Plus it is only about heating effects so it has nothing to do with cancer. <https://ecfsapi.fcc.gov/file/7520958286.pdf>

In fact for carcinogens the safety limit can be up to 10,000 times the level that cancer was found So even if there was a 50 times safety margin- it is not adequate protection.

From Cece Doucette to Everyone: 11:11 AM

Rec. 10: Can we expand this to bring hard-wired to residential premises too?

From Jen White to Everyone: 11:14 AM

<https://www.emfanalysis.com/fiber-optics-increasing-electrical-sensitivity/> - Will low EMI fiber optics be explored or discussed at some point?

From Cece Doucette to Everyone: 11:15 AM

Reliability is a factor too, in emergencies from storms, fires, etc., cell antennas often go down which leaves the public vulnerable to not being able to call for emergency services.

From Jen White to Everyone: 11:17 AM

We have a wired internet system that is not fiber optic. This is preferred and residents should have a choice, especially RF sensitive people such as myself.

From EH Trust to Everyone: 11:20 AM

There are no protections at the federal level to stop companies from using fiber for wireless purposes. Remember that if fiber optic is laid on a road, then a company can use it for their small cell. There should be federal protections in place to stop this.

Wireless companies like fiber because then they can attach wireless antennas. It should be wired to and through the premises. Please see this study on how to hardwire in buildings <https://www.sciencedirect.com/science/article/pii/S0360132319305347>

From EH Trust to Everyone: 11:31 AM

Please read about how wired technology uses more energy consumption compared to wireless. <https://ehtrust.org/science/reports-on-power-consumption-and-increasing-energy-use-of-wireless-systems-and-digital-ecosystem/>

The California Association of Realtors' Property Sellers Questionnaire specifically "cell towers" listed on the disclosure form for sellers of real estate. The seller must note "neighborhood noise, nuisance or other problems from.." and includes cell towers and high voltage transmission lines on the long list problems. Click here to see the California Association of Realtors' Property Sellers Questionnaire (p. 3-4 under K. Neighborhood) <https://ehtrust.org/wp-content/uploads/Real-Estate-Seller-Property-Questionnaire-reduced-12-17-1.pdf>

From Paul Bloede to Everyone: 11:32 AM

I show a vote was taken on both 8 and on 8A, at the 9/22 meeting. Both were approved, with slightly different tallies. 8 was voted in with 7 yes, 1 no, and 5 abstain.

From EH Trust to Everyone: 11:33 AM

2014 Survey by the National Institute for Science, Law and Public Policy (NISLAPP) in Washington, D.C., "Neighborhood Cell Towers & Antennas—Do They Impact a Property's Desirability?" Home buyers and renters are less interested in properties located near cell towers and antennas, as well as in properties where a cell tower or group of antennas are placed on top of or attached to a building. 94% said a nearby cell tower or group of antennas would negatively impact interest in a property or the price they would be willing to pay for it.

Read the Press Release: Survey by the National Institute for Science, Law & Public Policy <https://electromagnetichealth.org/electromagnetic-health-blog/survey-property-desirability/>

Best Best and Krieger Letter to Ms. Marlene H. Dortch, Secretary Federal Communications Commission September 19, 2018 "RE" Smart Communities and Special Districts Coalition – Ex Parte Submission: Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment, WT Docket No. 17-79; Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment, WC Docket No. 17-84" "A good example lies in the Commission's discussion of undergrounding.⁶² The Commission at once appears to recognize that communities spend millions of dollars on undergrounding projects, and that allowing poles to go up in areas where poles have been take down has significant impacts on aesthetics (not to mention property values)."

From EH Trust to Everyone: 11:34 AM

[https://www.montgomerycountymd.gov/cable/Resources/Files/Towers/cellTowerInfo/Ex%20Parte-Smart%20Communities%20and%20Special%20Districst%2009-19-18-c2%20\(1\).pdf](https://www.montgomerycountymd.gov/cable/Resources/Files/Towers/cellTowerInfo/Ex%20Parte-Smart%20Communities%20and%20Special%20Districst%2009-19-18-c2%20(1).pdf)

“Appraiser: Cell Tower Will Affect Property Values” New Jersey Patch on T Mobile Cell Tower
“Properties that are approximately close to the tower will suffer substantial degradation to their value based on the nature of the unusual feature in the residential neighborhood.” <https://patch.com/new-jersey/bridgewater/appraiser-t-mobile-cell-tower-will-affect-property-values>

From Deb Hodgdon to Everyone: 11:34 AM

I know a home inspector who is very interested in being trained and licensed to do that

From EH Trust to Everyone: 11:37 AM

ConsumerWatch: 5G Cellphone Towers Signal Renewed Concerns Over Impacts on Health
In this news report below- California investigative reporter Julie Watts interviews firefighters and California officials on the SB649 exemption for firefighters. It is very clear this is about health effects as the firefighters state it

From Deb Hodgdon to Everyone: 11:37 AM

sounds like it interferes because you can't think quickly and efficiently

From EH Trust to Everyone: 11:39 AM

Read it here <https://sanfrancisco.cbslocal.com/2018/01/25/consumerwatch-5g-cellphone-towers-signal-renewed-concerns-over-impacts-on-health/>

you can simply say that the firefighters lobbied because of health effects

Which is documented in numerous documents

The CBS story say So, following lobbying by firefighters, assemblyman Quirk and his co-author exempted fire stations from their bill, making them one place cell companies couldn't put a tower."

read it here <https://sanfrancisco.cbslocal.com/2018/01/25/consumerwatch-5g-cellphone-towers-signal-renewed-concerns-over-impacts-on-health/>

you could quote the CNS report <https://sanfrancisco.cbslocal.com/2018/01/25/consumerwatch-5g-cellphone-towers-signal-renewed-concerns-over-impacts-on-health/>

From Cece Doucette to Everyone: 11:39 AM

Rec 7: There is a private property owner in Pittsfield, MA who just opted for a cell tower on the edge of the property, which abuts a neighborhood of eight streets. Only three of the proposed 46 antennas have been turned on, and children and adults are already experiencing headaches, insomnia, cognitive impairment, and one little girl described it as, "Mommy, I feel all buzzy inside." The public needs to be protected from all cell antennas regardless of whose property they are on. The epidemiological studies

show similar biological effects within 1,500 or so feet from a cell antenna:

<https://sites.google.com/site/understandingemfs/cell-towers>

From Deb Hodgdon to Everyone: 11:40 AM

yes pat.

From EH Trust to Everyone: 11:42 AM

““This is the first piece of legislation that anyone is aware of where somebody got an exemption because they were concerned about health. Did they tell you at all about the study?” we asked the assemblyman.

Quirk’s response: “All I know is that when the firefighters ask, I do what they ask me to do.”

<https://sanfrancisco.cbslocal.com/2018/01/25/consumerwatch-5g-cellphone-towers-signal-renewed-concerns-over-impacts-on-health/>

This is a study- although a few years old- details why restricting cell towers from schools is a human rights issue https://ecfsapi.fcc.gov/file/1070795887708/Roda%26Perry_EnvSci%26Policy_.pdf

From EH Trust to Everyone: 11:54 AM

The FCC is not actively taking measurements.

In fact a Wall Street Journal shows many sites exceed FCC limits

<https://www.wsj.com/articles/cellphone-boom-spurs-antenna-safety-worries-1412293055> One in 10 sites violates the rules, according to six engineers who examined more than 5,000 sites during safety audits for carriers and local municipalities, underscoring a safety lapse in the network that makes cellphones hum, at a time when the health effects of antennas are being debated world-wide.

No, the FDA does not say anything about bees and trees

From Cece Doucette to Everyone: 11:54 AM

6A: Minor typo on the bold line, "...be empowered is to be immediately..." remove the words "is" and "be".

From EH Trust to Everyone: 11:59 AM

If you go to the website by the FDA

you will see that in fact they have not looked at all the data

The FDA did not look at impacts to sperm or impacts to brain damage. That is all on the record

<https://ehtrust.org/scientistsletter-calling-for-a-retraction-to-the-fda-report-on-cell-phone-radiation-and-cancer/>

From Jen White to Everyone: 11:59 AM

If 5G moves forward in NH, Will there be any RF "safe zones" in residential areas where RF sensitive residents live? If we have a 5G repeater outside of our home.....that is literally a sick sentence for my 10 year old son!

From EH Trust to Everyone: 12:03 PM

For the record <https://www.sciencedirect.com/science/article/pii/S2542519618302213?via%3Dihub>
Ronald N. Kostoff, Paul Heroux, Michael Aschner, Aristides Tsatsakis, Adverse health effects of 5G mobile networking technology under real-life conditions, Toxicology Letters, Volume 323, 2020, Pages 35-40, <https://www.sciencedirect.com/science/article/abs/pii/S037842742030028X>

Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective, Environmental Pollution, Volume 242, Part A, 2018, Pages 643-658, ISSN 0269-7491, <https://doi.org/10.1016/j.envpol.2018.07.019> . <https://www.ncbi.nlm.nih.gov/pubmed/30025338>

**NH COMMISSION TO STUDY THE ENVIRONMENTAL AND HEALTH EFFECTS
OF EVOLVING 5G TECHNOLOGY**

Meeting held:

10/27/20

1:00 -1:47pm EST

Via Zoom (<https://unh.zoom.us/j/8760768986>)

Via telephone-US (1 312 626 6799 (US Toll) ID: 876 076 8986)

In attendance: (13)

Rep. Patrick Abrami-speaker of the house appointee

Rep. Ken Wells- speaker of the house appointee

Kent Chamberlin, Phd.-UNH-appointed by the chancellor

Denise Ricciardi-public-appointed by the governor

Michele Roberge-DHHS- Commissioner of DHHS appointee

Paul Heroux,Phd.- Professor of Toxicology, McGill University- speaker of the house appointee

Rep. Gary Woods-speaker of the house appointee

Senator Jim Gray-president of the senate appointee

Senator Tom Sherman-president of the senate appointee

Brandon Garod,Esq.-AG designee, Asst. AG Consumer Protection

Bethanne Cooley-CTIA , trade association for wireless industry and manufacturers

Carol Miller-NH Business & Economic Affairs Dept.

David Juvet-Business and Industry Association

Not present: (0)

Meeting called to order by Rep Abrami at 1:03 am

Abrami: Due to the Covid 19 virus and the Executive order signed by the Governor this public meeting is allowed to be conducted via Zoom. It is open to the public for viewing and was duly posted as a zoom meeting. With that said, if you are not a member of the Commission, can you please turn your cameras off and mute yourselves? That would be much appreciated. In addition the meeting is being recorded as an aid to doing the minutes. All chat room discussions will be included in the minutes.

I. Approval of minutes from 10-8-20

Let's start with the minutes from the October 8th meeting. I have not received any changes to the minutes that I sent out about a week ago. Are there any changes that anyone wants to make? Seeing none, I will say ...without objection, we approve the minutes from that meeting.

II: Agreed to Recommendation changes

Sherman: Pat, I think you need to do the “right to know” script and a call of the roll, don’t you? Maybe it’s different for the House than the Senate.

Abrami: I am doing it with what I just read. The last meeting we voted on many of the recommendations in the report and I want to go through to show you. Kent, can you pull up Page 9? I am not going to be able to see you all as Kent will be sharing his screen. So members just jump in if you have something to say.

Fourth line from the bottom, “principle” was spelled incorrectly and was corrected.

Recommendation #1 is the old 1. We agreed after the bold where you see Telecommunication Act, to delete “TTA”.

Recommendation #2 is the old 3. We changed “attachment” to “appendix”. “There is” in the last line was taken out as it made no sense.

Recommendation #3 is the old 4. The word “harm” was taken out three lines from the bottom as that made no sense.

Recommendation #4 is the #5, the next to the last paragraph: five lines up: is required for “data”.

Recommendation #5 is the old 6A. In the bold where it says, the municipality is... “to be” was deleted. “in “ was changed to “to”.

Recommendation 6 is the old 6B: should show “as having” instead of “to have” significant impact. Joel, please change that.

Recommendation 7 is the old 7. The “of” was inserted between right and property.

Recommendation 8 is the old 8.

Recommendation 9 is the old 8A.

Recommendation 10 is the old 9. “detailed” replaced detail.

Recommendation 11 is the old 10,

Recommendation 12 is the old 11,

Recommendation 13 is the old 12.

Recommendation 14 is the old 13.

Recommendation 15 is the old 14.

Those are the changes. Does anybody recall anything differently about any of these changes?

III: Report walk through

Abrami: Kent, can you put the report back up? On this first page, Beth contacted me. We have Beth as representing cell phone/wireless technology industry. We are going to put CTIA, representing the wireless industry. Is that okay with you Beth?

Cooley: That's fine. Thank you.

Abrami: The next page is the disclaimer that all three agencies were okay with.

Miller: Before we move on, my title is incorrect as well. I am not representing the High Tech Council. That no longer exists. It's the Tech Alliance but I am not representing them either. I am from the New Hampshire Dept. of Business and Economic Affairs.

Abrami: Any others on title changes? Ok. Next we have the Table of Contents. We have a bit of introductory discussion then a summary of observations and the recommendations that we went over. We have chosen to insert the Minority Report in the report. We will get to the Minority Report in a while. Then we have the Appendices and the Minutes, which are extensive. They are basically a total recording of what happened in our meetings. As far as the introduction, I talk about the Commission responsibilities and my view that it's an evolving role as we learned about the different technologies and how 5G works with 4G and 3G. Our discussions evolved over time. Basically, it became all things RF radiation. We talked about the various meetings that we had and who the main presenters were and our big hiatus for four months. Then we have Questions posed by HB522. Then we have a section on Summary and Observations. We actually got the reference to the 800,000 small cell towers from the CTIA website.

IV: Discussion

Abrami: Any discussion?

Sherman: Pat, I just want to thank people both on the Majority and the Minority side for all the work they put in. I think everybody in spite of their differences of opinion or their different interpretations of the science. I think everybody has approached this with incredible fairness and collegiality. Thank you for leading it and for all the work that everybody has done.

Abrami: I was going to say when we got to the Minority Report, Jim I think you did a great job on it. To me, it makes the report even better having both sides represented in the report. The majority of the members yielded to the precautionary principle because there are still a lot of unanswered questions. Is there any other discussion?

V: Report Vote

Let's vote on the majority report: Yes, No or Abstain.

Sherman: yes

Wells: yes

Chamberlin: yes

Miller: abstain

Ricciardi: yes

Juvet: no

Cooley: no

Garod: abstain

Roberge: abstain

Heroux: yes

Woods: yes

Gray: no

Abrami: yes

7-yes, 3-no, 3-abstain. This will be considered the Majority Report.

VI. Minority Report:

Abramj: Jim, we have to have a lead in. For example, Jim Gray and the others who want to sign on have to let us know who they are. Jim do you want to go through this?

Gray: I am not going to go through a lot. One of the reasons that we got the report to you twenty four hours before this meeting is so that you could look at it. It's the same things that I have been talking about in the various meetings. The FCC and the FDA have on their websites a plethora of information about the safety of 5G and 4G and 3G as they are used for the cell phone industry. The first page starts off as a quick summary about the 50x safety factor that's in there and the rest. There are a lot of references in there because we were trying to say that we are not making these things up. There is stuff that is available on the FCC and the FDA websites. I can't remember if we left the WHO in there or not at the end. Things tend to get a little confused right now with campaigning and everything else. You have had a little time to review it. If anyone has questions, they can forward them to me. What I would do

rather than having anyone on this zoom meeting say they support or don't support. It would certainly be fine with me if someone wanted to notify you as the chair at some other point. I think I will leave it at that.

Abrami: Any questions for Jim?

Juvet: no questions, Mr. Chair. I think you said those who want to sign onto the Minority Report that they need to let you know. I wish to be signed on to the Minority Report.

Cooley: As would CTIA as well.

Abrami: Ok. Fine. So you don't have objection at the beginning to say the three of you are the Minority members? Is that ok?

Gray: either at the beginning or at the end.

Abrami: I am going to yield to Joel.

Anderson: I think it is just as well to put it at the beginning. People will know upfront who the Minority Report is from.

Gray: It can be as simple as, the undersigned not being able to agree with the majority, offer the following report and then list the three names. Does that work for everyone?

Abrami: yes.

Anderson: Can it be instead that you endorse the report? Because you won't actually be signing it.

Abrami: House Commissions don't require signatures.

Juvet: Whatever the appropriate wording is, I am good with.

Abrami: Joel, after we do it, we can share it with the three Minority members.

Ricciardi: is it acceptable to read my comments?

Abrami: yes. It's appropriate.

Ricciardi: I genuinely appreciate everybody's point of view.

First, on foot note two, it addresses only thermal effects but if you see appendix D of the Majority Report there is science showing harmful effects at the non-thermal level. I just wanted to draw attention to that. In the Minority Report, it cites the IEEE papers but the IEEE does not have medical or biological expertise. However even the IEEE has acknowledged harm at the non-thermal level in two papers which I have sent to you. In 2016 IEEE acknowledged biological effects of non-ionizing microwaves in the IEEE Power and Electronics magazine article. I wanted to also mention that the Minority Report makes several references to the American Cancer Society but fails to provide links to the sources. Furthermore, the American Cancer Society in 2016 called the NTP study a paradigm shifting of good science. The

public should also note that the American Cancer Society reports a sharp rise in colon and rectal cancer among young adults at the very locations where many carry their cell phones. In footnotes 11 and 12, the World Health Organization citations are out of date. In 2020, the WHO reopened its investigation into the biological effects. Additionally, there are two groups at the WHO that report on EMFs. One is represented by the industry. The other is represented by independent scientists with credentials appropriate to weigh in on the biological effects. In footnotes 18 and 19, the Minority Report indicated the rate of brain tumors in humans as being flat for the last twenty years. This is not true. Cancer registries are typically five years behind and while overall cancer cases are not rising as they once did. The following show dramatic growth where cell phones and wireless devices are used or stored on the body or cell tower emissions. The incidence of glioblastoma is the deadliest type of brain tumor and I have links to all of this that I have mentioned which I am going to forward to you. The last thing I want to say is that industry tends to focus on the cancer rates as cancer takes the longest time to develop during which time the industry can continue to promote toxic products. Other diseases are developing more rapidly as shown in the Majority Report, in Appendix D, including infertility, neurological harm and especially to children. With regard to the section on 5G mm waves, the IEEE is referenced yet again. These are industry engineers who do not have the biological expertise. I just wanted that for the record.

Abrami: Ok. It will be in the minutes.

Heroux: Essentially, one thing I regret is I am addressing primarily the people of the Minority Report, is that there was not more discussion between us. What I mean by this is technical discussion in looking at the actual issues. I know that probably most of the people of the Minority Report felt very solid in their opinions relying on legislation that was passed and I can understand that. In spite of our differences, I do respect your opinion because this is your opinion. One last comment is that we were not provided the material that would have led to this discussion. Perhaps the people who were in the Majority Report could assemble more energy to present. In fact, the same amount of enthusiasm was not apparent on the other side. I would like to remind the Commission that on January 10th meeting, there were promises by the CTIA to provide us with reports that support the positive health impacts of cellphone deployment. These reports did not materialize. Essentially, I think that the lopsidedness that is quoted in the Minority Report is more a result of energy and initiative in providing evidence. Thank you.

Abrami: Ok. Any other comments at this point?

VII: Minutes of this Meeting:

Abrami: Let's talk about the minutes of this meeting. They will be in the report. Deb Hodgdon is going to work very hard and we will get the minutes out to everybody. We will not have a meeting to approve them. If you see something you think is incorrect, please email me. We want to get this report in by November 1st with the minutes of this meeting included. Is that okay with everybody? Ok. Thank you.

VIII: Submission Process

Abrami: I talked to Jim about this. I think he is okay with us putting the Minority Report in the same style type as the rest of the report. There will be a letter of transmittal. The report goes to the Governor, the Speaker and the Senate President. There is a letter of transmittal that the House staff will put together. There are no signatures on it just the letter of transmittal that goes on top of the report and it's sent out. This report will be posted online on the Commission's website. We added that website to the report so if anybody wanted to see the additional information or papers we posted there, things like that will be available for the public. It's all about the minutes. No pressure Deb. If I stop talking, we can get the minutes done sooner right?

IX. Commission Farewells

Abrami: First I want to say, it's been a pleasure working with all of you. We had a great group. There were a lot of scientific minds in the room, legal, business. We didn't agree on everything as Tom said but I think we all got along very well. I want to specifically point out Kent Chamberlin for coming to the rescue. When we couldn't get bandwidth from the state to continue this Commission, he volunteered. Or I asked him to volunteer! UNH's zoom capacity was great as well as setting up all those meetings and being behind the scenes making the meetings go smoothly.

I want to thank Joel Anderson for his support behind the scenes. It was a lot of work especially when it came to the report and I think I hinted at this when I sent something out. There was one night he worked until ten o'clock at night to get the report ironed out. He proofed a lot of the report and found links that were outdated or not working and corrected those. Thank you, Joel for going beyond the call of duty.

And of course I want to point out Deb Hodgdon who has been doing our minutes since the beginning. These minutes are more like a court transcription. I know she spends a lot of time going through and preparing those.

I also want to thank the audience. I know we never formally opened it to the public which I had promised. That has to do with the fact that we closed down for four months. We missed five meetings. We were just cramped for time or we would have opened this up more to the public. But with zoom, we were able to open it up to more than just ten or so people that would gather at the onsite meetings at the statehouse. We have people from all over participating. Their comments in the zoom chat were captured and added to the minutes.

I thank you all again. Does anybody want to make any closing comments?

Ricciardi: I just want to say that it was an honor to work with all of you. It really was and I am so proud of the work that we have all done. So, thank you.

Heroux: To me, this commission is extremely memorable. I would like to congratulate the Chair on bringing this difficult boat to port. I want to ensure all of you, especially those of the Minority Report

that you can contact me at any point in the future and you will have my full cooperation if you need my help. Thank you.

Cooley: Will we be notified when the letter of transmittal is sent? Will the Commission know?

Abrami: We will make sure everyone gets notified. It will be out there electronically and we will let you know where to go to find it.

Cooley: Thank you.

Abrami: Stay well. We are formally adjourned (1:47 pm)

Chat from HB522 5G Commission Meeting, October 27, 2020

From Beth Cooley to Me: (Privately) 01:23 PM

Should Herman's video be shown? just curious. I've directed my members to turn their videos off

From Theodora Scarato to Everyone: 01:27 PM

The World Health Organization EMF Project The World Health Organization EMF Project says "There is no consensus."

Dr. Emilie van Deventer, Head of the World Health Organization's EMF Project was quoted in The Daily Princetonian, "The data is gray. It's not black and white...There is no consensus, it's true."

"Furthermore, as I see it, the WHO EMF Project was not only hijacked by the ICNIRP but, from the inception, it was set up as a front for the ICNIRP agenda of unifying exposure standards to RF-EMF," stated Dariuz Leszczynski PHD (a member of the EMF working group of the WHO/IARC who stated in 2020," ICNIRP is a private club. Its new members are selected by the current members where the prerequisite of selection is the very close similarity of opinions on non-ionizing radiation health effects. There are no published criteria for the selection of new members. Nobody checks whether the selected experts are sufficiently good experts."

<https://betweenrockandhardplace.wordpress.com/2020/09/08/leszczynski-there-is-something-utterly-wrong-with-the-icnirp-membership/>

From Theodora Scarato to Everyone: 01:27 PM

Fact: There is no 50 times safety margin. The FCC is ignoring the science and promoting the myth of the 50 times safety factor despite being informed that it is not based on scientific fact.

Scientific data refutes the claim. The FCC says this factor is based on studies that show behavioral disruptions to animals at 4 w/kg. However the EPA found thermal harm at 1 W/kg. The EPA stated in 2020 that the last time the agency did a research review was in 1984 as detailed in the 1984 EPA Report The Biological Effects of Electromagnetic Fields. The EPA 1984 Report concludes with the summary that

“It has been concluded from this review that biological effects occur at SAR up to about 1 W/kg some of them may be significant under certain environmental conditions.” Therefore the level of harm of 4W/kg used by IEEE and adopted by FCC is inaccurate. See the 1984 EPA report, Comments of Pong Research Corporation, Environmental Working Group and Environmental Health Trust.

<https://ehtrust.org/epa-1984-report-biological-effects-of-emfs/>

From Theodora Scarato to Everyone: 01:28 PM

Furthermore, the Environmental Protection Agency typically uses safety factors in the 100s or 1000s range for noncancer endpoints and for carcinogens, a threshold or nonthreshold approach is used (National Research Council (US) Committee on Improving Risk Analysis Approaches Used by the U.S. EPA).

<https://www.ncbi.nlm.nih.gov/books/NBK214619/>

Of key importance, even if there were a slim safety factor, the level chosen is about heating harm only. It is thermally based and has nothing to do with biological harm from non thermal exposures that can occur at far far lower RF exposures.

Furthermore these limits were not based on protecting trees, birds, insects or the natural environment. Thus, flora and fauna are entirely unprotected.

The EPA 1984 Report concludes with the summary that “It has been concluded from this review that biological effects occur at SAR up to about 1 W/kg some of them may be significant under certain environmental conditions.” Therefore the level of harm of 4W/kg used by IEEE and adopted by FCC is inaccurate.

From Theodora Scarato to Everyone: 01:30 PM

There is no 50 times safety factor as a fact of science. The FCC is ignoring this science - ignoring the EPA Ignoring facts

Despite the fact that the WHO EMF Project website seems to imply the research shows no harm, such statements are unsubstantiated and are based on a house of cards. The fact is the WHO EMF Project has yet to do a full evaluation of the recent research and the last monograph was in 1993. This is stated on their website quite clearly “The World Health Organization is undertaking a health risk assessment of radiofrequency electromagnetic fields, to be published as a monograph in the Environmental Health Criteria Series. This publication will..update the monograph on radiofrequency fields (1993).”

https://www.who.int/peh-emf/research/rf_ehc_page/en/

Do not confuse the World Health Organization EMF Project with the The World Health Organization International Agency for the Research on Cancer.

These are two separate entities. Unlike the WHO EMF Project (started by a scientist found to be funneling industry money though a university), the WHO International Agency for Research on Cancer (WHO/IARC) which is vetted for conflicts of interest and for whom scientists cannot be financially connected to Telecom.

From Theodora Scarato to Everyone: 01:34 PM

In 2011, the WHO/IARC classified RF as a Class 2 B “possible” human carcinogen based primarily on evidence from human studies that long-term users of mobile phones held to the head resulted in an elevated risk of developing brain cancer. One major reason that the IARC rating was not at “probable” or “known” was the lack of clear evidence from animal studies for exposure leading to cancer.

https://www.iarc.fr/wp-content/uploads/2018/07/pr208_E.pdf

In 2019, the advisory group of the International Agency for Research on Cancer (IARC) of the World Health Organization released new recommendations to reassess as a “high priority” the cancer risks of radiofrequency (RF) radiation between 2020–2024. The recommendations were published in The Lancet Oncology on April 18, 2019.

[https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045\(19\)30246-3/fulltext](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(19)30246-3/fulltext)

CDC shows tumors increasing in children. Read it here <https://ehtrust.org/cdc-finds-brain-liver-and-thyroid-cancers-increasing-among-us-children-2001-2014/>

From Theodora Scarato to Everyone: 01:35 PM

http://aspho.org/uploads/meetings/2018annualmeeting/Abstracts_for_Website.pdf

Centers for Disease Control and Prevention, Atlanta, Georgia, United States

link: http://aspho.org/uploads/meetings/2018annualmeeting/Abstracts_for_Website.pdf

“increased for non-Hodgkin lymphomas (except Burkitt lymphoma), central nervous system neoplasms, renal tumors , hepatic tumors , and thyroid carcinomas...”

http://aspho.org/uploads/meetings/2018annualmeeting/Abstracts_for_Website.pdf

From EHT- Recently a reporter told EHT that this data seemed to be in contradiction to information posted on the National Cancer Institute (NCI) website. The reporter asked how EHT could be stating that CDC says brain cancers are rising in pediatrics when the reporter went online and found information stating “the brain cancer rates were stable.” He sent this link.

So we wrote the CDC scientist and the CDC scientist responded to EHT that that the NCI link sent by the reporter refers to statistics that represent only 13.4% of the US population, whereas the new CDC report uses the USCS database representing 98% of the US population.

From Theodora Scarato to Everyone: 01:37 PM

The European Scientific Committee on Health, Environmental, and Emerging Risks’ “Potential effects on wildlife of increases in electromagnetic radiation statement identified emerging issues (including 5G, E-cigarette, and chronic diseases.) The Committee prioritized 5G impact as “high” noting the lack of adequate research and citing studies documenting harmful effects such as Pall 2018, Di Ciaula 2018 and Russell 2018. The report concluded “the lack of clear evidence to inform the development of exposure guidelines to 5G technology leaves open the possibility of unintended biological consequences.”

https://ec.europa.eu/health/sites/health/files/scientific_committees/scheer/docs/scheer_s_002.pdf

The 2020 Executive Summary of the Health Council of the Netherlands said clearly that there is no information on mm-waves and human health:“...There has been almost no research into the effects of exposure to frequencies around 26 GHz...”And they recommended against using higher frequencies stating “...The committee recommends not using the 26 GHz frequency band for 5G for as long as the potential health risks have not been investigated...”

From Theodora Scarato to Everyone: 01:37 PM

<https://www.healthcouncil.nl/documents/advisory-reports/2020/09/02/5g-and-health>

From Cece Doucette to Everyone: 01:39 PM

When will the report be posted?

From Theodora Scarato to Everyone: 01:39 PM

Numerous governments also educate their citizens with recommendations to reduce cell phone radiation, especially to the heads of children. Governments with policy and/or recommendations by health authorities include Belgium, Switzerland, French Polynesia, Finland, Ireland, Germany, Greece, Israel, Turkey, Singapore, France, United Kingdom, Russia, Denmark, India, Australia, Austria, Cyprus, Canada, Italy, Korea and Croatia. In 2011 the Parliamentary Assembly of the Council of Europe issued Resolution 1815: "The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment." A call to European governments to "take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours" and numerous municipalities have issued resolutions to follow Resolution 1815. <https://ehtrust.org/policy/international-policy-actions-on-wireless/>

From Cece Doucette to Everyone: 01:43 PM

Sincere gratitude to all for your dedication in seeking the truth and laying the path to transition to safe, sustainable, fiscally responsible technology.

From Theodora Scarato to Everyone: 01:44 PM

Thanks beyond words for your incredible effort in putting forward scientific facts in a transparent fashion.



P.O. Box 549
Brookings, SD 57006
Tel 605.697.5204

DRA West
2650 Jackson Blvd. #14
Rapid City, SD 57702

www.dakotarural.org

Secretary Jennifer Granholm
US Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Sent via email: secretary@hq.doe.gov

Subject: Uranium Mining

Dear Secretary Granholm,

We, members of Dakota Rural Action, are writing to express our dismay that the DOE appears to be considering a Strategic Uranium Reserve. Dakota Rural Action is a grassroots family agriculture and conservation group that organizes South Dakotans to protect our family farmers and ranchers, and natural resources.

Putin's war against the Ukrainian people seems to have spurred urgent conversations about banning uranium imports from Russia, thereby strengthening the hand of uranium mining companies and their political pals elsewhere, who want subsidies to make up for any supply shortfall. While understandable, this logic is flawed scientifically and flawed from a perspective of environmental justice.

Keeping in mind that uranium is not classified as a strategic mineral, the entire idea of a Strategic Uranium Reserve is only a thin mask of a name for bald-faced subsidies to a mining sector that cannot feasibly stand on its own.

Scientifically, according to the Argonne National Laboratories, “recycling used [spent] nuclear fuel could produce hundreds of years of energy from just the uranium we’ve already mined... Problems with older technology put a halt to recycling used nuclear fuel in the United States, but new techniques developed....can address many of those issues.”

US nuclear plants get 16 percent of their uranium from Russia. Instead of subsidizing an alternative supply stream, the older dangerous plants should be decommissioned and replaced with power plants using renewable energy sources. More importantly, the US must reduce its energy usage. A ban on Russian uranium should be seen as an incentive to save energy and transition to renewables power, not as a motive to reinforce the market for a material that has left us a legacy of unmanageable cleanup issues. The taxpayers money that would go to the subsidies, should instead be used to restore the radioactively dangerous old uranium mining sites that threaten communities like ours in the Black Hills.

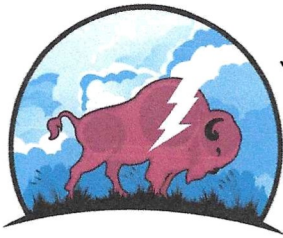
From the perspective of social justice, it is well understood that much of the uranium mining in the US has occurred at the expense of rural poor and Indigenous communities. The peoples of the Lakota, Havasupai, Hopi, Navajo, Ute, and other nations have experienced deleterious health, economic, social, and spiritual effects of uranium mining.

An examination of that history of uranium mining in this country reveals that public policy has been disproportionately influenced by corporations with little commitment to the environment, to Native treaty rights, or to the spiritual and economic treasures embodied in our National Parks (cf. The Grand Canyon). In fact, these corporations seem committed to Environmental INjustice, not to Environmental Justice.

We call on you and your administration to avoid the establishment of a Strategic Uranium Reserve; to honor the recommendations of the White House Environmental Justice Council, and other plans and policy recommendations made by the current administration; to mitigate climate concerns, to direct climate investments to frontline communities; and to respectfully engage Indigenous communities in policies that affect their sovereignty, health, and well being.

Respectfully submitted for your consideration,
The Members of Dakota Rural Action
Brookings, South Dakota

Dusty Johnson, U.S. Representative
Michael Rounds, U.S. Senator
John Thune, U.S. Senator
Deb Haaland, Secretary of the Interior, Department of the Interior
Bryan Newland, Assistant Secretary, Indian Affairs
Brenda Mallory, Chair of the White House Council on Environmental Quality
Gina McCarthy, National Climate Advisor
Michael S. Regan, EPA Administrator
Cecilia Martinez, PhD., Senior Director for Environmental Justice CEQ
White House Environmental Justice Interagency Council
Members of the White House Environmental Justice Advisory Council



THUNDER VALLEY

COMMUNITY DEVELOPMENT CORPORATION

April 22, 2022

Secretary Jennifer M. Granholm
U.S. Department of Energy
1000 Independence Ave. SW
Washington DC 20585

Sent via Email: the.secretary@hq.doe.gov

Subject: Uranium Mining Concern

Dear Secretary Granholm,

The Thunder Valley Community Development Corporation would like to express our concern about the U.S. Department of Energy's consideration of a uranium reserve. We are deeply concerned with ongoing discussions taking place to increase uranium mining in the United States due to Russia's invasion of Ukraine. While we understand the United States position on potentially banning uranium imports from Russia, we cannot stress enough that any uranium mining at the Pinyon Plaine Mine (formally known as the Canyon Mine) located on federal lands near their reservation will have effects from not only their tribe but other tribes who may be experiencing the same difficulty. A horrible war across the world should not be grounds for harming the Havasupai Tribe, and its members, as well as other indigenous communities located here in the United States.

Energy Fuels, Inc. currently operates the Pinyon Plain Mine (Canyon Mine) next to their reservation and on their Ancestral lands and traditional cultural property- Red Butte. This mine has a history of problems, including that it pierced a major aquifer digging what it claimed would be a dry mineshaft, and then sprayed the now-contaminated water into the national forest. This mine should not be eligible for participation in any federal program or to receive funding to operate. Allowing the Pinyon Plain Mine (Canyon Mine) to participate in a U.S. uranium mine reserve program under your department will essentially shift the sacrifice of lives in the war-torn Ukraine for lives of the Havasupai tribal members. This is how serious we all see this issue. We are also in the understanding that when President Biden ran for office, he pledged to protect tribal communities and restore tribal sovereignty. We need you to support this pledge to us.

Healing • Hope • Liberation

290 Empowerment Drive • Porcupine, SD 57772

Office (605) 455-2700 • Fax (605) 455-2970

WWW.THUNDERVALLEY.ORG

Thunder Valley CDC is located in the Pine Ridge Indian reservation. Where the Oglala Sioux Tribe has taken a stand against any uranium mining. Thunder Valley CDC and Oglala Lakota Oyate know first-hand the damages that uranium mining can cause to the people as well as the water aquifers. We ask the Department of Energy to uphold President Biden's pledge to protect not only the Havasupai Tribe but all Indigenous nations and honor Tribal sovereignty. We need you and others to hear our voice and take action for the first nations and Indigenous peoples of the United States of America. We ask that you withhold participation of the Pinyon Plain Mine (Canyon Mine) in any federal uranium program or funding to operate. Not doing so will place our Indigenous tribes and the Havasupai tribe's existence in harm's way.

Sincerely,



Tatewin Means
Executive Director
Thunder Valley CDC



April 24, 2022

Secretary Jennifer M. Granholm
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
the.secretary@hq.doe.gov

RE: Strategic Uranium Reserve

Dear Secretary Granholm:

I write today as the Executive Director of a non-profit organization based in the Black Hills of South Dakota and Wyoming and as an expert on uranium mining issues. For the last 40+ years, I have worked with others from our area to block new attempts to mine uranium and to protect this unique ecological, historical, geological, and scenic place that is the treaty homeland of the Lakota people and home to a vibrant agriculture, tourism, and outdoor recreation economy. As a scholar, I have written, published, and spoken about uranium regulation and politics.

I am writing because we know something about uranium mining here, having experienced it in the 1950s to 1970s. Only a handful of the 169 abandoned uranium mines and prospects in our area have been cleaned up. Our water – including a major irrigation and recreation reservoir -- is contaminated with uranium and/or arsenic. The people of the Pine Ridge and Cheyenne River Indian Reservations coexist with contaminated water, with virtually all of the water on Pine Ridge being highly contaminated with uranium. When large companies came to the Black Hills in the late 1970s, the people of our area ran them out, and uranium mining was stopped. Now we are fighting for our water, our local economy, and our health again, as one company is exploring and a second is seeking licenses to mine.

We know that nuclear power is not carbon neutral, because we know that mining is one of the largest contributors to carbon emissions in the world. We know that uranium must be transported repeatedly and enriched, and that the construction and decommissioning of nuclear power plants create carbon emissions, and that storage and – maybe someday – disposal of high-level nuclear wastes will create more carbon emissions. The only part of the nuclear chain that does not emit large amounts of carbon is the power plant. The nuclear industry has fooled a lot of people with their carefully-worded language, but I hope you are not fooled.

P.O. Box 591 – Rapid City, South Dakota 57709 – www.bhcleanwateralliance.org
605-787-2872 -- nobhuranium@gmail.com – Facebook: Black Hills Clean Water Alliance
Twitter: Black Hills Clean Water Alliance -- Instagram: bhcleanwateralliance

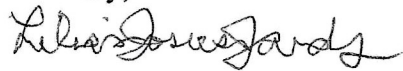
Moving toward a lower-carbon economy means moving away from uranium mining and nuclear power.

Now we hear that some officials are pushing the idea of a new strategic uranium reserve. This makes no sense from a carbon emissions point of view. It endangers our communities and our water – as well as the water of other communities that might end up downstream or downwind from renewed uranium mining. Nuclear power is vastly expensive and takes a decade or more to make a reality. We need immediate solutions to the climate crisis, particularly as our area is already experiencing greatly increased incidences of flooding.

We oppose the creation of the new strategic uranium reserve and ask the full federal government to put a stop to this nonsense and to work instead toward a non-nuclear, carbon-minimizing future. The latter path has great potential for our communities, our water, and our livelihoods.

Please feel free to contact me, if you have any questions. I appreciate your time, attention, and action.

Sincerely,



Lilias Jones Jarding, Ph.D.
Executive Director

Cc: Michael S. Regan, EPA Administrator
Deb Haaland, Secretary of the Interior, Department of the Interior
Brenda Mallory, Chair, White House Council on Environmental Quality
Gina McCarthy, National Climate Advisor
John Thune, Senator, South Dakota
Mike Rounds, Senator, South Dakota
Dusty Johnson, Representative At-Large, South Dakota
Joe Manchin, Senator, West Virginia
Raul Grijalva, Representative, District 3, Arizona
Cecilia Martinez, Ph.D., Senior Director for Environmental Justice, CEQ
Members of the White House Environmental Justice Advisory Council
White House Environmental Justice Interagency Council

P.O. Box 591 – Rapid City, South Dakota 57709 – www.bhcleanwateralliance.org
605-787-2872 -- nobhuranium@gmail.com – Facebook: Black Hills Clean Water Alliance
Twitter: Black Hills Clean Water Alliance -- Instagram: bhcleanwateralliance



Oglala Sioux Tribe
Natural Resources Regulatory Agency

P.O. Box 320
Pine Ridge, SD 57770
Phone: (605) 867-5624
Fax: (605) 867-2818



Natural Resources Regulatory Agency
Water Resources Department
Administrator
Reno Red Cloud
ostnrrawrd@gwtc.net

Secretary, Jennifer M. Granholm
US Department of Energy
1000 Independence Ave. SW
Washington DC 20585

Subject: Oglala Sioux Tribe's concerns with federal uranium mining reserve program.

The Oglala Sioux Tribe, Natural Resources Regulatory Agency, was created by the Oglala Sioux Tribal Council to provide guidance and technical assistance in the assertion of 1851 and 1868 Treaty and reserved water rights. In regards to the compliance with Tribal law, in the protection, conservation, management, and preservation of the Oglala Sioux Tribe's Natural and Water Resources to meet the needs of present and future generations,

We provide guidance for our best management practices by utilizing traditional 'Lakota' knowledge for our ecosystem, which helps us integrate ecological, economic, and social factors to maintain and advance the quality of our environment. We have a Tribal no nuclear policy, and oppose any mining on our Treaty homeland. We are impacted by 'Uranium Mining' from activity from the Black Hills, SD. and Northwestern Nebraska for potential contamination of our surface and ground water resources.

The Oglala Sioux Tribe, opposes the strategic uranium reserve program, by the US Department of Energy.

If you should have any questions, please contact my office at your earliest convenience.

Respectfully,

Reno L. Red Cloud Sr.
Administrator
Oglala Sioux Tribe, Natural Resources Regulatory Agency / Water Resources Department

April 24, 2022

Resolution
It's All About the Water
A Grassroots Movement in Fall River and Custer Counties
South Dakota
510 Jennings Avenue
Hot Springs, SD

WHEREAS, the Cheyenne River in Fall River County, South Dakota is already contaminated with uranium from old open pit mines NW of Edgemont, we cannot afford any more contamination from Powertech USA's proposed In Situ Leach mining.

WHEREAS, we have intervened in every Powertech USA permit process since 2012. There is no mining as of today. Many permits are in litigation

WHEREAS, the water from the Cheyenne River is controlled in Angostura Dam for irrigation and flood control. The uranium contaminated water flows northeast and into the Missouri. This waterway is contaminated. Radioactive water from Cheyenne River allows ranches to grow corn and hay to produce cattle for human consumption.

WHEREAS, an application was sent to the EPA in Denver to clean up one of the old open pit uranium mines. After two attempts by the EPA to assess the contamination, the case was closed as the Project Manager refused access to private property. The mine continues to contaminate the water.

WHEREAS, on April 12, 2022 Pegasus Resources, another uranium mining company, purchased 147 lode mine claims on 3,037 acres in Fall River County for In Situ mining.

WHEREAS, uranium contamination of water has never been brought back to baseline, uranium in our water and aquifers is a deadly risk to human and all life.

WHEREAS, the mining, processing, transportation, manufacturing of any uranium product, radioactive waste produce from mining and nuclear powerplants are all deadly. There is no safe storage of this radioactive waste to date.

WHEREAS, Russian uranium imports are only 13% of our annual Reserve and there is nothing "Green" or sustainable about Nuclear Power. Keep it in the ground.

THEREFORE, BE IT RESOLVED, It's All about the Water opposes the creation of the Strategic Uranium Reserve.

BE IT FINALLLY RESOLVED, we will continue to take peaceful actions if needed to carry out the intent of this Resolution.

Sarah Peterson
Organizer of It's All about the Water

COMMENTARY

The drive to widen the digital divide



BY GUEST COMMENTARY
OCTOBER 20, 2021



Illustration via iStock

IN SUMMARY

The American Legislative Exchange Council and telecoms are working in tandem to ensure consumers in California and the U.S. do not get access to world-class telecommunication services.



By Larry Ortega, Special to CalMatters



by Larry Ortega, Special to CalMatters

Larry Ortega is founder of Community Union Inc., a nonprofit corporation that trains consumers living in the digital divide, and a 35-year veteran of the technology sector.

For almost 30 years, America's telecom companies have been receiving billions of dollars in rate increases and extra fees to finance the build-out of a national fiber optic network. Along the way, they discovered that such a network would hamper their opportunity to make a financial killing with wireless technology. So in 2010, [they stopped upgrading phone customers](#) with fiber optics, thus widening the digital divide and leaving millions of Americans unconnected.

This is not just another digital divide story about rural or inner-city residents who lack access to broadband services. This is a story about a skillfully thought-out, well-financed scheme that involves the [American Legislative Exchange Council \(ALEC\)](#), [Koch Industries](#) (the largest privately held company in the U.S.) and [a gang of lobbyists](#) joining forces to write legislation.

This [legislation](#) would use the levers of state government to fast-track the deployment of an unregulated and a highly profitable wireless business. In state after state, [the same political forces](#) that are legislating away voting rights and increasing the power of corporations are pushing fast-track 5G legislation under the guise of fixing the digital divide.

The wireless industry claimed that rapid deployment of 5G technology will bring great new benefits to consumers, and just like that, almost every one of our California legislators were on board. What the industry purposefully omits is that fiber optics (wired) connections are [10,000 times faster than 5G](#), more secure, less expensive for the consumer and future-proof.

In fact, it was the phone companies themselves that abandoned the completion of fiber connections midstream, leaving millions of miles of “dark fiber” in the ground. A [2018 Network Exam by the California Public Utilities Commission](#) detailed how abandoning fiber optic upgrades to low-income and rural areas left consumers with wireless-only options. This is a well-known – and unethical – strategy called “[harvesting](#).”

These attacks on consumers by ALEC and the telecommunications industry have been constant. Gov. Gavin Newsom faced off with telecom when he was mayor of San Francisco. Federal Communication Commission Commissioner Brendan Carr had fought the city's effort to ensure consumer protections. Carr wrote the FCC's current regulations on 5G, known as [Carr's 5G Orders](#).

These orders obliterate state and local government oversight of infrastructure build-out, throwing out both financial and physical safety protocols, all in the name of a race to third place. Even when 5G can be successfully deployed, [it is still slower than fiber optics](#) and cable TV.

ALEC, Carr and the phone companies are working in tandem to ensure that consumers in California and the U.S. do not get access to world-class telecommunication services. Fiber optic upgrades would slash profits by hundreds of billions of dollars, breaching telecoms' fiduciary duty to their shareholders. The telecoms want no part of profit-slashing and therefore have chosen to drive a strategy that ensures the persistence of a digital divide.

Community groups, unions (such as the Communication Workers of America) and parents who fear their children may be harmed by unregulated deployment of wireless infrastructure are on to this nonsense. They recently asked for, and were granted, the governor's veto on [Senate Bill 556](#), one of the ALEC bills. The effort was a massive grassroots undertaking. But while this cohort of consumers and activists prevailed this time, it is not a sustainable long-term strategy.

The veto of SB 556 is a victory for local governments in California, but it's only temporary. ALEC and friends have a history that has had a devastating impact on families living with the digital divide, starting with 2012's [SB 1161](#), which the CPUC Network Exam points to as a culprit in exacerbating the digital divide; followed by 2017's [SB 649](#), which was vetoed by Gov. Jerry Brown; and 2021's [AB 537](#), which created a "deemed granted" law that [puts safety protocols at risk](#). Gov. Newsom signed AB 537 into law.

Consumers, telecoms and our legislators are charged with the task of ensuring that all Californians have quality, high-speed, fiber optic access to online resources, be they in the rural cities of Huron, Mendota or Firebaugh or the inner-city MacArthur Park, Huntington Park or Leimert Park neighborhoods of Los Angeles.

It is time for the governor to call for an investigation into why these ALEC bills keep landing on his desk. Consumers deserve to know how it is that the telecom industry's plans since 1993 to [upgrade consumers with fiber optics](#) still have not been delivered. At no point did consumers agree to a more expensive, less efficient wireless network. Wireless technology has its application, but to reiterate, 5G is 10,000 times slower, requires higher maintenance and [will consume much more energy](#) than fiber optics once deployed, guaranteeing a larger, not smaller, carbon footprint.

We might begin by looking at increasing oversight of fiber optics deployed under [Title II](#) of the Communications Act of 1934 – a federal mandate that all customers shall be served. This increased oversight, by itself, might be able to close the digital divide.

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PROUDLY POWERED BY NEWSPACK BY AUTOMATTIC

THE HAZARDS OF ELECTROMAGNETIC FIELDS (EMFs) [AND WHY YOU SHOULD CARE]



Energy. Power. Connection. We use these words a lot to talk about our Paleo lifestyles. Our nutrition fuels our energy. Our workouts strengthen our power. Our community provides vital connection. But apply these words to electromagnetic fields (EMFs), and we unearth an emerging health issue that impacts our wellness and prosperity. There's a lot to learn, so consider this your EMF 101 intro course.

Why should we be concerned about EMF exposure?

You see it everywhere: "Free Wi-Fi." You feel excited. Comforted. Relieved. You whip out your digital trifecta—smartphone, tablet, laptop. Yes! Connection! But there is mounting scientific evidence pointing to potentially harmful biological effects from this exact type of radiofrequency radiation.

As Paleo biohackers, we are committed to figuring out how the body can run most efficiently and reach homeostasis, and we do this through nutrition, movement, mindfulness and our environment—all based on the wisdom of our ancestors. We need only revisit John Durant's *The Paleo Manifesto* to intuit the problem with the deluge of EMFs in our world: "An organism is likely to thrive in a habitat that resembles its ancestral habitat." And that includes our earth's

natural electromagnetism and energy fields.² But these overabundant man-made frequencies fly in the face of that environmental constant. So what is this fundamental change in our habitat's energy doing to our bioelectrical bodies?

How do EMFs harm?

We love our technology for its convenience, productivity and entertainment value, but the sobering reality is there are now hundreds of studies from independent scientists and health experts around the world indicating biological effects from both low-frequency and radiofrequency radiation. This type of non-ionizing, non-thermal radiation is not powerful enough to break electrons out of orbit, but it can nonetheless interfere with normal body processes. How exactly? EMFs are an external bodily

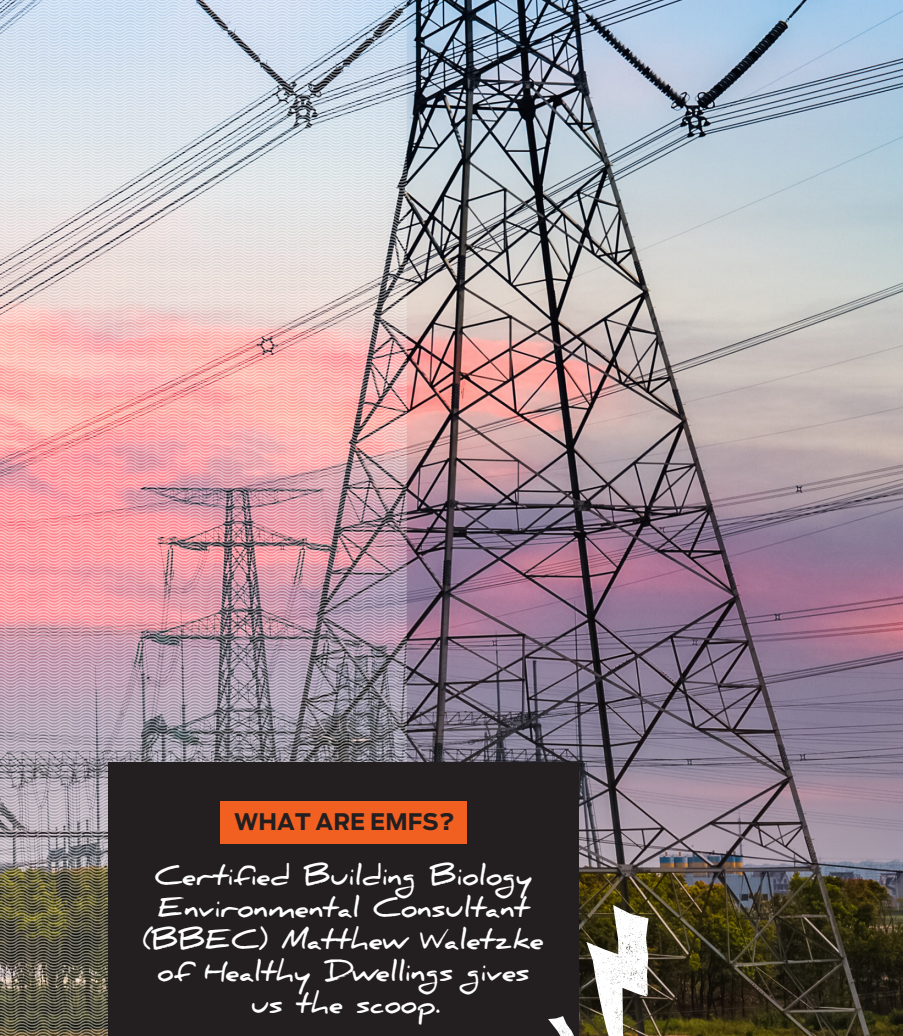
stressor like any other. There is a wealth of scientific evidence showing that even low levels of electromagnetic fields can activate the body's cellular stress response.⁵ This assault on the cells stimulates stress proteins,⁹ thereby disrupting biological balance. This all in turn prevents the body from healing, causes immune system imbalances, disrupts metabolic function and lowers disease resistance.³ Not good—since this is all the stuff we Paleo folks vow to overcome.

The list of associated health concerns with non-ionizing EMF exposure is significant, including (but not limited to): brain cancer; childhood and adult leukemia; leakage of the blood-brain barrier; genotoxic effects on DNA damage; cognitive and memory problems; increased risk of neurodegenerative disease; increased harm of chemical toxins due to combined exposure; low

sperm count; learning disorders and behavioral problems; increased allergic and inflammatory responses; insomnia; decreased melatonin production; and risk factors for childhood hyperactivity, learning and behavioral disorders.^{1,3} Alarming, to say the least.

But wait, aren't there EMF safety standards?

The question of EMF safety levels continues to spark a complex worldwide debate. Christopher Buonocore, BBEC, EMRS, of LifeSource Environmental Solutions explains why. In the U.S., the Federal Communications Commission (FCC) regulates wireless technologies, radio frequencies and all associated devices. Yet the current national safety standards for maximum allowable EMF exposures are set by the FCC at 10,000,000



WHAT ARE EMFS?

Certified Building Biology Environmental Consultant (BBEC) Matthew Waletzke of Healthy Dwellings gives us the scoop.

EMF STANDS FOR “ELECTROMAGNETIC FIELD.” We are surrounded by EM fields—both natural and man-made. These fields have two components: an electric field and a magnetic field. The strength of EMFs is measured in units of power density, and EMFs differ in frequency and wavelength. The spectrum of EM fields ranges from extremely low (e.g., your blender’s power cord) to very high (e.g., gamma rays).

RADIOFREQUENCY (RF) refers to invisible, man-made wireless technologies, such as wireless routers, cellphones, cell towers, cordless phones, smart meters, Wi-Fi-enabled devices, e-readers and wearable smart tech.

LOW-FREQUENCY/EXTREMELY LOW-FREQUENCY (LF/ELF) is electricity generated from power lines, transformers and electrical appliances.

DIRTY ELECTRICITY refers to contaminated signals, harmonics or high-frequency micro-surges that ride on top of our clean electrical current. Think about this like a distortion. Examples include improper wiring, the power grid, fluorescent lights, LED lights and dimmer switches.

$\mu\text{W}/\text{m}^2$ —that’s literally millions of times higher than the 3 to 6 $\mu\text{W}/\text{m}^2$ precautionary level presented by the 2012 BioInitiative Report.¹

So why is the FCC’s level so high? Because they based their recommendations on safety standards issued by the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE), and the National Council on Radiation Protection and Measurements (NCRP).¹⁰ These organizations only considered *thermal* effects (i.e., heating) on the body when setting exposure limits.³ Yet, as Mr. Buonocore explains, “there is a substantial amount of peer-reviewed research published nationally and internationally indicating that much lower *non-thermal* levels have dramatic biological effects.” And it’s at these non-thermal levels where we find our wireless toys and electronic devices.

Not to mention, U.S. federal regulations did not consider cumulative or multiple overlapping exposures—a serious problem when most of us spend our days glued to a cellphone, while typing on a laptop, all connected on a wireless network, as we sit under LED lights, drive a car synced with Bluetooth, and sleep in a house with a smart meter, perhaps with a power transformer outside the window. For the first time in the history of man, we are surrounded by omnipresent, entire-body exposures to artificial electromagnetic frequencies in our homes, communities, schools, businesses, restaurants, transportation systems and public infrastructures.

In 2011, the International Agency for Research on Cancer (IARC), part of the World Health Organization (WHO), published a risk assessment guideline that raised radiofrequency radiation to “Group 2B: possibly carcinogenic to humans”—meaning it could potentially be cancerous.

But is anyone actually sick from this yet?

There is a small, but growing, percentage of the world’s population now suffering from a multisystemic condition called electrohypersensitivity (EHS). Individuals with EHS experience a wide gamut of physiological manifestations while in the presence of electromagnetic fields (even at extremely weak power densities). Symptoms of EHS worsen with dose and duration of EMF exposure and include headaches, heart palpitations, chest pains, skin

"A friend of mine once said, 'It's the new smoking,' and proceeded to pull out an old print advertisement with the headline 'Doctors Smoke Camels.'"

(BBEC)—Christopher Buonocore, BBEC, EMRS, LifeSource Environmental Solutions

rashes, disturbed sleep, burning/tingling/numbness, muscle aches, joint pains, nausea, restless leg syndrome, tinnitus, vertigo, brain fog, memory problems, cognitive dysfunction and more.^{4,6}

When this condition is unmanaged, individuals with EHS become significantly more sensitive to increasingly smaller and shorter intensities of EMF stimuli. Currently, management of EHS is dependent upon strict avoidance of EMFs and other environmental toxins. An individual will usually go into remission once living in a low-EMF and chemically pure environment. However, it remains unclear if full recovery is possible, once the individual re-enters an EMF-laden area.⁶

While EHS is not yet accepted as a legal disability in the U.S., several countries classify it as a "functional impairment," and the WHO states that "the symptoms are certainly real... EHS can be a disabling problem for the affected individual."¹¹ While exact numbers are hard to pinpoint at this stage, it is estimated that roughly 3 to 5 percent of the world's population currently has EHS, with approximately 35 to 50 percent mildly to moderately affected by EMF pollution.^{4,6}

The most severely debilitating cases of EHS require the individual to break from our high-tech society and live entirely off the grid. These so-called "EMF refugees" seek solace in remote rural locations and rapidly disappearing radiofrequency-free "white zones" around the world—no easy task given the expansion of community WiMAX and cellular networks, as well as the international rollout of the smart grid.

What we should all learn as a takeaway from EHS is this: These highly sensitive individuals may be the proverbial "canaries in the coal mine." If they can sense physical danger around our wireless technologies and electrical fields, maybe we should all heed the warning, as well.

So, what can we do about this?


If we're Paleo, that means we bypass the sugary-sweet, neon-colored candies in the grocery store. We skip the industrial foods in favor of our own

organically grown, locally sourced, unprocessed meals. Retailers may line their shelves with chemically infused, mega-marketed industrial foods, personal care and home products, but that doesn't mean we have to buy them, stock our pantries with them or use them. So, the same self-mandated bio-individual control can be implemented with EMF devices and wireless technologies. Just because it's everywhere, just because "everyone else is doing it," and just because these products don't come with a literal skull and crossbones label, doesn't mean any of this is actually healthy for us, nor does it mean that we "should" overindulge when merely given the opportunity.

"Sensitive or not, anyone can benefit from reducing these EMFs in the home environment. It's a holistic health perspective... EMF is a stressor on the body. Just like chemicals in the environment, or the stress on our jobs, you want to create a space where all of those stressors are as low as possible, and that frees the body up to do what it is supposed to do."

—Matthew Waletzke, BBEC, Healthy Dwellings

Good (and bad) vibrations

The seductive lure of modern technology keeps us in this constant, unnatural feed cycle of EMF hyper-exposure. As MIT Professor Sherry Turkle writes in *Reclaiming Conversation*, "We turn to our phones instead of each other. We readily admit we would rather send an electronic message or mail than commit to a face-to-face meeting or a telephone call."⁷ Sure, our digital technologies may be harming our interpersonal relationships, but what if they're also harming our bodies? We are here to nourish ourselves, in mind, body and spirit. We may be living in the "smart tech" era, but our ancestors had some mega-smarts of their own. It's time we disconnect from the constant barrage of artificial EMFs, and reconnect to the natural rhythms and vibrations our Earth intended. There is a difference between surviving and thriving. And we want to thrive. 



TIPS & TRICKS

GET SMART ABOUT YOUR SMARTPHONE.

- 1 Never hold your smartphone next to your head. When talking, use a wired air tube headset or speaker option, and place the phone away from your body.
- 2 Only use your smartphone when you have a good signal. The weaker the signal, the more radiofrequency is used to connect, which increases your exposure.
- 3 Text more than talk. Smartphones use less radiation to send a text versus talking.
- 4 Never put your smartphone in your pocket or directly on your body. And if you must, then keep it turned off.
- 5 Use a corded landline at home instead of your smartphone when making calls.
- 6 Pregnant women should keep their smartphones (and all wireless devices) away from their abdomen. New parents? Move that device away from your baby's head and body.
- 7 Meet up IRL! Drop your smartphone, go outside and connect in person when you can.

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Alison Main is a freelance writer with a focus on natural living, clinical nutrition, and EMF safety. Echoing her own wellness journey, she is passionate about helping others heal from environmental illness through holistic tenets and Paleo philosophies. [UncommonAlchemy.me](#)

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The Kids Are Not All Right

How Wireless Tech Is Harming Our Youth And What Parents Can Do Right Now

Alison Main



“Children are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children.”

—American Academy of Pediatrics, 2013

Don't run with scissors. Don't talk to strangers. Don't play with matches. Don't drink and drive. Don't do drugs.

Parents are eternally concerned about their children's safety. From infancy to adolescence, children are developing humans—physically, behaviorally and intellectually. To emerge as healthy, well-adjusted adults, kids need their parents' protection. And when it comes to children and wireless-tech safety, there's a lot parents need to know.

What is Wi-Fi, Really?

We can't see Wi-Fi with the naked eye—but we're surrounded by it, 24/7. Wireless technology encompasses our cell phones, tablets, cell towers, smart meters, wireless-enabled laptops, baby monitors, gaming consoles, e-readers, virtual-reality toys and the emerging Internet of Everything.

The term “Wi-Fi” sounds harmless enough, right? Its utterance like a baby's coo or cartoon slang. It alliteratively conjures “Sci-Fi” flying cars and time travel. But let's call wireless tech what it really is—radiofrequency radiation, also called microwave radiation.

Technically speaking, “Wi-Fi deploys pulse-modulated microwave radiation (within the larger radiofrequency spectrum) with a carrier frequency that is similar to that used by a microwave oven (about 2.45 gigahertz).”⁵ In 2011, the International Agency for Research on Cancer classified radiofrequency radiation as “possibly carcinogenic to humans.” This is the same category as lead, DDT, and other pesticides.

Who's at Risk?

Science shows that wireless radiation can cause a gamut of biological effects, from cancer and neurodegenerative diseases to birth defects and infertility. And yet, outdated world-wide safety regulations only consider short-term heating (i.e., thermal) and shock effects. They don't consider the chronic, non-thermal exposures of our wireless tech world.²

As a human population, we are all at risk from environmental exposures and toxins. But, the most vulnerable are children, the developing fetus and pregnant women. A child's brain, nervous system and immune system are in development at these critical periods. Despite this, "there is a growing, unchecked and unregulated availability of a range of transmitting equipment specifically aimed at parents of babies and young people."²

Yes, this includes that wireless baby monitor (2 inches from your baby's head), that working cell phone in your toddler's mouth, or that tablet broadcasting under your teen's pillow—all these seemingly innocuous devices can be hazardous to your child's health.

AMERICAN ACADEMY OF PEDIATRICS CELL PHONE SAFETY TIPS FOR FAMILIES

- 1 Use text messaging when possible, and use cell phones in speaker mode or with the use of hands-free kits.
- 2 Avoid carrying your phone against the body like in a pocket, sock or bra. Cell phone manufacturers can't guarantee that the amount of radiation you're absorbing will be at a safe level.
- 3 If you plan to watch a movie on your device, download it first, then switch to airplane mode while you watch in order to avoid unnecessary radiation exposure.
- 4 Keep an eye on your signal strength (i.e., how many bars you have). The weaker your cell signal, the harder your phone has to work and the more radiation it gives off.
- 5 Avoid making calls in cars, elevators, trains and buses. The cell phone works harder to get a signal through metal, so the power level increases.
- 6 Remember that cell phones are not toys or teething items.

Read more tips at:
HealthyChildren.org

REFERENCE:

+American Academy of Pediatrics. "Cell Phone Radiation & Children's Health: What Parents Need to Know." <https://www.healthychildren.org/English/safety-prevention/all-around/Pages/Cell-Phone-Radiation-Childrens-Health.aspx>

"Around the world we are paying the price now for having delayed actions on tobacco and asbestos after insisting on human harm before taking action. We cannot afford to wait for definitive proof of human risks from radiation emitted by wireless transmitting devices before taking steps to reduce exposures. The absence of evidence of hazard is not proof of safety"—says Dr. Devra Davis, president of the Environmental Health Trust and visiting professor at the Hebrew University Hadassah Medical School and Ondokuz Mayıs University, Turkey.

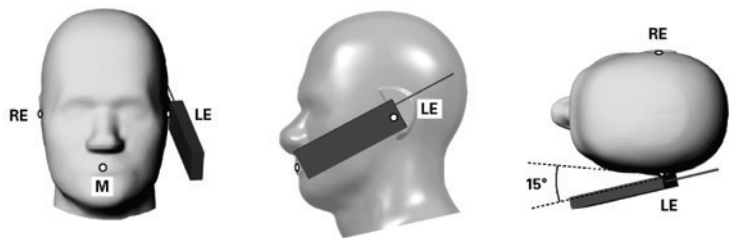
Who is SAM?

Standing for "Specific Anthropomorphic Mannequin," SAM is a plastic model of a head, which, in 1989, was made to represent the top 10 percent of U.S. military recruits. That's a 220-pound man with a pretty large head.

SAR, another relevant acronym, stands for "Specific Absorption Rate"—a measure of tissue-radiation exposure.⁹ The cell phone industry currently uses SAM for compliance testing against safety guidelines and to certify the SAR for mobile phone users.

However, research shows that a smaller head than SAM will absorb significantly more radiofrequency radiation.¹² Obviously, children's smaller heads have a shorter distance to the brain center. Also, children's skulls and ears are thinner, allowing radiation to penetrate farther. And children's brains contain more fluid, and thus absorb more radiation.^{4, 12}

The SAR for a 10-year-old is up to 153 percent higher than the SAR for the SAM model,¹ yet there is no pre-market certification testing for SAR on a child-equivalent head (or an adult's head smaller than SAM). And "when electrical properties are considered, a child's head's absorption can be over two times greater, and absorption of the skull's bone marrow can be 10 times greater than adults."¹



An example of a test position used on the Specific Anthropomorphic Mannequin, in this case with cell phone in tilted position on the left side.

+ <https://biomedical-engineering-online.biomedcentral.com/articles/10.1186/1475-925X-3-34>.

IMAGE SOURCE: BIOMED CENTRAL LTD

What Does the Latest Science Say?

In May 2016, the National Toxicology Program released partial findings of their \$25 million study on cell phones and cancer. The results showed that exposure to wireless radiation significantly increases the prevalence of highly malignant heart and brain cancers in rodents.

"The findings of brain tumors (gliomas) and malignant Schwann cell tumors of the heart in the NTP study, as well as DNA damage in brain cells of exposed animals, present a major public health concern because these tumors occurred in the same types of cells that had been reported to develop into tumors (gliomas and acoustic neuromas) in epidemiological studies of adult cell phone users,"

SHOW US THE FINE PRINT

Cell phone companies issue instructions to keep wireless devices at specified distances from our bodies. So, if you've got your mobile on your ear, or your tablet on your abdomen, you may be exposed to higher radiation levels than those tested as safe. But this information is often buried in the fine print, sometimes even buried in the device itself.

Here's a sampling of manufacturer instructions:

● **Baby Monitor Motorola MBP33**

"The Baby unit shall be installed and used such that parts of the user's body other than the hands are maintained at a distance of approximately 20 centimeters (8 inches) or more."

● **Samsung 3G Laptop**

"Usage precautions during 3G connection: Keep safe distance from pregnant women's stomach or from lower stomach of teenagers. Body worn operation: Important safety information regarding radiofrequency radiation exposure. To ensure compliance with radiofrequency exposure guidelines the Notebook PC must be used with a minimum of 20.8 centimeters antenna separation from the body."

● **iPhone 6**

"To reduce exposure to radiofrequency energy, use a hands-free option, such as the built-in speakerphone, the supplied headphones, or other similar accessories. Carry iPhone at least 5 millimeters away from your body to ensure exposure levels remain at or below the as tested levels. Cases with metal parts may change the radiofrequency performance of the device, including its compliance with radiofrequency exposure guidelines, in a manner that has not been tested or certified."

Find your device at:

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REFERENCE:

+Show Us The Fine Print. <http://showthefineprint.org/>

explains Ron Melnick, Ph.D., senior toxicologist and director of Special Programs in the Environmental Toxicology Program at the National Institute of Environmental Health Sciences, National Institutes of Health, now retired.

In response to these results, the American Academy of Pediatrics issued new recommendations for reducing exposure to cell phones and wireless devices. In an AAP press release, Jennifer A. Lowry—M.D. and chair of the AAP Council on Environmental Health Executive Committee—said: "They're not toys. They have radiation that is emitted from them and the more we can keep it off the body and use (the phone) in other ways, it will be safer."⁷

Microwave Tech in Schools

Computers and the Internet are vital learning tools. But the crux of the matter with wireless tech is safety. And this rampant technology has never been tested for the long-term, overlapping, cumulative exposures experienced in today's schools by the most vulnerable population: children.

Students in schools are bombarded with wireless radiation from every conceivable angle: their own personal devices, the devices of all nearby users in surrounding classrooms, wireless devices in the school itself (routers, printers, smart boards, etc.), and transmitters (i.e., cell towers) in close proximity outside the school. Plus, to simultaneously handle the hundreds of devices needed to conduct its daily activities, schools typically install stronger Wi-Fi systems. Most residential homes now have Wi-Fi hubs and multiple devices per household member—meaning that when kids return home, they get no respite.

"They're not toys. They have radiation that is emitted from them and the more we can keep it off the body and use (the phone) in other ways, it will be safer."

Consequently, in schools across the world, kids are getting sick from this unprecedented level of wireless exposure. Dafna Tachover, founder of We Are The Evidence—an advocacy group for those injured by wireless technology—is an attorney in both Israel and New York. She regularly works with children and parents who have developed electro-sensitivity to wireless tech. Symptoms commonly reported include: headaches, nausea, vomiting, cognitive problems, tingling, severe exhaustion, noise sensitivity, sinus pressure and nose bleeds.

In a case submitted to the Israeli Supreme Court, Tachover presented 200 children, from six schools, who had become sick from wireless tech. In one particular school, 70 children from three classes started having symptoms after a second wireless router was installed. Tachover uncompromisingly states: "Our school systems are creating the most intense environment of radiation, and they're doing it to the most sensitive population. The harm has already been proven. There's an epidemic of sickness in the schools."

After significant efforts, in April 2016 the city of Haifa, in Israel, ordered all Wi-Fi to be disconnected in schools. In a press release, Haifa's mayor, Yona Yahav, is cited saying, "When there is a doubt, when it comes to our children, there is no doubt."

This is a step in the right direction, but internationally there continue to exist countless groups of concerned parents and researchers urging school administrations to adopt best tech practices. Schools can get the same educational benefits from a *wired* (fiber-optic and Ethernet) network, and in doing so, they wouldn't be putting an entire generation of kids at risk.

There's No Wi-Fi in Narnia

Some schools are now rolling out virtual-reality curricula, like the Google Expeditions Pioneer Program. Sure, it sounds cool to take a trip to Mars without leaving the classroom. But, hold that virtual-reality visor up to a child's eyes, and what you've got is a cell phone encased in a cardboard box, beaming microwave radiation directly into a child's brain.

Whether used in school or at home, virtual-reality toys have never been pre-market tested for health consequences. Dr. Mary Redmayne, a researcher at Monash University in Australia, explains: "Children's brains are not fully myelinated and eyes absorb radiation readily due to their high water content. Placing a two-way microwave radiating device directly in front of young eyes is not a wise choice in my opinion."⁹

Schools can get the same educational benefits from a wired (fiber-optic and Ethernet) network, and in doing so, they wouldn't be putting an entire generation of kids at risk.

Theodora Scarato—Environmental Health Trust's director of Public Affairs and Educational Resources—speaks to another angle regarding digital play. "The research shows that simpler is often better in terms of toys. When you have a bunch of building blocks, then a child can use their own creativity to imagine what these blocks are. But when it's already pre-scripted, the child is using less creativity, because the choice has already been taken away. You can only be as creative as the program application is. And that is stifling. When I listen to children tell me about what they imagine in their minds, I'm always blown away. A computer's drop down menu can't even come close."

Tech Addiction

"A representative survey of American tweens (8- to 12-year-olds) and teens (13- to 18-year-olds), documented that outside of school and homework, tweens spend almost six hours per day (5:55 hours) and teens spend almost nine hours per day (8:56 hours) using media."¹¹

While "Tech Addiction" is not yet classified as a disorder in *The Diagnostic and Statistical Manual of Mental Disorders*, the phenomenon is nonetheless being investigated by a host of psychologists and researchers. Clinical psychologist Catherine Steiner Adair sheds light on the impact of the omnipresent glowing screen within the family dynamic: "Everything a baby needs from its environment between birth and 2 years comes from people, from relationships with people and interactions with the environment—physically exploring, playing, crawling, and interacting with others. When we triangulate our relationship with our babies and tech, we compromise that essential connection."¹⁰

Further, "the development of empathy is a critical step in early childhood and over a lifetime. Empathy is the caring glue that creates our humanity, our compassion."¹⁰ We learn empathy through direct human contact. This is thwarted when kids correlate personal identity with their Xbox avatar or their Facebook status. The blood in Halo isn't real; sad-face emojis aren't tears. When disconnected from real-life interaction, kids don't learn accountability for negative actions or mean words. What kind of society will emerge when our technology-obsessed youth is decoupled from the tangibility of human consequences?

Like a Kid in a Candy Store

An apt allegory might be Roald Dahl's *Charlie and the Chocolate Factory*. Faced with his tempting, addictive, untested, fantastical inventions, the story's overindulgent kids were squeezed, colorized, ballooned and miniaturized, while their parents stood idly by and watched—all for Mr. Wonka's industrial benefit and profit.

Kids today should not literally be left to their own devices. The proliferation of wireless radiation is the biggest public health experiment ever conducted, and it's happening on an entire generation of children. Do you want to experiment on your kids?

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10 STEPS FOR PREGNANT WOMEN TO LIMIT THEIR WIRELESS RADIATION EXPOSURE:

- 1 Avoid carrying your cell phone on your body.
- 2 Avoid holding any wireless device against your body when in use.
- 3 Use your cell phone on speaker setting or with an "air tube" headset.
- 4 Avoid using your wireless device in cars, trains or elevators.
- 5 Avoid cordless phones, especially where you sleep.
- 6 Whenever possible, connect to the Internet with wired cables.
- 7 When using Wi-Fi, connect only to download, then disconnect and disable Wi-Fi.
- 8 Avoid prolonged or direct exposure to nearby Wi-Fi routers.
- 9 Unplug your home Wi-Fi router when not in use.
- 10 Sleep as far away from wireless utility meters (i.e., "smart meters") as possible.

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Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective[☆]

Dominique Belpomme^{a, b, 1}, Lennart Hardell^{a, c, 1, 2}, Igor Belyaev^{a, d, e, 1}, Ernesto Burgio^{a, f}, David O. Carpenter^{a, g, h, *, 1}

^a European Cancer Environment Research Institute, Brussels, Belgium

^b Paris V University Hospital, Paris, France

^c Department of Oncology, Orebro University Hospital, Faculty of Medicine, Orebro, Sweden

^d Department of Radiobiology, Cancer Research Institute, Biomedical Research Center, Slovak Academy of Science, Bratislava, Slovak Republic

^e Laboratory of Radiobiology, Institute of General Physics, Russian Academy of Science, Moscow, Russian Federation

^f Istituto Scientifico Biomedico Euro Mediterraneo, Mesagne, Italy

^g Institute for Health and the Environment, University at Albany, Albany, NY, USA

^h Child Health Research Centre, The University of Queensland, Faculty of Medicine, Brisbane, Australia

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ABSTRACT

Exposure to low frequency and radiofrequency electromagnetic fields at low intensities poses a significant health hazard that has not been adequately addressed by national and international organizations such as the World Health Organization. There is strong evidence that excessive exposure to mobile phone-frequencies over long periods of time increases the risk of brain cancer both in humans and animals. The mechanism(s) responsible include induction of reactive oxygen species, gene expression alteration and DNA damage through both epigenetic and genetic processes. *In vivo* and *in vitro* studies demonstrate adverse effects on male and female reproduction, almost certainly due to generation of reactive oxygen species. There is increasing evidence the exposures can result in neurobehavioral decrements and that some individuals develop a syndrome of “electro-hypersensitivity” or “microwave illness”, which is one of several syndromes commonly categorized as “idiopathic environmental intolerance”. While the symptoms are non-specific, new biochemical indicators and imaging techniques allow diagnosis that excludes the symptoms as being only psychosomatic. Unfortunately standards set by most national and international bodies are not protective of human health. This is a particular concern in children, given the rapid expansion of use of wireless technologies, the greater susceptibility of the developing nervous system, the hyperconductivity of their brain tissue, the greater penetration of radiofrequency radiation relative to head size and their potential for a longer lifetime exposure.

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1. Introduction

Electromagnetic fields (EMFs) are packets of energy that have no mass. They vary in frequency and wavelength. At the high end of the electromagnetic spectrum there are cosmic and X-rays that have enough energy to cause ionization, and therefore are known

as ionizing EMFs. Below in frequency and energy are ultraviolet, visible light and infrared EMFs. Excessive exposure to ultraviolet EMFs poses clear danger to human health, but life on earth would not be possible without visible light and infrared EMFs. Below these forms of EMF are those used for communications (radiofrequency or RF-EMFs, 30 kHz–300 GHz) and those generated by electricity (extremely low-frequency or ELF-EMFs, 3 Hz–3 kHz). These EMFs do not have sufficient energy to directly cause ionization, and are therefore known as non-ionizing radiation. RF-EMFs at sufficient intensity cause tissue heating, which is the basis of operation of the microwave oven. However the question to be addressed here is human health effects secondary to exposures to non-ionizing EMFs at low intensities that do not cause measureable heating.

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* Corresponding author. Institute for Health and the Environment, University at Albany, Renaissance, NY 12144, USA.

E-mail address: dcarpenter@albany.edu (D.O. Carpenter).

¹ These authors contributed equally to this work.

² Current address: The Environment and Cancer Research Foundation, Örebro, Sweden.

In spite of a large body of evidence for human health hazards from non-ionizing EMFs at intensities that do not cause measurable tissue heating, summarized in an encyclopedic fashion in the Bioinitiative Report (www.bioinitiative.org), the World Health Organization (WHO) and governmental agencies in many countries have not taken steps to warn of the health hazards resulting from exposures to EMFs at low, non-thermal intensities, nor have they set exposure standards that are adequately health protective. In 2001 the International Agency for Research on Cancer (IARC, 2002), part of the WHO, declared ELF-EMFs to be “possibly carcinogenic to humans”, and in 2011 they made a similar declaration for RF-EMFs (Baan et al., 2011; IARC, 2013). The classification of RF-EMFs as a “possible” human carcinogen was based primarily on evidence that long-term users of mobile phones held to the head resulted in an elevated risk of developing brain cancer. One major reason that the rating was not at “probable” or “known” was the lack of clear evidence from animal studies for exposure leading to cancer. The US National Toxicology Program has released preliminary results of a study of long term exposure of rats to cell phone radiation which resulted in a statistically significant increase in brain gliomas, the same cancer found in people after long-term cell phone use, and schwannomas, a tumor similar to the acoustic neuroma also seen after intensive mobile phone use (Wyde et al., 2016). Similar results in rats have been reported in an independent study at the Ramazzini Institute with exposures similar to those from a mobile phone base station (Falcioni et al., 2018). This evidence, in conjunction with the human studies, demonstrates conclusively that excessive exposure to RF-EMF results in an increased risk of cancer. In light of this new evidence for cancer in rodents in response to prolonged exposure to mobile phone frequencies, the IARC rating should be raised at least to “probable” (Group 2A) if not “known” (Group 1).

Unfortunately the International EMF Project of the WHO, which is part of the Department of Public Health, Environment and Social Determinants of Health in Geneva, has consistently minimized health concerns from non-ionizing EMFs at intensities that do not cause tissue heating (WHO, 2014). In this regard WHO has failed to provide an accurate and human health-protective analysis of the dangers posed to health, especially to the health of children, resulting from exposure to non-thermal levels of electromagnetic fields. The Department of Public Health, Environment and Social Determinates of Disease takes its advice on the issues related to human health effects of non-ionizing EMFs from the International Commission on Non-ionizing Radiation Protection (ICNIRP). Almost all members of the core group preparing the new Environmental Health Criteria (EHC) document for the WHO are members of ICNIRP (Starkey, 2016; Hardell, 2017), a non-government organization (NGO) whose members are appointed by other members. In spite of recent efforts to control for conflicts of interest, ICNIRP has a long record of close associations with industry (Maisch, 2006). When queried as to why the WHO would take recommendations from such a group, WHO staff replied that ICNIRP is an official NGO which works closely with the WHO. Why this should exclude other scientific research groups and public health professionals is unclear, particularly since most members of ICNIRP are not active researchers in this field. We are particularly concerned that a new WHO EHC document on RF-EMFs is scheduled to be released soon, and that the members of the EHC Core Group and the individuals whose assistance has been acknowledged are known to be in denial of serious non-thermal effects of RF-EMFs in spite of overwhelming scientific evidence to the contrary (Starkey, 2016; Hardell, 2017).

Others have dismissed the strong evidence for harm from ELF- and RF-EMFs by arguing that we do not know the mechanism whereby such low energetic EMFs might cause cancer and other diseases. We have definitive evidence that use of a mobile phone

results in changes in brain metabolism (Volkow et al., 2011). We know that low-intensity ELF- and RF-EMFs generate reactive oxygen species (ROS), alter calcium metabolism and change gene expression through epigenetic mechanisms, any of which may result in development of cancer and/or other diseases or physiological changes (see www.bioinitiative.org for many references). We do not know the mechanisms behind many known human carcinogens, dioxins and arsenic being two examples. Given the strength of the evidence for harm to humans it is imperative to reduce human exposure to EMFs. This is the essence of the “precautionary principle”.

There are a number of reasons for our concern. In the past the major exposure of the general population to RF-EMFs came from radio and television signals. Now there are almost as many mobile phones as there are people in the world, all of them being exposed to RF-EMFs. There are mobile phone towers everywhere, and in many developing countries there are no land-lines that allow communication without exposure to RF-EMFs. There is rapid movement in many developed countries to place small cell transmitting devices (5G) operating at higher frequencies (24–70 GHz) every approximately 300 m along sidewalks in residential neighborhoods. There are other significant sources of exposure, coming from WiFi, smart meters and soon from automobiles operating without a human driver. Therefore human exposure has increased dramatically in recent years, and continues to increase rapidly. While we already are seeing harm from these exposures, the degree of harm will only increase with time because of the latency that is known to occur between exposure and development of diseases such as cancer.

Standards for protection of human health from EMFs vary greatly around the world. Many countries set standards based on the false assumption that there are no adverse health effects of RF-EMFs other than those that are caused by tissue heating. This is the case in North America, Australia and some European countries. Many countries from the former Soviet Union have much more restrictive standards. However information from cellular and human studies show biological effects that constitute hazards to human health at exposure levels that are often exceeded during daily life.

This report follows a recent non-official meeting in Geneva with WHO representatives, where the authors urged WHO to acknowledge low intensity effects of ELF-EMFs and non-thermal health effects of RF-EMFs. This report does not attempt to present a complete overview of the subject [see the Bioinitiative Report (www.bioinitiative.org) for that] but rather to provide a holistic picture of the processes explaining most or all of the adverse effects of EMF exposures. It summarizes the evidence for cancer resulting from exposure to EMFs, and identifies other diseases or pathological conditions such as Alzheimer's disease and hypofertility that have been shown to be associated with excessive exposure to low-intensity EMFs. We also focus on electrohypersensitivity (EHS) in both children and adults and cognitive and behavioural problems in children resulting from the increasing exposure. Finally we discuss what is known about the mechanisms whereby non-thermal EMF radiation can cause disease with special reference to EMF-related free radical production and epigenetic and genetic mechanisms.

2. Mobile phone use and the risk for glioma, meningioma and acoustic neuroma

The brain is the main target for exposure to RF-EMF radiation during use of handheld wireless phones, both mobile and cordless phones (Cardis et al., 2008; Gandhi et al., 2012). An increased risk for brain tumors has been of concern for a long time. The results of the Swedish National Inpatient Register have documented an

increasing incidence of brain tumors in recent years (Carlberg and Hardell, 2017). In May 2011 RF radiation in the frequency range 30 kHz–300 GHz was evaluated to be a Group 2B, i.e. a “possible” human carcinogen, by IARC (Baan et al., 2011; IARC, 2013). This was based on an increased risk for glioma and acoustic neuroma in human epidemiological studies. In the following an updated summary is given of case-control studies on brain and head tumors; glioma, meningioma and acoustic neuroma. The Danish cohort study on ‘mobile phone users’ (Johansen et al., 2001; Schüz et al., 2006) is not included due to serious methodological shortcomings in the study design, including misclassification of exposure (see Söderqvist et al., 2012a).

2.1. Glioma

Glioma is the most common malignant brain tumor and represents about 60% of all central nervous system (CNS) tumors. Most of these are astrocytic tumors that can be divided into low-grade (WHO grades I-II) and high-grade (WHO grades III-IV). The most common glioma type is glioblastoma multiforme (WHO grade IV) with peak incidence in the age group 45–75 years and median survival less than one year (Ohgaki and Kleihues, 2005). Three research groups have provided results in case-control studies on glioma (Interphone, 2010; Coureau et al., 2014; Hardell and Carlberg, 2015). Hardell and colleagues have published results from case-control studies on use of wireless phones and brain tumor risk since the end of the 1990s (Hardell et al., 1990; for more discussion see Carlberg and Hardell, 2017).

A random effects model was used for meta-analyses of published studies, based on test for heterogeneity in the overall group (“all mobile”). Note that only the Hardell group also assessed use of cordless phones. Thus their reference category included cases and controls with no use of wireless phones in contrast to the other studies investigating only mobile phone use. In Table 1 results for highest cumulative use in hours of mobile phones is given. All studies reported statistically significant increased risk for glioma and the meta-analysis yielded an odds ratio (OR) = 1.90 [95% confidence interval (CI) = 1.31–2.76]. For ipsilateral mobile phone use the risk increased further to OR = 2.54 (95% CI = 1.83–3.52) in the meta-analysis based on 247 exposed cases and 202 controls.

Carlberg and Hardell (2014) found shorter survival in patients with glioblastoma multiforme associated with use of wireless phones compared with patients with no use. Interestingly mutation of the p53 gene involved in disease progression has been reported in glioblastoma multiforme in patients with mobile phone use ≥ 3 h per day. The mutation was statistically significantly correlated with shorter overall survival time (Akhavan-Sigari et al., 2014). Further support for the increased risk of glioma associated with mobile phone use has been obtained in additional analyses of parts of the Interphone study (Cardis et al., 2011; Grell et al., 2016; Momoli

et al., 2017).

2.2. Meningioma

Meningioma is an encapsulated, well-demarcated and rarely malignant tumor. It is the most common benign tumor and accounts for about 30% of intracranial neoplasms. It develops from the pia and arachnoid membranes that cover the CNS. It is slowly growing and gives neurological symptoms by compression of adjacent structures. The most common symptoms are headaches and seizures. The incidence is about two times higher in women than in men. Meningioma develops mostly among middle aged and older persons (Cea-Soriano et al., 2012). Carlberg and Hardell (2015) included meningioma in their case-control studies. The results of the meta-analysis for cumulative exposure in the highest category are given in Table 2. In total there was an increased (but not statistically significant) risk for cumulative exposure but the increased risk was statistically significant for ipsilateral use of mobile phones (OR = 1.49, 95% CI = 1.08–2.06).

2.3. Acoustic neuroma

Acoustic neuroma, also called vestibular schwannoma, is a benign tumor located on the eighth cranial nerve from the inner ear to the brain. It is usually encapsulated and grows in relation to the auditory and vestibular portions of the nerve. It grows slowly and due to the narrow anatomical space may give compression of vital brain stem structures. First symptoms of acoustic neuroma are usually tinnitus and hearing problems. Results for use of mobile phones in Interphone (2011) and Hardell et al. (2013) are given in Table 3. Statistically significant increased risk was found for cumulative ipsilateral use ≥ 1640 h yielding OR = 2.71 (95% CI = 1.72–4.28).

The study by Moon et al. (2014) was not included in the meta-analysis because data on cumulative mobile phone use with numbers of cases and controls were not given. Support of an increased risk was seen in the case-case part of the study (Moon et al., 2014) and also in the report by Sato et al. (2011). Pettersson et al. (2014) made a case-control study on acoustic neuroma in Sweden not overlapping the Hardell et al. (2013) study. An increased risk for the highest category of cumulative use of both mobile phone (≥ 680 h OR = 1.46, 95% CI = 0.98–2.17) and cordless phone (≥ 900 h OR = 1.67, 95% CI = 1.13–2.49) was found. Pettersson et al. (2014) was not included in the meta-analysis due to the many scientific shortcomings in the study, e.g. laterality analysis was not made for cordless phone, the numbers in the laterality analysis for mobile phone are not consistent in text and tables and the ‘unexposed’ reference category included subjects using either mobile and cordless phone, which is clearly not correct (Hardell and Carlberg, 2014).

Table 1

Numbers of exposed cases (Ca) and controls (Co) and odds ratio (OR) with 95% confidence interval (CI) for glioma in case-control studies in the highest category of cumulative hours of mobile phone use.

	All			Ipsilateral		
	Ca/Co	OR	95% CI	Ca/Co	OR	95% CI
Interphone 2010						
Cumulative use ≥ 1640 h	210/154	1.40	1.03–1.89	100/62	1.96	1.22–3.16
Coureau et al., 2014						
Cumulative use ≥ 896 h	24/22	2.89	1.41–5.93	9/7	2.11	0.73–6.08
Carlberg and Hardell, 2015						
Cumulative use ≥ 1640 h	211/301	2.13	1.61–2.82	138/133	3.11	2.18–4.44
Meta-analysis						
Longest cumulative use	445/477	1.90	1.31–2.76	247/202	2.54	1.83–3.52

Table 2
Numbers of exposed cases (Ca) and controls (Co) and odds ratio (OR) with 95% confidence interval (CI) for meningioma in case-control studies in the highest category of cumulative hours of mobile phone use.

	All			Ipsilateral		
	Ca/Co	OR	95% CI	Ca/Co	OR	95% CI
Interphone 2010						
Cumulative use ≥ 1640 h	130/107	1.15	0.81–1.62	46/35	1.45	0.80–2.61
Coureau et al., 2014						
Cumulative use > 896 h	13/9	2.57	1.02–6.44	6/4	2.29	0.58–8.97
Carlberg and Hardell 2015						
Cumulative use ≥ 1640 h	141/301	1.24	0.93–1.66	67/133	1.46	0.98–2.17
Meta-analysis						
Longest cumulative use	284/417	1.27	0.98–1.66	119/172	1.49	1.08–2.06

Table 3
Numbers of exposed cases (Ca) and controls (Co) and odds ratio (OR) with 95% confidence interval (CI) for acoustic neuroma in case-control studies in the highest category of cumulative hours of mobile phone use.

	All			Ipsilateral		
	Ca/Co	OR	95% CI	Ca/Co	OR	95% CI
Interphone 2011						
Cumulative use ≥ 1640 h	77/107	1.32	0.88–1.97	47/46	2.33	1.23–4.40
Hardell et al., 2013						
Cumulative use ≥ 1640 h	27/301	2.40	1.39–4.16	19/133	3.18	1.65–6.12
Meta-analysis						
Cumulative use ≥ 1640 h	104/408	1.73	0.96–3.09	66/179	2.71	1.72–4.28

2.4. In summary

Based on case-control studies there was a consistent finding of increased risk for glioma and acoustic neuroma associated with use of mobile phones. Similar results were found for cordless phones in the Hardell group studies, although such use was not reported by the other study groups. The findings are less consistent for meningioma although somewhat increased risk was seen in the meta-analysis of ipsilateral mobile phone use. A longer follow-up time is necessary for this type of slow growing tumor.

The results on glioma and acoustic neuroma are supported by results from animal studies showing co-carcinogenic and tumor promoting effects from RF-EMF (Tillmann et al., 2010; Lerchl et al., 2015). Recent results from the National Toxicology Program (NTP) study showed genotoxicity of RF radiation in rats and mice exposed to RF-EMF (Smith-Roe et al., 2017). That result supports previous findings of DNA strand breaks in rat brain cells exposed to RF-EMF (Lai and Singh, 1997).

Of importance also is that the results in the NTP and Ramazzini studies both demonstrated an increased incidence of tumors of the same type, glioma and malignant schwannoma, as has been seen in humans with mobile phone use (Wyde et al., 2016; Falcioni et al., 2018). Acoustic neuroma (vestibular schwannoma) is a similar type of tumor as malignant schwannoma, although benign. In fact, rates of brain tumors are increasing in Sweden and use of wireless phones has been suggested to be the cause (Hardell and Carlberg, 2017).

3. Other diseases and pathological conditions attributed to exposure to low-intensity EMFs

The evidence for harm from RF-EMF is strongest for cancer as a consequence of intensive mobile phone use, especially gliomas, glioblastomas and acoustic neuromas. But there is other evidence for elevation in risk of leukemia among children living near to very high intensity radio transmission towers (Michelozzi et al., 2002; Ha et al., 2007). This is particularly interesting because leukemia is the cancer most associated with elevated exposure to ELF-EMFs

arising from power lines (Ahlbom et al., 2000; Greenland et al., 2000). There is some evidence for elevations in breast cancer risk among women who wear their mobile phones in their bra (West et al., 2013). Heavy use of a mobile phone was associated with significantly elevated rates of ipsilateral parotid tumors in studies from both Israel (Sadetzki et al., 2007) and China (Duan et al., 2011). No increased risk was found in a Swedish study, but the results were limited by low number of participants and lack of data on heavy and long-term use of wireless phones (Söderqvist et al., 2012b).

There are other significant human health hazards of concern. There is strong animal and human evidence that exposure to RF-EMFs as well as ELF-EMFs reduces fertility in both males (reviewed by McGill and Agarwal, 2014) and females (Roshangar et al., 2014). An association between spontaneous abortion and non-thermal EMF exposure including ELF-EMFs was reported in several case-control studies (Dodge, 1970; Juutilainen et al., 1993; Li et al., 2017). The increased use of mobile phones and increased exposure coming from WiFi, smart meters and other wireless devices has been paralleled in time with male hypofertility and sperm abnormalities in semen (Rolland et al., 2013). These effects may be related to holding an active wireless laptop in a man's lap or having an active mobile phone on their belt, but more study is needed. There is evidence that isolated human sperm exposed to RF-EMFs are damaged by generation of reactive oxygen species (Agarwal et al., 2009).

There are other diseases or physiologic alterations which have been reported to be associated with exposure to non-thermal EMFs in humans and in animals (Belyaev et al., 2016). Alzheimer disease has been shown to be significantly associated with chronic ELF-EMF occupational exposure in prospective epidemiological studies (García et al., 2008; Davanipour and Sobel, 2009). Exposure to RF-EMFs has been reported to increase neuropsychiatric and behavioural disorders (Johansson et al., 2010; Divan et al., 2012), trigger cardiac rhythm alteration and peripheral arterial pressure instability (Havas, 2013; Saili et al., 2015), induce changes in immune system function (Lyle et al., 1983; Grigoriev et al., 2010; Sannino et al., 2011, 2014) and alter salivary (Augner et al., 2010) and

thyroid (Koyu et al., 2005; Mortavazi et al., 2009; Pawlak et al., 2014) function. There is an urgent need for more study of these diseases or biological alterations in relation to exposure to both ELF- and RF-EMFs.

4. An emerging concern: cognitive and neurobehavioral problems in children

Children, and especially fetuses, are more vulnerable than adults for most environmental exposures (Sly and Carpenter, 2012). This is because their cells are rapidly dividing and their organ systems are not mature. As a result, events that perturb cellular function early in life can result in abnormalities that last. There is a building body of evidence indicating that exposure to RF-EMFs has adverse effects on cognition and neurobehavior, especially in children and adolescents. Concern about the particular sensitivity of children to RF-EMFs emitted from mobile phone was first raised in 2000 by a British independent expert group (IEG, 2000) that noted that the increased sensitivity to EMFs of children could be due not only to the natural vulnerability of the developing nervous system, but also to the smaller head size and thickness of the skull. These factors, plus the higher conductivity of the young nervous system, result in greater penetration of RF-EMFs into the brain (Gandhi et al., 1996). Of concern is the fact that any adverse effects during development may have life-long consequences and that young people, because they will have a longer life span, will receive a greater cumulative exposure than adults (Kheifets et al., 2005; Hansson Mild et al., 2006).

There are several reasons to be concerned. Animal studies have shown that *in utero* RF-EMF exposure from mobile phones affects fetal programming and leads to alteration in neurodevelopment and behavior of offspring (Aldad et al., 2012; Zhang et al., 2015). Exposure of young rats to non-thermal intensities impairs learning and spatial memory secondary to a deleterious impact of EMFs on hippocampal, pyramidal or cortical neurons. Similar detrimental cognitive and behavioural defects were also observed in adult animals exposed to low-intensity.

EMFs (Bas et al., 2009; Deshmukh et al., 2015; Kumari et al., 2017; Shahin et al., 2017). The exposure induces markers of oxidative stress and inflammation in the brain (Dasdag et al., 2012; Megha et al., 2015).

There are human data consistent with these animal studies. Divan et al. (2008) reported that prenatal and to a lesser degree postnatal exposure to cell phones is associated with emotional and hyperactivity problems in 7-year old children. This finding was confirmed in a second replicative study involving different participants (Divan et al., 2012). Birks et al. (2017) used data from studies in five cohorts from five different countries (83,884 children) and concluded that maternal mobile phone use during pregnancy increased the risk that the child will show hyperactivity and inattention problems. A meta-analysis involving 125,198 children (mean age 14.5 years) reported statistically significant associations between access to and use of portable screen-based media devices (e.g. mobile phones and tablets) and inadequate sleep quality and quantity and excessive daytime sleepiness (Carter et al., 2016). Early life exposure to lead has long been known to cause a reduction in cognitive function and shortened attention span (Needleman et al., 1979). Two studies have shown that prenatal (Choi et al., 2017) or postnatal (Byun et al., 2017) mobile phone exposure results in greater neurobehavioral effects in children with elevated lead levels than those seen with elevated lead alone. These results raise concern that EMFs may have synergistic actions with other environmental contaminants known to cause a reduction in intelligence quotient (IQ) and attention, such as polychlorinated biphenyls, methyl mercury, environmental tobacco smoke and probably others (Carpenter, 2006).

Finally the problem should be considered at the societal, worldwide level. Many adolescents (Lenhart, 2015) and even very young children and infants (Kabali et al., 2015) use cordless devices immoderately, to such a point that the common intensive use of devices in children and adolescents has been ascribed as an addiction (Paz de la Puente and Balmori, 2007; Roberts et al., 2014).

The specific absorption rate (SAR)-based ICNIRP safety limits were established on the basis of simulation of EMF energy absorption using standardized adult male phantoms, and designed to protect people only from the thermal effects of EMFs. These assumptions are not valid for two reasons. Not only do they fail to consider the specific morphological and bioclinical vulnerabilities of children, but also they ignore the effects known to occur at non-thermal intensities. The same criticisms apply to other so called “independent” advisory groups or agencies, such as the Advisory Group of Non-Ionizing Radiation in the UK (AGNIR, 2012), the French Agency for Food, Environmental and Occupational Health & Safety in France (ANSES, 2013), and the Scientific Committee on Emerging Newly Identified Health Risk (SCENIHR, 2009), all of whom deny the detrimental health effects of low intensity, non thermal EMF exposure and make recommendations based only on thermal SAR considerations.

Although several scientific authorities, such as the US American Academy of Pediatrics (AAP, 2013), and the Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP, 2011) have made specific recommendations to not allow the use of mobile phones by children and to limit their use by adolescents, unfortunately these age categories remain a target for marketing of mobile phone devices [<http://www.who.int/peh-emf/project/mapnatreps/RUSSIA%20report%202008.pdf>]. The RNCNIRP has warned that if no rational, health-based safety limits are adopted for children and adolescents and no measures are taken to limit the use of cordless devices, we can expect disruption of memory, decreases in learning and cognitive capabilities, increases in irritability, sleep disturbance, and loss of stress adaptation in this population. There will also be long-term effects, including an increase in brain cancer, infertility, EHS, Alzheimer disease and other neurodegenerative diseases (RNCNIRP, 2011; Markov and Grigoriev, 2015). National and international bodies, particularly the WHO, will bear major responsibility for failing to provide specific science-based guidance and recommendations so as to avoid such global health threats.

5. Electrohypersensitivity, microwave illness or idiopathic environmental intolerance attributed to electromagnetic fields

There is a segment of the human population that is unusually intolerant to EMFs. The term “electromagnetic hypersensitivity” or “electrohypersensitivity (EHS)” to describe the clinical conditions in these patients was first used in a report prepared by a European group of experts for the European Commission (Bergqvist et al., 1997). Santini et al. (2001, 2003) reported similar symptoms occurring in users of digital cellular phones and among people living near mobile phone base stations.

In 2004, because of the seemingly increasing worldwide prevalence, WHO organized an international scientific workshop in Prague in order to define and characterize EHS. Although not acknowledging EHS as being caused by EMF exposure, the Prague working group report clearly defined EHS as “a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic or electromagnetic fields” (www.who.int/pehemf/EHS_Proceedings_June2006.pdf). Following this meeting, WHO acknowledged EHS as an adverse health condition (WHO, 2005).

According to the Prague Workshop recommendations, it was proposed to use the term “idiopathic environmental intolerance (IEI) attributed to electromagnetic fields” (IEI-EMF) because of the lack of a proven causal link with EMF exposure (Hansson Mild et al., 2006). This pathological disorder is identical to what has been previously described under the term “microwave illness” (Carpenter, 2015).

This syndrome is characterized by fatigue, chronic pain and impaired cognitive function (see the Paris appeal, <http://appel-de-paris.com/?lang=en>). The precise mechanism(s) whereby environmental exposure to either ELF- or RF-EMFs can cause the development of this syndrome are still uncertain. However several lines of experimental and clinical data are sufficiently strong so as to indicate that ELF-EMFs and RF-EMFs exposure is associated with adverse biological and clinical health effects in humans as well as animals (Rea et al., 1991; McCarty et al., 2011; Belpomme et al., 2015; Hedendahl et al., 2015; Irigaray et al., 2018a). The prevalence of EHS has been estimated to range 1–10% in developed countries (Hallberg and Oberfeld, 2006) but appears today to be around 3% (Huang et al., 2018).

Since WHO official reports on mobile phone exposure and public health (WHO, 2014) and more particularly on EHS (WHO, 2005), much clinical and biological progress has been made to identify and objectively characterize EHS, as was summarized during the international scientific consensus meeting of the 5th Paris Appeal Congress that took place in May 2015 in Brussels at the Royal Belgium Academy of Medicine (ISD, 2015). EHS has many characteristics in common with other IEI pathological disorders, including chronic fatigue syndrome, fibromyalgia, Gulf War Illness and especially the syndrome of multiple chemical sensitivity (MCS), which Belpomme et al. (2015) have shown to be associated with EHS in many patients who report being electrohypersensitive.

5.1. Bioclinical identification and characterisation of electrohypersensitivity

In a prospective study involving systematic face-to-face questionnaire-based interviews and clinical physical examinations of nearly two thousand patients who self-reported having EHS or EHS and MCS, Belpomme and colleagues reported that EHS is a well-defined clinico-biological entity, characterized by the progressive occurrence of neurologic symptoms, including headache, tinnitus, hyperacusis, superficial and/or deep sensibility abnormalities, fibromyalgia, vegetative nerve dysfunction and reduced cognitive capability. These symptoms are repeatedly reported by the patients to occur each time they are exposed to EMFs, even of weak intensity. They result in chronic insomnia, fatigue, emotional lability and depressive tendency (Belpomme et al., 2015; Irigaray et al., 2018b).

Table 4 presents the detailed symptomatic picture which was obtained during face-to-face interviews with subjects with EHS in comparison to those with both EHS and MCS and to a series of apparently healthy control subjects that showed no evidence of EHS and/or MCS. As shown in the Table, the symptoms reported are consistent with those in other published questionnaire-based studies of EHS patients (Dodge, 1970; Johansson et al., 2010; Nordin et al., 2014; Medeiros and Sanchez, 2016; Rösli, 2008). The clinical symptoms observed in EHS or EHS/MCS patients are statistically significantly much more frequent than those in apparently normal controls. Although many of these symptoms are non-specific, the general clinical picture resulting from their association and frequency strongly suggests that EHS can be recognized and identified as a specific neurological disorder.

Because of the multiple and relatively common symptoms and the lack of recognized objective diagnosis criteria, studies on EHS

were left with only the patient's self-reported interpretation for many years. As a result, EHS has unfortunately been considered to be a psychiatric disease of unknown origin. This helps explain why most mainstream public health and societal bodies claim there is not sufficient data proving that the clinical symptoms experienced and reported by EHS patients are caused by EMF exposure. Therefore they refuse to acknowledge EHS as a true neuropathological disorder. This negative point of view was supported by some blind or double blind studies showing that most individuals who report they suffer from EHS were not able to identify when they were exposed to either EMFs or sham controls (Rubin et al., 2011; Eltiti et al., 2015). However other studies have found that EHS subjects can identify EMF exposure in a statistically significant manner when they are blinded to whether or not the exposure was on (Rea et al., 1991; McCarty et al., 2011).

To account for these seemingly negative results a nocebo effect was suggested (ANSES, 2017). However there is presently no consensus on a biological mechanism through which a nocebo effect could occur (Medeiros and Sanchez, 2016; Chrousos and Gold, 1992; Jakovljevic, 2014). Moreover, results obtained in a carefully designed psycho-clinical study in self-reporting EHS patients are not consistent with an initial nocebo response to perceived EMF exposure, even though it is plausible that after the onset of the disease such phenomena may intervene secondarily through an acquired learning and conditioning process (Dieudonné, 2016). In addition, a meta-analysis of cross sectional studies has documented a 38% greater risk of development of headaches among mobile phone users than non-users, and an increasing risk of headache with longer daily call duration (Wang et al., 2017).

Belpomme, Irigaray and colleagues recently identified several biomarkers in EHS and/or MCS patients which allow physicians to identify and objectively characterize EHS as a true somatic pathological disorder, discounting the hypothesis of a causal psychosomatic or nocebo-related process. These came in part from a prospective clinical and biological analysis of a series of several hundred consecutive cases of individuals who self-reported that they suffered from EHS or both EHS and MCS (Belpomme et al., 2015) and more recently from the prospective analysis of an additional series of EHS patients (Irigaray et al., 2018a). Table 5 summarizes the different biomarkers that have been measured in the peripheral blood of these patients and the results which have been obtained based on the EHS and EHS/MCS patient groups. Note that among the different markers, the 6-hydroxymelatonin sulfate/creatinine ratio in urine appears to be the best marker to be used in medical practice since it has been found to be decreased in all cases evaluated to date (Belpomme et al., 2015).

By measuring different major oxidative stress-related biomarkers, such as thiobarbituric acid reactive substances (TBARS), oxidized glutathione (GSSG) and nitrotyrosine (NTT) in EHS patients, Irigaray et al. (2018b) have recently shown that near 80% of the EHS patients present with detectable oxidative stress biomarkers (Fig. 1). More than 40% of EHS patients present with at least one positive biomarker, 20% with two and 15% will all three of the biomarkers investigated. This indicates that in addition to the inflammation-related biomarkers previously associated with EHS, EHS patients are also characterized by exhibiting biomarkers of oxidative stress (Belpomme et al., 2015; Irigaray et al., 2018a,b).

The significance of the different biomarkers measured in the peripheral blood of EHS and EHS/MCS patients is that these results imply that these patients present with some degree of oxidative/nitrosative stress, inflammation and autoimmune response. Increased levels of several of these markers (notably protein S100B and NTT) may reflect hypoxia-associated oxidative stress-induced blood brain barrier (BBB) opening. It has been previously hypothesized that opening of the BBB can be caused by environmental

Table 4
Clinical symptom occurrence in EHS and EHS/MCS patients in comparison with normal controls^a.

	EHS	EHS/MCS	p ^b	Normal controls	p ^c	p ^d
Headache	88%	96%	0.065	0%	<0.0001	<0.0001
Dysesthesia	82%	96%	0.002	0%	<0.0001	<0.0001
Myalgia	48%	76%	<0.0001	6%	<0.0001	<0.0001
Arthralgia	30%	56%	<0.001	18%	0.067	<0.0001
Ear heat/otalgia	70%	90%	<0.001	0%	<0.0001	<0.0001
Tinnitus	60%	88%	<0.0001	6%	<0.0001	<0.0001
Hyperacusis	40%	52%	0.118	6%	<0.0001	<0.0001
Dizziness	70%	68%	0.878	0%	<0.0001	<0.0001
Balance disorder	42%	52%	0.202	0%	<0.0001	<0.0001
Concentration/Attention deficiency	76%	88%	0.041	0%	<0.0001	<0.0001
Loss of immediate memory	70%	84%	0.028	6%	<0.0001	<0.0001
Confusion	8%	20%	0.023	0%	0.007	<0.0001
Fatigue	88%	94%	0.216	12%	<0.0001	<0.0001
Insomnia	74%	92%	0.001	6%	<0.0001	<0.0001
Depression tendency	60%	76%	0.022	0%	<0.0001	<0.0001
Suicidal ideation	20%	40%	0.003	0%	<0.0001	<0.0001
Transitory cardiovascular abnormalities	50%	56%	0.479	0%	<0.0001	<0.0001
Occular deficiency	48%	56%	0.322	0%	<0.0001	<0.0001
Anxiety/Panic	38%	28%	0.176	0%	<0.0001	<0.0001
Emotivity	20%	20%	1	12%	0.176	0.176
Irritability	24%	24%	1	6%	<0.001	<0.001
Skin lesions	16%	45%	<0.0001	0%	<0.0001	<0.0001
Global body dysthermia	14%	8%	0.258	0%	<0.0001	<0.007

^a This data results from the clinical analysis of the 100 first clinically evaluated cases issued from the already published series of EHS and/or MCS patients who have been investigated for biological markers [Belpomme et al., 2015]. It has been compared symptomatically with data obtained from a series of 50 apparently normal subjects matched for age and sex, used as controls.

^b Significance levels (p values) obtained for comparison between the EHS and EHS/MCS groups.

^c Significance levels (p values) obtained for comparison between the EHS and normal control groups.

^d Significance levels (p values) obtained for comparison between the EHS/MCS and normal control groups.

Table 5

Patient mean values and standard deviations of biomarker levels in comparison with normal reference values as well as the percentage of patients with abnormal values in the peripheral blood in subjects with EHS or both EHS and MCS (Belpomme et al., 2015).

Biomarker and Normal reference values	Patients groups			
	EHS Mean \pm SD % Above normal		EHS/MCS Mean \pm SD % Above Normal ^a	
hs-CRP < 3 mg/l	10.3 \pm 1.9	15%	6.9 \pm 1.7	14.3%
Vitamine D > 30 ng/ml	20.6 \pm 0.5	69.3%	14.5 \pm 1.3	70.1%
Histamine < 10 nmol/l	13.6 \pm 0.2	37%	13.6 \pm 0.4	41.5%
IgE < 100 UI/ml	329.5 \pm 43.9	22%	385 \pm 70	24.7%
S100B < 0.105 μ g/l	0.20 \pm 0.03	14.7%	0.17 \pm 0.03	19.7%
Hsp 70 < 5 ng/ml	8.2 \pm 0.2	18.7%	8 \pm 0.3	25.4%
Hsp 27 < 5 ng/ml	7.3 \pm 0.2	25.8%	7.2 \pm 0.3	31.8%
Anti-O-myelin auto-antibodies ^b	Positive	22.9%	Positive	23.6%
24-h urine 6-OHMS/creatinine ratio >0.8 ^c	0.042 \pm 0.003	100%	0.048 \pm 0.006	100%

hs-CRP, high-sensitivity C-reactive protein; IgE, Immunoglobulin E; S100B, S 100 calcium binding protein B; Hsp 27, heat shock protein 27; Hsp 70, heat shock protein 70; anti-O-myelin auto-antibodies, auto-antibodies against O-myelin; 6-OHMS, 6-hydroxymelatonin sulfate.

^a There is no statistically significant difference between the two groups of patients for the different biomarkers analyzed, suggesting that EHS and MCS share a common pathological mechanism for genesis.

^b Qualitative test.

^c Data restricted to those not on neuroleptic medication as the simultaneous use of several psychotherapeutic drugs may also be associated with a decrease of this 24-h urine ratio by modifying melatonin metabolism.

stressors, be they chemicals or EMFs. This may have occurred in these patients, as has been shown to occur in several (but not all) animal experiments involving EMF exposure (Oscar and Hawkins, 1977; Persson et al., 1997; Eberhardt et al., 2008; Sirav and Seyhan, 2009). Comparable data using metabolic and genetic biomarkers were also obtained in another large series of EHS patients (De Luca et al., 2014). Overall these data indicate that the clinical use of biomarkers allows the objective characterisation and identification of EHS and MCS as two etiopathologic facets of a unique

pathological disorder, and also allows insight into the genesis of these two diseases.

The development of new imaging techniques has also greatly increased our ability to objectively characterize EHS and MCS. Using ultrasonic cerebral tomography (UCTS) (Parini et al., 1984), EHS- and EHS/MCS-patients were found to have a statistically significant decrease in mean pulsometric index in several middle cerebral artery-dependant portions of the temporal lobes, especially in the capsulo-thalamic area, which is part of the limbic

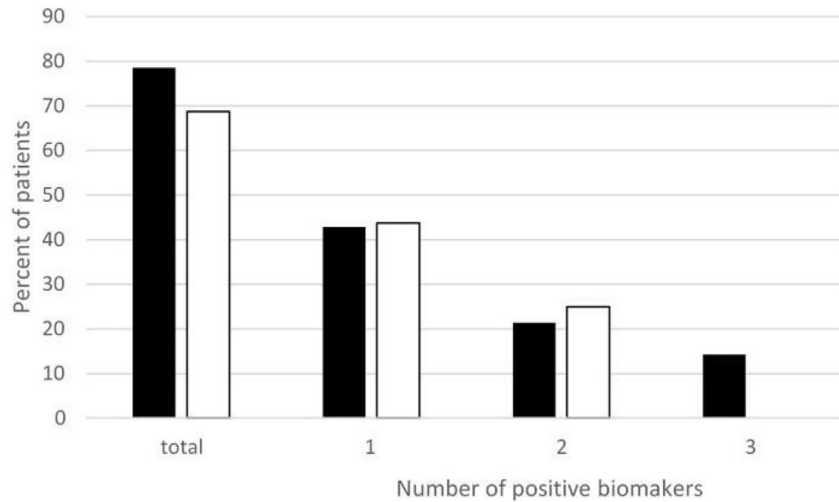


Fig. 1. Percentage of EHS self-reporting patients having positive TBARS, GSSG and/or NTT oxidative stress biomarkers measured in the peripheral blood. “Positive” biomarkers correspond to marker levels above the upper normal limit; “total” corresponds to the patients with one or more positive biomarker levels. Black bars show the percentage of patients with one, two or all three of the biomarkers for TBARS, GSSG and NTT. The white bars show the percentage of patients with either TBARS or GSSG or both oxidative stress markers.

system and the thalamus. This suggests that EHS and EHS/MCS may be associated with a brain blood flow (BBF) deficiency and/or neuronal dysfunction in these brain structures (Belpomme et al., 2015; Irigaray et al., 2018a,b). Irigaray et al. (2018c) have recently confirmed that UCTS is the best imaging technique to diagnose EHS and to follow patients treated for EHS and/or MCS.

In addition, using positron emission tomography (PET) it has been shown that short term exposure to pulse-modulated RF-EMF causally affects regional BBF in normal subjects using a mobile phone (Aalto et al., 2006; Huber et al., 2005), a finding that may account for the modifications observed in the sleep and waking EEG (Huber et al., 2002). By use of functional MRI (fMRI) in EHS patients exposed chronically to ELF-EMFs, regional BBF changes have been reported in the frontal lobes, such as abnormal default mode network and more particularly a decrease in BBF and cerebral metabolism. These observations indicate that fMRI may also be a tool for diagnosis of EHS and clinical follow up of patients (Heuser and Heuser, 2017). A decreased BBF-associated pulsometric index decrease in both hemispheres was also recently observed by the Belpomme group by using transcranial Doppler ultrasound (TDU) (Purlaustja and Sorond, 2012) applied to the middle cerebral artery in a study involving 120 EHS and/or MCS patients. This study revealed a decrease in pulsatility index and an increase in diastolic flow velocity in 70% of the 120 cases investigated to date.

In summary it is the strong opinion of the authors that there is presently sufficient clinical, biological and radiological data emanating from different independent international scientific research groups for EHS, whatever its causal origin, to be acknowledged as a well-defined, objectively characterized pathological disorder. As a result, patients who self-report that they suffer from EHS should be diagnosed and treated utilizing presently available objective biological tests, among which are the concentration of peripheral blood biomarkers and the use of imaging techniques such as PET, fMRI and TDU and, when available, UCTS. Whatever its etiological origin and mechanism of action, EHS should be acknowledged by the WHO as a real and distinct neurological and pathological disorder (McCarty et al., 2011; Hedendahl et al., 2015) and thus be included in the International Classification of Diseases.

5.2. Possible etiopathogenic processes involved in genesis of electrohypersensitivity

EMFs, both RF-EMFs at non-thermal intensities and ELF-EMFs, have been found to cause persistent adverse biological effects in microorganisms (Fojt et al., 2004), plants (Roux et al., 2008; Maffei, 2014), birds (Balmori, 2005; Balmori and Hallberg, 2007; Frey, 1993), and mammals. Therefore the effects observed in humans cannot be due to only a placebo or psychosomatic effect. These biological effects may be due both to the pulsed and polarised characteristics of man-made EMFs emitted by electric or wireless technologies as opposed to the terrestrial non-polarised and continuously emitted natural EMFs (Blackman, 2009; Belyaev, 2015; Panagopoulos et al., 2015).

The inflammatory and oxidative/nitrosative states that have been documented in EHS patients are remarkable since they confirm the data obtained experimentally in animals exposed to non-thermal EMFs (Esmekaya et al., 2011; Burlaka et al., 2013), and especially in the brain (Megha et al., 2015; Kesari et al., 2011). The limbic system-associated capsulo-thalamic abnormalities that the Belpomme group has observed by using UCTS in EHS and/or MCS patients (Belpomme et al., 2015; Irigaray et al., 2018a,c) may likely correspond to the hippocampal neuronal alterations caused by EMF exposure in the rats (Bas et al., 2009; Furtado-Filho et al., 2015; Deshmukh et al., 2013). Fig. 2 summarizes our hypothesis regarding the inflammation and oxidative stress-related mechanisms which may account for EMF- and/or chemically-related health effects in the brain and consequently for EHS genesis.

6. Mechanisms whereby low intensity electromagnetic fields cause biological effects and harm

Arguments used in the past to attempt to discount the evidence showing deleterious health effects of ELF-EMFs and RF-EMF exposure at non-thermal SAR levels were based on the difficulties encountered in understanding the underlying biological effects and the lack of recognized basic molecular mechanisms accounting for these effects. This is no longer the case. There are a number of well-documented effects of low intensity EMFs that are the mechanistic basis behind the biological effects documented above (www.who.int).

bioinitiative.org). These include induction of oxidative stress, DNA damage, epigenetic changes, altered gene expression and induction including inhibition of DNA repair and changes in intracellular calcium metabolism. Both low-intensity ELF-EMF and non-thermal RF-EMF effects depend on a number of physical parameters and biological variables and physical parameters, which account for the variation in health outcomes (Belyaev, 2015; Belyaev et al., 1999). Importantly, the most severe health effects are observed with prolonged chronic exposures even when intensities are very low (Belyaev, 2017). The physics of non-equilibrium and non-linear systems and quantum mechanics are at least in part the basis of the physical mechanisms responsible for the non-thermal molecular and biological effects of non-thermal EMF radiation (Belyaev, 2015), although a detailed report on these actions is beyond the scope of this review.

Lower RF-EMF intensity is not necessarily less bioactive or less harmful. Non-thermal EMF effects can be observed at intensities which are very close to ordinary background levels and quite similar to intensities emitted by mobile phone base stations. There are time windows for observation of non-thermal EMF effects which may be dependent upon the endpoint measured, the cell type and the duration and power density of exposure. Non-thermal RF-EMF effects are affected by static magnetic fields and electromagnetic stray fields, which result in the variation of non-thermal EMF effects from mobile phones because of adjacent electrical appliances, power lines and other sources of ELF and static magnetic fields, including changes in the geomagnetic field (Gapeev et al., 1999a and b).

Cell-to-cell interactions potentiate the response to non-thermal EMFs (Belyaev et al., 1996). Biological responses to EMFs have been shown to be influenced by sex and age (Zhang et al., 2015; Sirav and Seyhan, 2016). Physiological parameters such as the stage of cell growth, oxygen, divalent ions and temperature are important

variables affecting cellular responses to EMFs (Liburdy and Vanek, 1987; Sannino et al., 2011).

6.1. Combined exposures

EMFs at non-thermal intensities may interfere with other environmental stressors, showing an interplay of molecular pathways and resulting in either beneficial or detrimental health effects, depending on the nature and conditions of co-exposures (Novoselova et al., 2017; Ji et al., 2016). One example is the demonstration that RF-EMF exposure modulates the DNA damage and repair induced by ionizing radiation (Belyaev et al., 1993). Another example is the synergistic of exposure to lead and EMFs on cognitive function in children described above (Choi et al., 2017; Byun et al., 2017). These co-exposure factors should be considered when assessment of detrimental effects, including carcinogenicity, is performed.

Not all of the effects of EMFs on the nervous system and other organs are necessarily harmful. The best example of a positive effect is the well-documented and clinically useful benefit of applied magnetic fields to promote bone healing (Bassett, 1994). Both ELF-EMF (Zhang et al., 2015) and RF-EMF (Arendash et al., 2010) have been reported to slow cognitive decline in rodent models of Alzheimer's disease. Some human studies report a facilitating effects of cognitive performance (Lee et al., 2001) while Koivisto et al. (2000) reported an increase in response time and vigilance tasks but a decrease in mental arithmetic tasks. These studies clearly show that EMFs have biological effects at non-thermal intensities, but suggest that not all biological effects are necessarily harmful.

6.2. Duration of exposure and dose intensity

Such parameters as power density, dose, and duration of exposure have been analyzed for development of reliable safety standards, which would protect against the detrimental health effects of chronic exposure to RF-EMFs at non-thermal intensities. Some studies show no effect under fixed short-term exposures, but this does not imply that there are no effects from longer-term exposures (Choi et al., 2014). Exposure in studies showing RF-EMF effects was on average twice the duration as those with no significant effects (Cucurachi et al., 2013). The response to non-thermal EMFs depends on both power density and duration of exposure. Importantly, the same response is observed with lower power density but prolonged exposure as at higher power density and shorter exposure (Nordenson et al., 1994). While SAR is a good surrogate for thermal RF effects from acute exposures, many studies have shown that SAR should be either replaced by "dose-specific absorption" or power density complimented by duration of exposure for description of non-thermal RF effects (Belyaev, 2015). Recent studies have provided more evidence for the greater importance of dose and duration of exposure than SAR alone for biological and health effects from long-term exposures to non-thermal RF-EMFs (Furtado-Filho et al., 2015).

6.3. Oxidative stress

Non-ionizing radiation does not have sufficient energy to directly break chemical bonds, and therefore the DNA damage that occurs with non-ionizing EMF exposures is primarily a consequence of generation of reactive oxygen species (ROS), resulting in oxidative stress. There are numerous animal experiments which clearly demonstrate that non thermal EMFs can cause oxidative stress (Esmekaya et al., 2011; Burlaka et al., 2013), particularly in the brain (Shahin et al., 2017; Dasdag et al., 2012; Megha et al., 2015; Furtado-Filho et al., 2015). Oxidative stress is known to

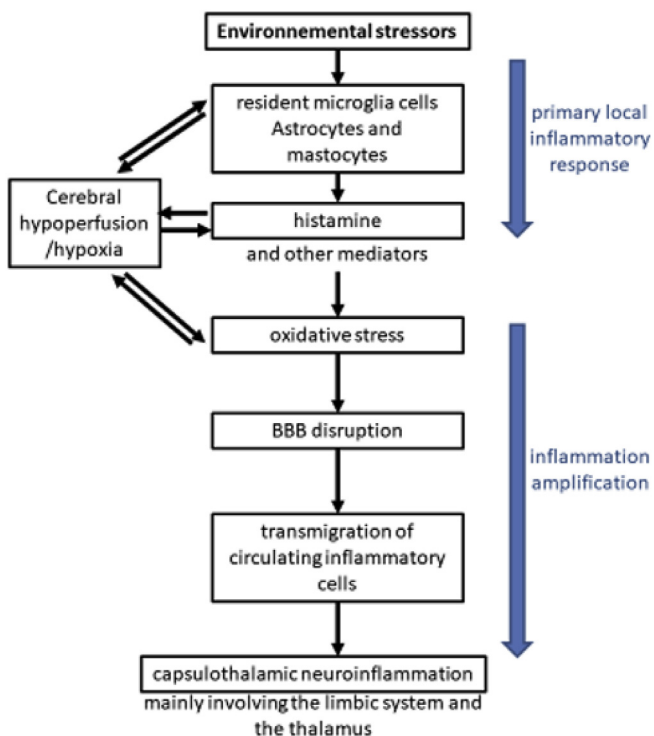


Fig. 2. Hypothetical EHS/MCS common etiopathogenic model based on neuro-inflammation and oxidative/nitrosative stress-induced blood brain barrier disruption (Belpomme et al., 2015).

play a central role in development of cancer and aging and serves as a signaling agent in the inflammatory response (Holmstrom and Finkel, 2014).

The brain is a particularly important organ for sensitivity to EMFs. Brain cancer resulting from EMF exposures is a serious concern, and EHS is a disease of the central nervous system. Several mechanisms at the cellular and molecular levels have been reported that may be the basis of these non-thermal RF-EMF effects on brain function. ELF- and/or RF-EMF exposure at embryonic or early postnatal stages can alter *in vivo* synaptic efficacy and plasticity of neurons (Balassa et al., 2014), a finding which was further supported by *in vitro* studies showing a significant decrease in the differentiation of neural stem cells into neurons (Eghlidospour et al., 2017), the alteration of transcript levels of neuronal differentiation-related genes and impairment of neurite outgrowth of embryonic neural stem cells exposed to ELF- or RF-EMFs (Ma et al., 2014). These observations support the conclusion that low-intensity but prolonged exposure to non-thermal EMFs may have adverse effects on neurogenesis during development and indicate how important it is to protect the fetus and young child from excessive exposure to all mobile devices.

Animal studies have documented that 900 MHz or 2.45 GHz non thermal RF-EMF exposure in rats, either short term or chronic, can trigger neuronal dysfunction and even apoptosis of hippocampal pyramidal cells (Bas et al., 2009; Shahin et al., 2017) and cerebellum Purkinje cells (Sonmez et al., 2010) through induction of oxidative stress. Exposure of pregnant dams elicited EMF oxidative stress-induced neuronal pathologic changes in offspring (Odaci et al., 2016). Such pathological changes could be due to ROS-induced opening of the BBB (Nordal and Wong, 2005) and/or to ROS-associated brain hypoxia caused by a decrease in EMF-induced BBF and/or EMF-induced hemoglobin deoxygenation (Mousavy et al., 2009; Muehsam et al., 2013). The resulting hypoxia may induce metabolic neuronal dysfunction as in the case of EHS patients (Belpomme et al., 2015) but also neuronal cell death by either apoptosis or necrosis as in the case of Alzheimer's disease and other forms of dementia (Bell and Zlokovic, 2009).

While some consider the laboratory data on EMFs as being inconsistent, showing either detrimental or no effects and on occasion even beneficial effects, the vast majority still show detrimental effects. For example Henry Lai in the Bioinitiative Report Research Summaries Update of November 2017, Chapter 6 on Genotoxic Effects, reported that i) of 46 studies on ELF genotoxicity with the comet assay as the end point, 34 studies (74%) showed detrimental effects, ii). Of 189 total studies on ELF and oxidative stress, 162 (87%) showed a positive correlation, and iii) of 200 studies on RF and free radicals, 180 (90%) showed detrimental effects. One reason for variability between laboratory studies is the strong dependence on low-threshold EMF effects on a number of physical and biological variables (Belyaev, 2010).

6.4. Genetic and epigenetic mechanisms

Genetic effects are the most direct cause for carcinogenicity. This is true both for genotoxic changes caused by exposure to EMFs and existing polymorphic genetic differences within a population that increase susceptibility to cancer. DNA can no longer be considered to be unaffected by environmental EMF levels, as many studies have shown that DNA can be activated and damaged by EMFs at levels that have been considered to be safe (Blank and Goodman, 1999).

The primary mechanism through which low-intensity EMFs can alter DNA is through ROS production. Lai and Singh (2004) first reported that a 2 h exposure of rats to 60 Hz EMFs at 0.1–0.5 mT resulted in DNA strand breaks in neurons, and provided evidence

that this effect was mediated by free radical formation and blocked by free radical scavengers. Vijayalaxmi and Prihoda (2009) in a meta-analysis of 87 publications found a biologically small but statistically significant difference between DNA damage in ELF-EMF-exposed somatic cells as compared to controls, and reported evidence for epigenetic changes for some outcomes. For ELF-EMFs this breakage effect was stronger when exposure was intermittent rather than continuous (Nordenson et al., 1994).

Yang et al. (2008) have reported an OR = 4.31 (95% CI = 1.54–12.08) for leukemia in children living within 100 m of a high voltage powerline if they had a certain polymorphism of a DNA repair gene.

Exposure to RF-EMFs can also induce DNA damage under specific conditions (Markova et al., 2005). Tice et al. (2002) and Vijayalaxmi et al. (2013) reported DNA damage and micronuclei formation in cultured human leukocytes and lymphocytes upon exposure to RF-EMF signals of at least 5 W/kg. Not all cell types showed similar responses. Schwartz et al. (2008) reported micronucleus changes in fibroblasts but not lymphocytes exposed to 1950 MHz EMFs. Kesari et al. (2014) also demonstrated DNA strand breaks in the brains of rats exposed for 2 h per day for 60 days to a 3G mobile phone. Changes in DNA secondary structure (Semin, 1995; Diem et al., 2005) and chromosome instability (Mashevich, 2003) have been observed upon exposure to RF-EMFs emitted by mobile phones.

Epigenetic changes, rather than genetic changes in DNA, may underlie many or even most of the biological effects of non-thermal EMFs (Sage and Burgio, 2017). Non-thermal EMFs are epigenetic stressors which can alter gene expression by acting through physical or biochemical processes and be reflected as chromatin remodeling (Belyaev et al., 1997), histone modification (Wei et al., 1990) or altered microRNA (Dasdag et al., 2015) at intensities far below those that cause measureable tissue heating.

Chromatin plays a key regulatory role in controlling gene expression and, more particularly, the access of transcription factors to DNA. It has been shown that extremely low intensity RF-EMF exposure, i.e. at intensities comparable to that of mobile phone and towers, results in changes in chromatin conformation and gene expression (Belyaev et al., 1997; Belyaev and Kravchenko, 1994; Belyaev et al., 2006; Belyaev et al., 2009). In a large number of cells and tissues, compaction of chromatin in specific loci may lead to gene silencing, loss of histone regulatory effects and DNA repair capacity (Wei et al., 1990). Belyaev and collaborators (Markova et al., 2005; Belyaev et al., 2009) have shown that exposure to RF-EMFs emitted by GSM mobile phone alters chromatin conformation in human lymphocytes and inhibits formation of p53-binding protein 1 (53BP1) and phosphorylated histone H2AX (γ -H2AX) DNA repair foci.

EMFs in both the ELF and RF ranges may epigenetically affect DNA by inducing the expression of stress response genes and consequently the synthesis of chaperone stress proteins (Blank and Goodman, 2011a and b). A specific gene sequence has been identified that acts as a sort of antenna, specifically sensitive and responsive to EMFs (Blank and Goodman, 2011b). This is a gene sequence coding for HSP70, a protein belonging to a family of conserved, ubiquitously expressed "heat shock proteins" that sense danger signals and protect cells from the most disparate stress conditions. This is an unambiguous demonstration that EMF exposure even at non-tissue heating intensities has the potential to be harmful to cells and organisms. The HSP70 promoter contains different DNA regions that are specifically sensitive to diverse stressors, thermal and non-thermal. The EMFs are specifically perceived by the sequences sensitive to non-thermal stimuli. During the process of HSP70-response induction, EMFs can activate directly the HSP70 gene promoter (Rodríguez-De la Fuente et al.,

2010) which contains a magnetic field-responsive domain (Lin et al., 1999, 2001).

EMF-related HSP70 and HSP27 stress responses have been detected in the hippocampus of rats exposed to non-thermal EMFs (Yang et al., 2012). Shahin et al. (2017) reported that mice exposed to 2G mobile phones continuously for four months showed elevated ROS, lipid peroxidation, total nitrate and nitrite concentrations and malondialdehyde levels in homogenates of different tissues, and decreased levels of several antioxidant enzymes. These observations justify the use of these markers to characterize EHS in patients who report that they are sensitive to EMFs.

The EMF effects have been suggested to be mediated by the mitogen-activated protein kinase (MAPK) cascades, which is a central signaling transduction pathway which governs all stress-related cellular processes occurring in response to extracellular stimuli (Friedman et al., 2007). It has been shown that long term exposure of cells to mobile phone frequencies or to ELF-EMFs (Goodman et al., 2009) activates the extracellular-signal regulated kinase (ERK), which is one of the four MAPK cascades so far identified.

Non-thermal RF-EMFs may also alter expression of other genes. As long ago as Byus et al., 1988 showed that 450 MHz RF increased ornithine decarboxylase activity in hepatoma cells. Markova et al. (2005) exposed human fibroblasts and mesenchymal stem cells to mobile phone RF-EMFs with analysis of tumor suppressor p53 binding protein 1. Formation of 53BP1 foci was inhibited in both cells types, but the stem cells always showed a greater response. Fragopoulou et al. (2011) exposed mice to either a typical mobile phone or a wireless DECT base station and analyzed the brain proteome. They found significant alteration in 143 specific proteins (ranging from a 0.003 fold downregulation to up to a 114-fold overexpression.) Luo et al. (2013) exposed pregnant women undergoing a first trimester abortion to a mobile phone applied to the abdomen and performed a proteomic analysis of placental villous tissue. They report 15 proteins which were significantly altered by at least 2- to 2.5-fold in exposed women as compared to control women. Twelve of these proteins were identified. Yan et al. (2008) exposed rats to mobile phones 6 h per day for 126 days, and found upregulation of specific mRNAs that regulated several proteins, including calcium ATPase, neural cell adhesion molecule, neural growth factor and vascular endothelial growth factor. EMFs at non thermal levels may not only alter the expression of many proteins but also may directly affect protein conformation (Fragopoulou et al., 2011; Bohr and Bohr, 2013; Beyer et al., 2013) and modify enzyme activity (Vojisavljevic et al., 2010), so altering the regulating capacity of the epigenome. These are epigenetic, not genetic, effects (Sage and Burgio, 2017).

Non-thermal EMF exposure can epigenetically interfere with the differentiation and proliferation programs of stem cells in fetal and adult tissues through ROS production (Wolf et al., 2007; Falone et al., 2007; Ayşe et al., 2010; Park et al., 2014). Stem cells are the most sensitive cells to EMF exposure (Eghlidospour et al., 2017; Markova et al., 2010) and this is particularly the case for neural stem cells of the hippocampus (Leone et al., 2014).

The endogenous natural ionic currents and electrical fields in the human body (Jaffe and Nuccitelli, 1977) are vulnerable to the oscillatory properties of non-thermal EMFs. These consequently may cause detrimental effect on cell differentiation and proliferation in adult tissues (Levin, 2003) in addition to the effects on cell differentiation, proliferation and migration in the fetus (Wolf et al., 2007; Ayşe et al., 2010; Leone et al., 2014). Fetal programming cannot be reduced to only genetic programs. Developmental processes are essentially epigenetic (Leone et al., 2014), and exposure to epigenetic stressors such as non-thermal EMFs are much more dangerous for the fetus than for the adults.

6.5. Calcium regulation

There has long been evidence that EMFs alter several aspects of calcium function. This is important because calcium regulates many different aspects of cell function. Bawin and Adey (1976) reported that very weak ELF-EMFs trigger efflux of calcium from isolated chick brain, although the implications of this observation were not clear. Later they reported a similar action of RF-EMFs (Adey et al., 1982). Pulsed low-frequency EMFs promote bone healing and promote calcium uptake into bone (Spadaro and Bergstrom, 2002) and osteoblasts (Zhang et al., 2010). 50 Hz EMFs increase the number of voltage-gated calcium channels in neuroendocrine cells (Grasso et al., 2004) and presynaptic nerve cell terminals (Sun et al., 2016). Wei et al. (2015) found that ELF-EMFs also altered the frequency of calcium transients in cardiomyocytes and decreased calcium concentrations in sarcoplasmic reticulum. These changes in calcium in heart muscle may be the basis for the cardiovascular effects reported in humans on exposure to EMFs (Havas, 2013). In spite of numerous studies reporting altered calcium metabolism upon exposure to both ELF- and RF-EMFs, the overall implications of these effects are still not clear. However, some have suggested (Ledoigt and Belpomme, 2013) that calcium activation of proteins could be the initial event that results in altered protein configuration, leading to generation of ROS and ultimately activating the molecular pathways to cancer.

7. Public Health Implications of Human Exposure to EMFs

The incidence of brain cancer in children and adolescents has increased between 2000 and 2010 (Ostrom et al., 2015). Gliomas are increasing in the Netherlands (Ho et al., 2014), glioblastomas are increasing in Australia (Dobes et al., 2011) and England (Philips et al., 2018) and all brain cancers are increasing in Spain (Etxeberrua et al., 2015) and Sweden (Hardell and Carlberg, 2017). The latency period between initial exposure and clinical occurrence of brain cancer is not known but is estimated to be long. While not all reports of brain cancer rates show an increase, some do. The continually increasing exposure to EMFs from all sources may contribute to these increases. The prevalence of EHS is unknown, but various reports suggest that it is between 1 and 10% of the population (Hallberg and Oberfeld, 2006; Huang et al., 2018). Male fertility has been declining (Geoffroy-Siraudin et al., 2012; Levine et al., 2017). EMFs increase the risk of each of these diseases and others. Alzheimer's disease is increasing in many countries worldwide and its association with ELF-EMF occupational exposure has been clearly demonstrated through several independent epidemiological studies (Davanipour and Sobel, 2009; Sobel et al., 1996; Qiu et al., 2004) and a meta-analysis of these studies (García et al., 2008). A recent meta-analysis (Huss et al., 2018) has reported an increased risk of amyotrophic lateral sclerosis in workers occupationally exposure to ELF-EMFs.

Safety limits for RF exposure have been based (until today) on the thermal effects of EMFs. But these standards do not protect people, particularly children, from the deleterious health effects of non-thermal EMFs (Naziroglu et al., 2013; Mahmoudabadi et al., 2015). Each of these diseases is associated with decrements in health and quality of life. Brain cancer patients often die in spite of some improvement in treatment, while EHS patients present with increased levels of distress, inability to work, and progressive social withdrawal. The ability for humans to reproduce is fundamental for the maintenance of our species.

The scientific evidence for harm from EMFs is increasingly strong. We do not advocate going back to the age before electricity or wireless communication, but we deplore the present failure of public health international bodies to recognize the scientific data

showing the adverse effects of EMFs on human health. It is encouraging that some governments are taking action. France has removed WiFi from pre-schools and ordered Wi-Fi to be shut off in elementary schools when not in use (<http://www.telegraph.co.uk/news/2017/12/11/france-ipose-total-ban-mobile-phones-schools/>). The State of California Department of Public Health has issued a warning on use of mobile phones and offered advice on how to reduce exposure (State of California, 2017). There are many steps that are neither difficult nor expensive that can be taken to use modern technology but in a manner that significantly reduces threats to human health.

It is urgent that national and international bodies, particularly the WHO, take this significant public health hazard seriously and make appropriate recommendations for protective measures to reduce exposures. This is especially urgently needed for children and adolescents. It is also important that all parts of society, especially the medical community, educators, and the general public, become informed about the hazards associated with exposure to EMFs and of the steps that can be easily taken to reduce exposure and risk of associated disease.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.envpol.2018.07.019>.

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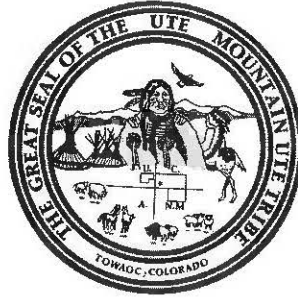
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RESOLUTION

UTE MOUNTAIN TRIBAL COUNCIL

REFERENCE: Opposition to the Proposal by United States National Nuclear Security Administration, Department of Energy to Establish a Strategic Uranium Reserve and Authorization to Submit Comments in Opposition

WHEREAS, the Constitution and By-Laws of the Ute Mountain Ute Tribe, approved June 6, 1940 and subsequently amended, provides in Article III that the governing body of the Ute Mountain Ute Tribe ("Tribe") is the Ute Mountain Ute Tribal Council and sets forth in Article V the powers of the Tribal Council exercised in this Resolution;

WHEREAS, the Tribal Council is responsible for protecting and promoting the best interests of the communities and the members of the Tribe and the resources of the Reservation;

WHEREAS, the White Mesa community sits three miles south of the White Mesa Mill owned and managed by Energy Fuels Resources (USA) which process radioactive waste materials, such as uranium, and has not only far exceeded the period of time for its operations, but has accepted and processed materials that were not a part of its original design and has gone beyond the purposes for which the Mill operates;

WHEREAS, the operations of the White Mesa Mill has had severe health impacts on the residents of White Mesa and should cease entirely;

WHEREAS, in the Consolidated Appropriations Act, 2021, \$75,000,000 is set aside for the Department of Energy for a Uranium Reserve Program;

WHEREAS, the Department of Energy, through the National Nuclear Security Administration, has published a Request for Information from the public and has set a deadline of September 10, 2021, to receive comments (See Fed.Reg. Vol. 86, No. 152 pp 44007 to 44009);

WHEREAS, the action taken by this Resolution is in the best interests of the Tribe.

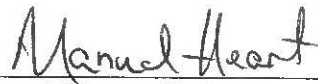
Resolution No. 2021-135

Re: Opposition to the Proposal by United States National Nuclear Security Administration, Department of Energy to Establish a Strategic Uranium Reserve and Authorization to Submit Comments in Opposition

NOW THEREFORE BE IT RESOLVED that the Tribal Council hereby opposes the creation of a Uranium Strategic Reserve and directs the Tribe's Justice Department and Environmental Programs Department to respond to the request for information by September 10, 2021; and

BE IT FINALLY RESOLVED that the Chairman of the Ute Mountain Ute Tribe is authorized to sign this Resolution and to take such further action as may be necessary to carry out the intent of this Resolution.

The foregoing Resolution was duly adopted this 24th day of August, 2021.



Manuel Heart, Chairman
Ute Mountain Ute Tribal Council

CERTIFICATION

This is to certify that there was a quorum of 6 Tribal Council Members present at the official meeting of the Ute Mountain Ute Tribal Council held on August 24, 2021, that 5 voted for this Resolution, that 0 opposed with 0 abstaining, and that this Resolution was, therefore, duly adopted.



Marilynn House, Council Secretary
Ute Mountain Ute Tribal Council

Resolution No. 2021-135

Re: Opposition to the Proposal by United States National Nuclear Security Administration, Department of Energy to Establish a Strategic Uranium Reserve and Authorization to Submit Comments in Opposition

Federal Court Instructs FCC to Review Electromagnetic Radiation Standards

By Barbara Koepfel

FOR 25 YEARS—THROUGH FIVE DEMOCRATIC AND Republican administrations—the Federal Communications Commission has refused to revise the regulations it set in 1996 that address what level of radiation from cell phones should be considered safe. Labeled radio-frequency radiation (RFR), these emissions are discharged from all wireless devices, Wi-Fi networks, and the thousands of towers stretched across the United States that transmit and receive the signals.

The FCC's power is promethean. It is the sole U.S. agency that determines the acceptable RFR exposure from wireless devices for people of all ages, wildlife, and the environment. And it insists its original 1996 limits are fine.

However, scientists who've reviewed hundreds of studies published over the last two decades claim the FCC ignores critical findings that show a "statistically significant" link between heavy cell phone use (10 or more years) and brain and thyroid tumors, especially on the side of the head where people hold their phones. Professional groups such as the American Academy of Pediatrics and the California Medical Association have asked the FCC to update its numbers.

The scientists and physicians worry that the FCC simply repeats the industry's line that all is well—which is particularly troubling since millions more people around the world are exposed each year. In the

United States, for example, only 44 million people had cell phones in 1996; today, the number has soared to about 300 million, and that doesn't include the tablets, watches, and other wireless products that increase RFR exposure exponentially.

Thus, in 2019, the Environmental Health Trust (EHT), Consumers for Safe Cell Phones, Children's Health Defense, and 11 other petitioners sued the FCC. They argued that although the U.S. Government Accountability Office told the FCC in 2013 to review its 1996 limits in light of new research, six years later, the FCC was still repeating its all-is-safe mantra. In a 2019 press release, the FCC said that "after a thorough review of the record, we find it appropriate to maintain the existing radiofrequency limits, which are among the most stringent in the world for cell phones."

At the least, this assurance is doubtful. The lawsuit against the FCC argues precisely the opposite: that the Commission

has *not* reviewed "the record." Also, researchers point out that countries such as Italy, Switzerland, France, Israel, China, India, and Russia have more stringent limits than the United States regarding the use of Wi-Fi in schools and day care centers, and on acceptable levels of radiation emissions from cell towers. In addition, some have banned all cell phone ads pitched to children.

The lawsuit notes that the FCC even ignored the landmark 10-year,

\$30 million National Toxicology Program study carried out under the National Institutes of Health—which produced unequivocal results in 2019. Having exposed rats and mice to cell phone radiation for two years, the NTP researchers reported "clear evidence of cancer in the male rats' heart cells, some evidence of increased brain gliomas (brain cancer), and adrenal gland tumors, DNA damage in the brains of male and female rats and mice, and lower birth weights of female rats' offspring."

Two years after the suit was filed, the U.S. Court of Appeals of the D.C. Circuit ruled in August 2021 that the FCC had to reexamine the research to determine if its regulations should be updated. Further, the court called the commission's behavior "arbitrary and capricious," since it had ignored evidence of the harm to children's brains (which are not fully developed) and to



Photo by BearFotos

ALSO INSIDE:

- 4 **Interest Rate Hikes**—The Editors
- 5 **Republican Tax Cuts**—Steven Pressman
- 6 **Turkish Elections**—Alexandra de Cramer
- 8 **Measures to Minimize RFR Exposure**

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male and female reproductive systems. It also ruled that because the FCC never produced regulations about radiofrequency radiation's effects on wildlife, it had "completely failed" to address the evidence of potential environmental harm.

However, the court did not set a date for the FCC to comply—which meant the commission could retain its old regulations indefinitely. Also, the court did not address the issue of whether RFR exposures cause cancer; instead it said the FCC had passed the "minimum legal requirement" to assure it had evaluated the research on cancer and radiation exposure. Thus, scientists are concerned that the FCC will again find ways to defer serious examination of the voluminous literature on the subject.

How could this be, given the NTP findings and other research? To bolster its no-cancer claims, the FCC points to a letter the U.S. Food and Drug Administration wrote the commission, which claimed the NTP results weren't relevant to humans since the study was done on rats and mice (although 10 years earlier, the FDA itself had approved the animal study).

Dr. Joel Moskowitz, director of the Center for Family and Community Health at the University of Cal-

[Dr. Joel Moskowitz:] "The FDA wrote a biased review of the research regarding cancer risk from cell phone radiation."

ifornia, Berkeley and a leading authority on radiofrequency radiation, says, "The FDA wrote a biased review of the research regarding cancer risk from cell phone radiation."

Also, the FCC cited reports from organizations that have undeclared conflicts of interest ([ties to the wireless industry](#)), which contest the cancer links. Dr. Ronald Melnick, the lead designer of the NTP study, has published [two articles](#) stating that the results from these groups' reports were "unfounded."

In fact, the FCC failed on several fronts. Besides ignoring the NTP study, the commission dismissed the American Academy of Pediatrics' request for regulations that reflect the special effects RFR have on children and pregnant women. It never explained why it ignored research that showed children's brains absorb higher levels of the radiation. Instead, it has insisted for 20-plus years that RFR is only harmful if it overheats the human body by at least one degree centigrade. This is a red herring, since wireless devices don't emit the kind of radiation that produces higher temperatures. Also, the FCC didn't consider the effects of long-term exposures.

Many researchers insist these links have been proven. As noted in an earlier article in this journal ("Wireless Hazards," [Washington Spectator](#),

December 2020), studies over the past 20 years have found strong evidence of brain tumors and leaks in the blood-brain barrier, acoustic neuromas (tumors on the nerves leading from the inner ear to the brain), thyroid tumors, and cognitive impairment. They also showed a link to male infertility: when men carried phones in their pants' pockets, their sperm were weakened and reduced. Also, physicians and scientists found that some individuals are particularly sensitive to RFR radiation, which can cause tinnitus, vertigo, headaches, fatigue, and loss of memory. Early this month, some experts studying the U.S. diplomats' and CIA agents' "Havana Syndrome" symptoms suggested they could be related to radiofrequency radiation.

The latest evidence

Theodora Scarato, the executive director of the Environmental Health Trust, says that since the FCC had not yet responded to the court's August ruling by last November, the EHT [asked the commission](#) to consider additional studies that were completed after 2019, when the suit was filed.

For example, in late 2019, the European Parliamentary Research Service said that electromagnetic fields (EMFs) emitted by 2G, 3G, and 4G cell phones (which operate at 450 to 6,000 megahertz) are "probably carcinogenic for humans," particularly in causing gliomas, acoustic neuromas, and meningiomas (slow-growing, mostly nonmalignant brain tumors).

In 2020, Yoon-Jung Choi and Joel Moskowitz (the lead authors) and three other scientists reviewed 46 "case-controlled studies" and published their findings in "Cellular Phone Use and Risk of Tumors: Systematic Review and Meta-Analysis," in the November *International Journal of Environmental Research and Public Health*. Moskowitz says, "This study updated our earlier analysis published in 2009." Evidence from the new study, he says, links cell phone use to increased tumor risk. The researchers' numbers are compelling: 1,000 or more hours of cell phone use, or about 17 minutes a day over 10 years, was associated with a statistically significant 60 percent increase in brain tumor risk.

Also in 2020, Devra Davis (an epidemiologist and co-founder of the Environmental Health Trust), Aaron Pilarcik (a biophysicist at the Worcester Polytechnic Institute), and Anthony Miller (an epidemiologist specializing in cancer etiology and

an adviser to the World Health Organization) reviewed data on colon and rectal cancer from the U.S. Centers for Disease Control, the U.S. SEER Program at the National Cancer Institute, and the Iranian National Cancer Registry. They found that the colon cancer risk for adults born in the 1990s had doubled and the rectal cancer risk had increased fourfold by the time they were 24 years old—when compared to those born 60 years ago. They hypothesized that cell phone radiation could play a role in the increased risk and recommended the FCC set limits to reduce the exposure. [Their study](#), “Increased Generational Risk of Colon and Rectal Cancer in Recent Birth Cohorts Under Age 40—the Hypothetical Role of Radiofrequency Radiation from Cell Phones,” was published in the *Annals of Gastroenterology and Digestive Disorders*.

In 2020, Henry Lai (a retired University of Washington scientist) reviewed the research on genetic effects and found that exposure to RFR can break DNA strands and affect the central nervous system. The review, “Genetic Effects of Non-Ionizing Electromagnetic Fields” was published in the December 2020 issue of *Electromagnetic Biology and Medicine*.

In 2021, Henry Lai, with Albert Manville (a biologist formerly at the U.S. Fish and Wildlife Service) and Blake Levitt (an environmental journalist), studied the effects of cell phone towers in various countries, comparing data from the 1980s to the present. They found that the toxic effects of EMFs on cells and genes had altered “the wildlife’s orientation and migration patterns, their ability to find food, mate, reproduce, build nests and dens, and maintain and defend their territory.” Yet the FCC has still set no standards for long-term, low-level EMF exposure on wildlife. The scientists’ three-part research was published in *Reviews on Environmental Health*, “Effects of Non-Ionizing Electromagnetic Fields (EMF) on Flora and Fauna.”

Also in 2021, the journal *Andrologia* published a [study](#) by Iranian scientists who found DNA fragmentation in sperm and recommended that men keep cell phones “away from the pelvis as much as possible.”

Further, from 2015 to the present, the French government has tested the radiation from cell phones when people hold them next to their bodies. Their findings are dramatic: They reported exposures to RFR up to 11 times higher than those approved in FCC guidelines. Thus, the government passed a ministerial order in 2019 urging the public to limit children’s cell phone use and “keep the phones away from the belly of pregnant women and the lower abdomen of adolescents.”

Moreover, the National Institutes of Health and the American Cancer Society funded a study in 2019 and 2020 at Yale University that found increased [thyroid cancer](#) among heavy cell phone users.

The accompanying table enumerates many of the ways that doctors and vigilant public jurisdictions have identified to help people reduce the health risks that could be associated with exposure to RFR and cell phone radiation emissions.

The EHT’s Scarato reminds readers concerned about RFR emissions exposure to “contact their senators and representatives to raise the issues with the committees.” In the Senate, the

[Committee on Commerce, Science, and Transportation](#), along with its [Subcommittee on Communications, Media, and Broadband](#) oversees the FCC. In the House, the FCC reports to the [Energy and Commerce Committee](#) and its [Communications and Technology Subcommittee](#). Public pressure on the members of these committees will help to prod the FCC to review the research and respond to the ruling of the Court of Appeals. ■

Barbara Koepfel is a Washington, D.C.-based investigative reporter who covers social, economic, political, and foreign policy issues.

PROTECT YOURSELF FROM WIRELESS RADIATION

The California Department of Public Health recommends these precautions:

- Use headsets—not ear buds—but remove them when not talking, since even headsets release small amounts of radiation when not in use.
- Text instead of talk.
- Carry phones away from your body in backpacks, tote bags, handbags, and briefcases.
- Keep phones away from your head when streaming.
- Download movies instead of streaming them.
- Don’t use cell phones when reception is poor and they show just one or two bars—in subways, cars, basements, or rural areas. Under such circumstances cell phones often need vastly more energy to communicate with cell towers and other phones, and radiation levels intensify.
- Men should not carry phones in pants’ pockets. Cleveland Clinic Center for Male Fertility researchers found this weakened and reduced sperm, which can cause infertility.

Go to page 8 for more information

(Continued from page 3)

PROTECT YOURSELF FROM WIRELESS RADIATION

Countries must adopt tough laws

- Belgium and France banned companies from designing phones to appeal to children.
- Israel and Cyprus banned Wi-Fi in day care centers and kindergartens, requiring connections be wired. Israel limited Wi-Fi use in first and second grades to three hours a week.
- France ordered cities to map the locations of antennae, measure their radiation levels, and tell the public. Also, it banned ads showing people holding phones next to their heads and ordered companies to list phones' exposure levels. If they don't, they can be fined up to 75,000 euros.
- India ordered companies to remove towers located near hospitals and schools.
- Israel ordered companies to list phones' radiation levels.
- Geneva (Switzerland) placed a moratorium on the rollout of 5G.

Scientists also recommend these steps:

- Use corded landlines at home, but put satellite or cordless handsets on speakerphone, since they emit even more radiation than cell phones.
- Push for laws to protect children.
- Get states to create expert commissions to study radiation emissions' effects. New Hampshire's commission recommended that towers and antennae be placed farther from schools and homes.

April 14, 2022

Via e-mail

White House Environmental Justice Advisory Council
U.S. Environmental Protection Agency
1200 Pennsylvania Ave. NW Washington, D.C. 20460
whejac@epa.gov

Dear White House Environmental Justice Advisory Council members:

Earthjustice writes to thank the White House Environmental Justice Advisory Council (WHEJAC) for your role in ensuring that the Biden Administration places the concerns of impacted and underrepresented communities front and center as they work to ensure communities in need see 40% of the benefits of critical federal investments through the Justice40 initiative. WHEJAC plays a unique and important role, as community members and environmental justice champions who have the ear of various arms of the Administration. Because of this unique position, we hope that WHEJAC will be able to communicate to President Biden, Vice President Harris, the Council on Environmental Quality (CEQ), and the White House Interagency Council on Environmental Justice (Interagency Council) the necessity of not squandering the unique moment we find ourselves in regarding equitable access to clean water. With lead service line replacement enjoying massive support to the tune of a \$15 billion dollar investment in the bipartisan Infrastructure Investment and Jobs Act, the administration must recognize that now is the time to *require* the U.S. Environmental Protection Agency (EPA) to take bold, decisive action. We urge WHEJAC to communicate the necessity of 1) a transformative Lead and Copper Rule Improvement (LCRI), and 2) equitable disbursement of the aforementioned \$15 billion to communities around the country based on need.

I. A Transformative Lead and Copper Rule

As WHEJAC members well know, the significance of drinking water as a lead exposure pathway is often underestimated. EPA modeling has shown that drinking water can constitute up to 80% of many U.S. children's lead exposures. Yet, the existing Lead and Copper Rule (LCR) itself is not anchored in science, is fundamentally broken, and is rarely enforced. Hazardous lead exposure of children as a result of drinking water has been documented throughout the US, not only by water systems that have a "lead action level exceedance," but also by many that do not. It is no accident that the lead crises in Washington DC, Flint, MI, Newark, NJ, and Clarksburg, WV, all occurred while the water systems claimed their water was safe.

Accordingly, we recommend that WHEJAC urge **EPA to take bold action by committing to propose a reformed, improved LCR by early 2023 and to finalize that rule by early 2024. EPA must also ensure that 100 percent of all lead service lines are removed within 10 years.** Attached as an appendix to these comments are specific recommendations contained in a sign-on letter joined by Earthjustice and over 50 other partners including many community and

environmental justice goals. Mere tweaks to the existing flawed framework of the LCR and the reforms to it finalized during the Trump administration will not deliver the protection or justice that communities dealing with years of dangerously elevated lead levels require from the federal government.

II. Ensuring IIJA funding for Lead Service Line Replacement is decided based on need

The funding provided to EPA through IIJA – including the \$15 billion for lead service line replacement (LSLR) -- is distributed to communities through the Clean Water and Drinking Water State Revolving Funds (CWSRF and DWSRF, or SRFs collectively). The SRFs depend on an outdated formula to determine how much funding from the SRFs go to each state. Among other flaws, the allocation does not factor in how many lead services exist in each state. As a result, certain states project to receive more funding for LSLR than they need, in proportion to how many lead service lines are in their state, and others with greater need will receive an inadequate share of this historic investment.

To avoid this inequitable outcome, we urge WHEJAC to recommend that EPA take two steps within their authority:

1. Complete, this year, the Drinking Water Infrastructure Needs Survey and Assessment (DWINSA). The analysis of the needs for lead service line replacement is needed in time to determine the FY23 allocations of funds under IIJA, as required by the America's Water Infrastructure Act of 2018.
2. Separate within the Drinking Water State Revolving Fund (DWSRF) three separate sub-funds: (1) the \$15 billion in IIJA for lead service lines; (2) the \$4 billion for emerging contaminants “with a focus on” PFAS; and (3) the \$11.7 billion in general DWSRF funding. EPA should then separately allocate funding from these three sub-funds based upon the needs for each category assessed in the DWINSA.

Thank you for your dedication to environmental justice and equitable access to clean water. Your efforts and partnership are critical to ensuring the Biden administration follows through on their promise to set us on the path to removal of all lead service lines across the country in ten years.

Sincerely,

Julian Gonzalez

Legislative Counsel

Earthjustice

Appendix: April 12 Letter to EPA from environmental and community groups

April 12, 2022

The Honorable Michael Regan
Administrator
US Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC. 20004

Dear Administrator Regan,

We write to thank you and the White House for continuing to raise awareness and take action related to the lead crisis plaguing communities across the country. As a result of our collective efforts, the issue of lead service line replacement has become a priority for President Biden. And the U.S. Environmental Protection Agency (EPA) promised in December 2021 to overhaul and strengthen the health protections in its Lead and Copper Rule (LCR) for drinking water. EPA has also publicly committed to taking advantage of the \$15 billion in lead service line replacement funding provided by Congress in the Infrastructure, Investment, and Jobs Act to begin an unprecedented push to, in the words of our President, “begin to replace poisonous lead pipes—so every child—and every American—has clean water to drink at home and at school.” A multi-pronged strategy using distribution of Congressionally appropriated funds, interagency coordination, collaboration with states, media outreach, and strengthening EPA’s rules governing lead exposure is exactly what is needed to get the lead out of our communities.

All of these initiatives, all of this media attention, and all of the community engagement this Administration has spearheaded will be undermined, however, if EPA does not issue a transformative further revised LCR. The significance of drinking water as a lead exposure pathway is often underestimated. EPA modeling has shown that drinking water can constitute up to 80% of many U.S. children’s lead exposures.¹ Yet, the LCR itself is not anchored in science, is fundamentally broken, and is rarely enforced. Hazardous lead exposure of children as a result of drinking water has been documented throughout the US, not only by water systems that have a “lead action level exceedance,” but also by

¹ See Lindsay W Stanek et al., *Modeled Impacts of Drinking Water Pb Reduction Scenarios on Children's Exposures and Blood Lead Levels*, 54 *Environ Sci Technol* 9474, 9474–82 (Aug. 2020); Ronnie Levin et al., *The Urban Lead (Pb) Burden in Humans, Animals and the Natural Environment*, 193 *Environ Res* (Feb. 2021)

many that do not. It is no accident that the lead crises in Washington DC, Flint, MI, Newark, NJ, and Clarksburg, WV, all occurred while the water systems claimed their water was safe. EPA itself has acknowledged that there are “significant opportunities to further improve upon” the LCR and the recent revisions to it “to achieve increased protection of communities from lead exposure through drinking water.” 86 Fed. Reg. 71,574, 71,577 (Dec. 17, 2021). EPA must take bold action and should commit to propose a reformed, improved LCR by early 2023 and to finalize that rule by early 2024.

EPA must ensure that 100 percent of all lead service lines are removed within 10 years to achieve the Biden Administration’s bold goal to “[Replace All Lead Pipes in the Next Decade](#),” as promised by the Vice President in her December 2021 announcement of the Administration’s [Lead Pipe and Paint Action Plan](#). The Trump LCR revisions, which the Biden Administration allowed to go into effect in December 2021, *extended* the allowable timeframe for replacement to up to 33 years for systems required to replace LSLs.

The LCR must be revamped so that it meets the SDWA’s requirements and goals to protect health. If EPA retains treatment technique,² the LCR must “prevent known or anticipated adverse effects on the health of persons to the extent feasible,”³ which it does not currently do. More specifically, EPA should shift its focus to prevention, rather than “testing and fixing,” given the dangers associated with lead, the variability of lead in drinking water, and the long-term benefits and cost savings associated with such an approach.

Under its current approach, remedial action is premised on extremely limited water sampling at a miniscule number of homes and often only once every few years. Due to the sporadic nature of lead release in drinking water, the very limited testing of tap water under the LCR does not provide an adequate snapshot of the actual public health threat from lead service lines and other lead-bearing plumbing materials. Further, no meaningful remediation is required until the lead levels in at least 10 percent of sampled homes exceed 15 parts per billion (“ppb”) at the time of sampling, even though any level of lead presents a health risk at any time. That construct knowingly and systematically sacrifices 9 percent of homes—which in New York City, for example, equates to almost 800,000 homes—regardless of how high the lead levels in their drinking water are at the time of sampling. In many jurisdictions, it likely sacrifices a far higher percentage of homes with significant lead-in-water contamination that the extremely limited LCR testing missed. Up to 12 million homes are served by LSLs and the majority of US homes have other lead-bearing plumbing; risking the health of that many people is unconscionable. With respect to schools and childcare centers, the LCR’s shockingly limited testing requirements (i.e.

² As many of the signatories of this letter have noted in previous correspondence, the SDWA requires EPA to establish a Maximum Contaminant Level (MCL) for lead because it is feasible to ascertain lead levels in drinking water. See 42 U.S.C § 300g-1(b)(7)(A). However, the agency has made it clear that it has no intention of establishing an MCL for lead, so we discuss how an LCR treatment technique should be strengthened in this letter.

³ 42 U.S.C § 300g-1(b)(7)(A).

only a one-time test of 5 outlets per school and two outlets in a childcare center) are inadequate, scientifically unsound (i.e., one-time testing is not appropriate for determining the “safety” of any single tap), and likely to mislead parents and staff into believing there is not a lead problem when there might very well be serious contamination.

A new LCR treatment technique must, at minimum:

- Mandate full and equitable removal of lead service lines at utility expense to be completed within 10 years for all water systems at no cost to homeowners. The rule should:
 - Tightly limit -- and over time eliminate -- the number of service lines permitted to be characterized as “lead status unknown” in a lead service line inventory;
 - Prioritize replacement in communities disproportionately exposed to lead from other sources.
- Improve LCR compliance sampling in lead service line homes by requiring more frequent, more widespread, and more representative sampling including both 1st- and 5th-liter samples for lead. The higher of the two samples should trigger corrective action.
- Require corrective actions to be health protective. To accomplish this, an LCR must:
 - Require system-wide action at as low a 90th percentile lead level as feasible, no higher than 5 parts per billion;
 - When system-wide action is mandated, require water systems to:
 - Immediately provide lead certified filters, as well as installation and training assistance to all homes with known or possible lead service lines and/or elevated lead levels (i.e. exceeding LAL) and then do a comprehensive investigation of the lead source;
 - Fully replace all lead service lines as quickly as possible, at no cost to the consumer, as even filter efficacy depends on a number of factors.
 - Ensure that customers served by small water systems are protected by regulatory standards as stringent as those applying to larger utilities.
- Establish a prevention-oriented approach to stop lead contamination of water in schools and child-care facilities. To accomplish this, an LCR must:
 - Shift away from relying mainly on a “test-remediate” paradigm where our kids go to learn and play each day;

- Use all appropriate policy levers to drive utilities, schools and child care centers to implement a “filter first” approach so that all water outlets used for cooking and drinking at schools and childcare facilities are equipped with filtration stations, point of use filters, or filtered water pitchers certified to remove lead.
- Installing water filtration stations in schools is significantly less expensive⁴ than inaccurate testing regimes, and more protective of public health with the added benefit of filtering out other contaminants of concern in school drinking fountains.

The LCR and EPA have also failed the public in terms of education by allowing public water systems to hide behind statements of “compliance” with the complex and non-health protective LCR, and by misleading people into believing their water presents no harmful exposure to lead, when, in reality, it may dispense exceedingly high concentrations of the contaminant. Given the commitment of this administration to environmental justice and community engagement, a new LCR framework should mandate resident-led community advisory councils provided with sufficient technical expertise and resources, and it must center public education that is complete and accurate. For example, EPA should broaden and strengthen public education and notification requirements to explain the widespread nature of lead in drinking water, the limitations of lead testing, and health impacts in all populations but especially including the most vulnerable – fetuses and infants dependent on reconstituted formula. Such outreach should also include steps people can take to decrease their families’ exposure to lead, such as using filters certified to remove both soluble and particulate lead.

For decades, advocates across the country have conveyed the urgency of this crisis at every turn, and another round of “tweaking” the LCR will not only undercut the historic investments in lead service line removal Congress recently authorized but, more importantly, it will condemn another generation of families to exposure to dangerous levels of lead in drinking water. We are hopeful that EPA will propose changes that our communities need, and we look forward to working with the agency as this urgent process unfolds.

Sincerely,

A Community Voice - Louisiana

Alabama Rivers Alliance

Alabama State Association of Cooperatives

American Indian Mothers INC

⁴See “MI Lawmakers Introduce Lead in Water Protections for Kids” <https://www.nrdc.org/experts/cyndi-roper/mi-lawmakers-introduce-lead-water-protections-kids>

BioRegional Strategies
Campaign for Lead Free Water
Center for Biological Diversity
Center for Neighborhood Technology (CNT)
Choctawhatchee Riverkeeper
Citizens for Clean Water Sycamore Illinois
Clean and Healthy New York
Waterway Advocates
Coalition on Lead Emergency
Community Water Center
Detroit Mercy Law Environmental Law Clinic
Earthjustice
East Chicago Calumet Coalition Community Advisory Group
Environmental Coalition for Water Justice
Environment America Research & Policy Center
Environmental Transformation Movement of Flint
Flint Rising
Food & Water Watch
Freshwater For Life Action Coalition
Green & Healthy Homes Initiative, Inc
GreenLatinos
Idaho Conservation League
Immigrants & Minorities Unify Services Association
League of Conservation Voters
Little Village Environmental Justice Organization
Metropolitan Planning Council
Milwaukee Riverkeeper
Natural Resources Defense Council
NC League of Conservation Voters

New Beginnings UMC
Newburgh Clean Water Project
Nourishing Our Mind
Ohio Environmental Council
Passaic River Coalition
Pennsylvania Council of Churches
Portland Advocates for Leadfree Drinking Water
Portland Harbor Community Coalition
RE Sources
River Guardian Foundation
River Network
Rural Coalition
Saint Joseph's Carpenter Society
Sierra Club
St Francis Prayer Center, Flint MI
The Water Collaborative of Greater New Orleans
U.S. PIRG
United Parents Against Lead
Washington Environmental Council
Water You Fighting For?
Waterway Advocates
We the People of Detroit



11 May 2022

White House Environmental Justice Advisory Council (WHEJAC)
Docket Number EPA-HQ-OA-2021-0683
whejac@epa.gov

Re: Comments to the WHEJAC, May 2022

Thank you for the continued opportunities to offer comments to the WHEJAC. I have commented before, and i plan to continue to comment until we see changes occurring in our Gulf Coast environmental justice and climate justice communities. I work for Healthy Gulf¹, a Gulf of Mexico regional environmental non-profit. We work on behalf of communities and ecosystems, for the health of both. WHEJAC solicited responses around disaster relief. I want to respond with a disaster justice lens.

(1) What type of support is needed for disadvantage communities to participate in federal disaster preparedness or relief programs?

Support is needed in the form of cash or direct deposit money (method should be of the recipient's choosing). People need money to be made available to them regardless of their income, race, home ownership status, immigration status, etc. Assistance must be made available for anyone affected, not only people that are under a mandatory evacuation order. People that are undocumented, underemployed, unemployed and unhoused are especially at risk and some cannot qualify for a bank account, so they need cash payments to be made available.

Also, related, housing for unhoused people and for renters is essential. Housing for people that are displaced is essential. In many cases after Hurricane Ida, it took 4 months or more for people to get a FEMA trailer. After Hurricane Laura, people are still living in FEMA trailers two years after the storm, and now those people who don't have anywhere else to go are being told they have to pay exorbitant rent in order to stay in the trailer. I've heard from Hispanic residents of Texas that they received zero assistance after Hurricane Harvey, and had to find places to stay and repair their houses with

¹ Healthy Gulf's purpose is to collaborate with and serve communities who love the Gulf of Mexico by providing research, communications and coalition-building tools needed to reverse the long-pattern of over exploitation of the Gulf's natural resources.

no recognition and no financial support or other support. FEMA needs to provide quick assistance, and needs to continue that assistance until the recipients are safely housed once again in permanent housing. Assistance finding a new rental should be made available, as should longer term, high quality housing (as opposed to a temporary trailer).

There must be absolutely no discrimination in assistance payments. Multiple journalists have reported that low income people and people of color receive less money, and their awards take longer to arrive, than those of more affluent, white recipients of awards. This is disgraceful and must be changed. If FEMA can't dispense funds equitably, move this job to another agency or outsource it so that funds are dispensed equitably and expediently. Perhaps an

Disaster relief agencies need to recognize tribes and tribal members, especially those that are not recognized at the federal level, but are recognized at the state level or are not officially recognized at all. Indigenous people on the Gulf Coast should be prioritized for relief money and rebuilding or relocation support (based on their preference), as opposed to affluent white people.

Furthermore, disaster relief should include money, housing, food, transportation and support, ongoing until the needs have been completely met, for either rebuilding or relocation. The same is true for renters.

There is also no recognition from any disaster by the federal government of the individual and collective trauma that occurs during and after a storm, and the support needs that arise around that. Myself and thousands of others on the Gulf Coast plead with you that all of these items be addressed, swiftly.

(4) What steps can Federal agencies and the White House take to reduce disparities in climate change impacts for communities, including, but not limited to risks from, extreme heat, flood, wildfire, drought, and coastal challenges?

Do not issue permits to new or expanding fossil fuel facilities including but not limited to LNG export terminals, petrochemical plants and pipelines. Please stop fueling climate disasters and the social large-scale trauma that results, disproportionately affecting Black, Indigenous, Creole and other people of color, as well as people with low income. Please consider reparations for Indigenous people and anyone descended from enslaved people in the United States. Please consider a "universal basic disaster

income” for the months of housing and working disruption that occurs after a storm.

I've already commented in previous letters to WHEJAC about our requests for the Gulf Coast in terms of disaster justice, but i'll restate some of those here. My requests include safe housing and evacuation, food security and what i'm calling “universal basic disaster income”. Furthermore:

1. WHEJAC should demand that the EPA (and other agencies) and the corporations ensure the human rights of clean water and clean air, by:
a) telling people what's in their water and b) telling people what's in their air.
2. WHEJAC should recommend that the agencies and the White House revoke and/or deny permits for those facilities in the fossil fuel industrial complex that add pollution or climate injustice to environmental justice communities (especially new and expanding facilities).
3. WHEJAC should insist that every environmental analysis of each project involve a rigorous cumulative impacts analysis.
4. Require states and counties/parishes to track cases of cancer and other illnesses (including COVID-19) that can be exacerbated by pollution by location or locations where the person lives (as opposed to the hospital they are treated at), and make this data is anonymized but publicly and readily available.
5. Require agencies like USCG, EPA, FEMA and NOAA to openly coordinate after a disaster especially in industrial zones, and to share with the public what's in the air and water.
6. Implementation of a Gulf Coast investigation group as Advisor McCarthy agreed to at the WHEJAC meeting on 11/17/21
7. Require that greenhouse gas (GHG) emissions be taken into account in NEPA.
8. Ensure that rigorous Environmental Justice review (including cumulative impacts) is conducted as a part of NEPA, including
 - Set out clear methodology for designation of an EJ area, and local revisions/petitions to be incorporated
 - WHEJAC should create methods for EJ analysis and community identification that are much more rigorous than what is currently used by the US Army Corps of Engineers, the Federal Energy Regulatory Commission and other agencies
9. Establish Just Transition plans for the Gulf Coast (and the nation) informed by regional Green New Deal goals

Thank you for your consideration. Please act swiftly and decisively to lift up the Gulf Coast communities that have long suffered, and provide remediation and justice.

(submitted via Docket at [regulations.gov](https://www.regulations.gov) and email)

Best regards,

A handwritten signature in black ink that reads "Naomi Yoder". The signature is written in a cursive, flowing style.

Naomi Yoder, Staff Scientist

Healthy Gulf

PO Box 66226

Houston, TX 77266

naomi@healthygulf.org

April 14, 2022

Submission to: White House Environmental Justice Advisory Council

- Via Docket ID No. EPA-HQ-OA-2022-0050 at <http://www.regulations.gov>
- Via <https://www.epa.gov/environmentaljustice/forms/white-house-environmental-justice-advisory-council-whejac-public-comment>
- Via email to whejac@epa.gov

Subject: The Climate and Economic Justice Screening Tool (CEJST or “Tool”)

Chair Brenda Mallory of the White House Council on Environmental Quality (CEQ) has stated that “The Climate and Economic Justice Screening Tool (CEJST or ‘Tool’) will help Federal agencies ensure that the benefits of the nation’s climate, clean energy, and environmental programs are finally reaching the communities that have been left out and left behind for far too long.”¹

The Tool is a good starting point to address issues of clean energy and environmental issues, particularly relating to unserved or underserved communities (the “Communities”) and environmental justice.

A major component that should be added to the Tool is a metric to measure in those Communities (1) the level of electrosmog generated, or that would be potentially generated, from wireless infrastructure in those Communities and (2) the amount of fiber optics deployed, and needed to deploy, in those Communities to close the digital divide.

What is emitted from wireless infrastructure, cell towers and cell phones is referred to as wireless radio-frequency radiation (RFR), electro-magnetic radiation (EMR), electro-magnetic fields (EMF) or microwave radiation. “ElectroSmog refers to all man-made electromagnetic radiation created and present in our surrounding environment.”²

Energy Consumption and Pollution from Wireless Infrastructure and Devices

The environmental footprint of wireless infrastructure contributes more to global warming than it does in preventing it.³ Wireless is not so “green.”⁴ As far back as 2013, it was predicted that the “wireless cloud” would produce “an increase in carbon footprint from 6 megatonnes of CO₂ in 2012 to up to 30 megatonnes of CO₂ in 2015, the equivalent of adding 4.9 million cars to the roads,” with up to 90% of this consumption “attributable to wireless access network technologies ...”⁵ More recently, energy consumption for wireless

¹ <https://www.whitehouse.gov/ceq/news-updates/2022/02/18/ceq-publishes-draft-climate-and-economic-justice-screening-tool-key-component-in-the-implementation-of-president-bidens-justice40-initiative/>.

² <http://www.emfrf.com/electrosmog/>

³ <https://ehtrust.org/wp-content/uploads/5G-and-Climate-Change-Flyer-EHT.pdf>.

⁴ Environmental Health Trust, “5G is Not So Green ...” <https://myemail.constantcontact.com/Studies-Confirm-5G-4G-Will-Increase-Radiation-Exposure.html?soid=1116515520935&aid=2ptEVCn03-U>.

⁵ <https://ehtrust.org/wp-content/uploads/5G-and-Climate-Change-Flyer-EHT.pdf>.

infrastructure has been reported at ten times that of fiber (with 5G requiring 2 to 3.5 times the energy needed for 4G towers).⁶ Energy consumption from 5G “is expected to increase 61x between 2020 to 2030 due to the energy demands of powerful network elements like massive MIMO⁷ and edge servers [and] the proliferation of 5G cell sites ...”⁸

By contrast, fiber optics has “[l]ower energy consumption, reduced waste and sustainable architecture, characteristics that make fiber infrastructure an environmentally advantageous choice.”⁹ “Fiber has a minimal ecological impact, reduces waste, consumes very little energy and helps decrease greenhouse gas emissions.”¹⁰

In terms of pollution, even the telecommunications industry has referred to wireless RFR as a pollutant in their product protection plans for which they disclaim liability for personal injury. For example, an industry brochure for consumers for cell phone insurance protection states:

“Pollutants means any ... gaseous, or thermal irritant or contaminant including ... artificially produced electric fields, magnetic field, electromagnetic field, sound waves, microwaves and all artificially produced ionizing or non-ionizing radiation ...”¹¹

Similar definitions for pollution are in the product protection plans for other telecommunications companies.¹²

Two of the largest insurance companies in the world (i.e., Lloyd’s of London and Swiss Re) have declined to insure telecom companies for any liability for personal injury that results from RFR exposures.^{13,14,15} Insurance companies, reviewing potential RFR injuries to the public from a risk analysis perspective, have assessed RFR as “high” risk by the insurance industry and is, therefore, excluded from coverage. The insurance industry acknowledges the high potential of claims of RFR injuries from the public arising from RFR exposure.

⁶ <https://www.emfacts.com/2020/09/5g-base-stations-use-up-to-three-and-a-half-times-more-energy-than-4g-infrastructure/>.

⁷ MIMO means Multiple-Input Multiple-Output and “is a wireless technology that uses multiple transmitters and receivers to transfer more data at the same time” by combining “data streams arriving from different paths” in contrast to Single-Input Single-Output (SISO) technology which “can only send or receive one spatial stream at a time.” See, <https://www.intel.com/content/www/us/en/support/articles/000005714/wireless/legacy-intel-wireless-products.html>.

⁸ <https://ehtrust.org/report-5g-to-increase-energy-consumption-by-61-times/>

⁹ <https://www.cablinginstall.com/cable/fiber/article/16465844/how-fiber-can-help-make-your-network-greener>

¹⁰ Fiber Optic Broadband, A Greener Internet Solution, <https://www.otelco.com/a-greener-internet-solution/>.

¹¹ <https://ehtrust.org/wp-content/uploads/device-protection-brochure-nationwide.pdf>;

¹² <https://ehtrust.org/key-issues/electromagnetic-field-insurance-policy-exclusions/>, <https://ehtrust.org/wp-content/uploads/ATT-Multi-Device-Protection-Pack-Insurance.pdf>, <https://ehtrust.org/wp-content/uploads/Sprint-Insurance-Terms-and-Conditions-Downloaded-2019.pdf>.

¹³ <https://5gtechnologynews.com/insurance-companies-can-refuse-claims-related-to-electromagnetic-radiation-illnesses/>

¹⁴ <https://ehtrust.org/wp-content/uploads/Swiss-Re-SONAR-Publication-2019-excerpt-1.pdf>, pg. 29.

¹⁵ <https://ehtrust.org/key-issues/reports-white-papers-insurance-industry>

Minority and rural communities have historically been affected by environmental hazards. Those mistakes should not be amplified by their exposure to wireless RFR in close proximity to their homes, schools and businesses. Fiber optics to the premises (FTTP) is the superior choice for these Communities, for digital inclusion and environmental equity to bridge the digital divide.

Facts and Statements by U.S. Preeminent Scientists and Experts In the Area of RFR Research

As shown by the following facts and statements by the United States' preeminent scientists and experts in the area of wireless RFR research, it has become well established that wireless radiation exposure produces or has the recognized potential of producing biological effects.

1. In 2011, the World Health Organization's (WHO) International Agency for Research on Cancer (IARC) classified wireless radiation as a Group 2B possible carcinogen.¹⁶ This conclusion was based upon an increased risk of malignant brain cancer (glioma) identified in those who used cell phones for over 10 years for an average of 30 minutes per day.

Anthony B. Miller, M.D., Senior Epidemiologist, IARC, states in a 2018 updated assessment to the 2011 IARC classification of wireless radiofrequency radiation (RFR), ***"When considered with recent animal experimental evidence, the recent epidemiological studies strengthen and support the conclusion that RFR should be categorized as carcinogenic to humans (IARC Group 1)."***¹⁷

2. "Since 2011, the scientific evidence linking wireless to cancer has significantly increased and today several published reviews conclude that the current body of evidence indicates cell phone radiation is proven Group 1 human carcinogen (Miller et al 2018, Peleg et al 2018 Carlberg and Hardell 2017, Belpomme et al 2018)." ¹⁸

3. Christopher J. Portier, Ph.D., former director of the National Center for Environmental Health at the Centers for Disease Control and Prevention (CDC) and a scientific advisor for the WHO, reviewed the most recent body of scientific research and literature to look at the feasibility of RFR causing specific brain tumors in humans and concluded in March, 2021:

- ***"Given the human, animal and experimental evidence, I assert that, to a reasonable degree of scientific certainty, the probability that RF exposure causes gliomas and neuromas is high."***

¹⁹

¹⁶ https://www.iarc.who.int/wp-content/uploads/2018/07/pr208_E.pdf

¹⁷ <https://www.sciencedirect.com/science/article/abs/pii/S0013935118303475>

¹⁸ <https://ehtrust.org/science/who-iarc-position-on-wireless-and-health/>

¹⁹ <https://www.saferemr.com/2021/03/expert-report-by-former-us-government.html?m=1>

4. Linda Birnbaum, Ph.D., former Director of the U.S. NIEHS and former Director of the National Toxicology Program (NTP) spanning across the Department of Health and Human Services organizations which involves NIH, FDA and CDC, has stated: ²⁰

- ***“Effects from [wireless] radiofrequency radiation (RFR) such as genetic toxicity, immunotoxicity, oxidative stress, changes in gene and protein expression, changes in cell differentiation and proliferation, and increased permeability of the blood brain barrier were reported in these [scientific] publications.” (pg. 8).***
- ***“The phase I [NTP] studies established that non-thermal levels (<1⁰C or no detectible change in temperature) of RFR exposure had toxicological implications in biological systems.” (pg. 9).***
- ***“The NTP found and published evidence of DNA damage after only 90 days of exposure.” (pg. 9).***
- ***“Overall, the NTP findings demonstrate the potential for RFR to cause cancer in humans. The independent peer review of the entire proceedings carried out by toxicologists, pathologists and statisticians independent of the NTP staff conducted March 26-28, 2018, concluded that there was ‘clear evidence of cancer,’.....exposure to RFR is associated with an increase in DNA damage.” (pg. 11).***

NOTE: NTP refers to the National Toxicology Program.²¹ Since completion of the \$30 million NTP study (originally sponsored by the FDA to research possible biological effects of RFR), the results have been replicated by the Ramazzini Institute²² in another study using exposures below the FCC thermal thresholds ²³ (simulating emissions from cellular base stations and wireless transmitters).

5. In 2021, the U.S. D.C. Circuit Court of Appeals in *EHT et al v. FCC* ruled that the FCC’s 2019 decision to maintain their 26 year old thermal-based exposure “safety” guidelines demonstrated that the FCC was acting in an ***“arbitrary and capricious”*** manner ***“in its complete failure to respond to comments concerning environmental harm caused by RF radiation”*** below the current FCC limits.²⁴

The Court further ruled that, ***“The factual premise—the non-existence of non-thermal biological effects—underlying the current RF guidelines may no longer be accurate.”*** The Court pointed out that the FCC had ignored the scientific evidence documenting biological harm at non-thermal levels (i.e., at levels hundreds and even thousands of times below the current FCC wireless exposure “safety” guidelines). Indeed, thousands of scientific studies of biological hazards from RFR and hundreds of personal accounts of injuries from RFR were in the FCC docket which the FCC ignored, and which the D.C. Circuit Court of Appeals admonished the FCC that it cannot ignore.

²⁰ <https://ehtrust.org/wp-content/uploads/20-1025-Amicus-Brief-Joe-Sandri.pdf>

²¹ <https://ntp.niehs.nih.gov/whatwestudy/topics/cellphones/index.html>

²² <https://pubmed.ncbi.nlm.nih.gov/29530389/>

²³ <https://ehtrust.org/worlds-largest-animal-study-on-cell-tower-radiation-confirms-cancer-link/>

²⁴ [https://www.cadc.uscourts.gov/internet/opinions.nsf/FB976465BF00F8BD85258730004EFDF7/\\$file/20-1025-1910111.pdf](https://www.cadc.uscourts.gov/internet/opinions.nsf/FB976465BF00F8BD85258730004EFDF7/$file/20-1025-1910111.pdf)

The ruling called into question the underlying basis for the FCC's extremely high thermal-only "safety" threshold and ruled in favor of health and safety advocates who sued the FCC.

6. Ronald Melnick, Ph.D., retired NIEHS senior toxicologist who won the American Public Health Association's 2007 David P. Rall Award for public health advocacy states:

"I strongly feel health and regulatory agencies should promote policies that reduce cell phone radiation exposure, especially for children and pregnant women. The agencies in the U.S. say, "if you are concerned" rather than "we are concerned." Agencies should be clear and straightforward educating the public on "here is what you should do."

"The risk can be greater for children than adults due to the increased penetration of the radiation within brains of children and the fact that the developing nervous system is more susceptible to tissue damaging agents." ²⁵

7. The American Academy of Pediatrics, a non-profit professional organization of 60,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists, stated in a letter to the FCC on July 12, 2012:

"Children ... are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. In fact, according to IARC, when used by children, the average RF energy deposition is two times higher in the brain and 10 times higher in the bone marrow of the skull, compared with mobile phone use by adults."²⁶

8. New Hampshire formed a State Commission to examine whether wireless radiation is harmful to human health. The majority of that New Hampshire State Commission came to the conclusion that exposure to wireless radiation is harmful to human health and the environment. The commission was convened through bipartisan legislation²⁷ that was signed by the governor. Commission membership included unbiased experts in fields relating to health and radiation exposure, and they issued their Final Report in November 2020.²⁸

You can hear directly from grassroot communities the health problems that they have been experiencing from RFR radiation. An example is in Pittsfield, MA where long-time residents and their children suffered from serious physical ailments after the installation of a wireless cell tower near their homes, and from which they had to evacuate.²⁹ The Pittsfield, MA Board of Health recently issued an emergency order to a telecommunications carrier to show cause why a cease and desist order should not be issued against the

²⁵ https://www.youtube.com/watch?v=zSx_yDzxvM8&t=2295s

²⁶ <https://ehtrust.org/wp-content/uploads/American-Academy-of-Pediatrics-letter-to-the-FCC-July-12-2012.pdf>

²⁷ <https://legiscan.com/NH/text/HB522/2019>

²⁸ <http://www.gencourt.state.nh.us/statstudcomm/committees/1474/reports/5G%20final%20report.pdf>

²⁹ <https://ehtrust.org/statement-by-courtney-gilardi-after-pittsfield-board-of-health-votes-to-send-cess-and-desist-order-for-verizon-cell-tower/>.

carrier to turn off a cell tower based on health effects and injuries sustained by residents as a result of the cell tower.³⁰ There have been other reports of health effects from cell towers.³¹

Fiber Optics as the Best Solution to Bridge the Digital Divide For Unserved and Underserved Communities

These Communities are disproportionately affected by lack of, or insufficient access to, broadband coverage in order to access the Internet and phone service. Middle mile fiber optics infrastructure has been built in many areas with middle mile fiber running past rural communities without serving them, hence the “digital divide.”

Fiber to the premises (FTTP)³² is the superior service for bridging the digital divide so that these Communities are not left behind. Former FCC Chair Tom Wheeler called fiber “future proof,” and wireless only as a last resort, not a first resort, in his testimony to Congress in March, 2021.³³ Wheeler stated that despite approximately \$40 billion of government subsidies “over the last decade,” those subsidies “have failed to deliver the goal of universal access to high-speed broadband ... because it failed to insist on futureproof technology, ... and focused more on the companies being subsidized than the technology being used or the people who were supposed to be served.”³⁴

Digital inclusion and digital equity are important for these Communities. To ensure digital inclusion and digital equity for the Communities, broadband should be affordable and have the capacity and scalability to meet increasing user demands for these Communities over its economic life, including performance, speed, low latency, capacity and reliability. Fiber best meets these demands. Wireless is less reliable and less scalable to meet future customer demands and has higher operational expense.³⁵

Fiber is more affordable, scalable from symmetrical (upload and download) speeds of 100 Mbps to 1Gbps to 10Gbps, has a longer life span of 25-50 years and is safer and more cybersecure, has lower operational expenses,³⁶ and is available at more affordable prices. By contrast, wireless typically requires equipment upgrades, constant maintenance and re-investments about every 5 years. An example of fiber deployment,

³⁰ <https://ehtrust.org/wp-content/uploads/Pittsfield-Health-Board-Cell-Tower-Order-to-Verizon-April-11-2022-FINAL-REDACTED.pdf>; see also, <https://ehtrust.org/the-first-cease-and-desist-order-against-verizon-cell-tower-to-be-sent-on-friday-by-by-board-of-health-pittsfield-ma/>.

³¹ Cell Tower Health Effects <https://www.saferemr.com/2015/04/cell-tower-health-effects.html>, Center for Family and Community Health, School of Public Health, University of California, Berkeley.

³² *Reinventing Wires* by Timothy Schoechle, PhD, National Institute for Science, Law and Public Policy, <https://electromagnetichealth.org/wp-content/uploads/2018/02/ReInventing-Wires-1-25-18.pdf>.

³³ Tom Wheeler’s Testimony to Congress,

https://energycommerce.house.gov/sites/democrats.energycommerce.house.gov/files/documents/Witness%20Testimony_Wheeler_FC_2021.03.22.pdf.

³⁴ Id.

³⁵ “To Reduce Network Operating Expenses, Choose FTTH,” Masha Zager, July 2020,

<https://www.bbcmag.com/broadband-applications/to-reduce-network-operating-expenses-choose-ftth>

³⁶ <https://optics.fiberbroadband.org/Full-Article/reduce-network-operating-expenses-choose-ftth>.

consumers in Hudson County, TN have multiple service options, which include speeds of up to 1000 Mbps (1 Gbps). Pricing and capacity are scalable and provide for 300 Mbps at \$57.99/month and 1 Gbps at \$67.99, in each instance symmetrical speeds.³⁷ Wireless technology is not able to effectively compete with similar high-speed Internet, with the FCC only requiring 25 Mbps download / 3 Mbps upload speeds.^{38 39} The Fiber Broadband Association has shown that consumers prefer the symmetrical speeds that fiber provides.⁴⁰ As the largest fiber optics trade association in the U.S. states, “If it isn’t fiber, it isn’t broadband.”⁴¹

An example of substantial long term cost savings using fiber broadband is Chanute, KS which “operates a 10 Gbps fiber-optic broadband ring.” This fiber network “connects schools and other community anchor institutions with gigabit networks ... The network generates \$600,000 per year for Chanute’s Electric Utility ... This ... has demonstrated that communities can meet their own telecommunications needs with smart public investments — they did not wait for national corporations to solve their problems.” City Manager J.D. Lester refers to municipal broadband as ‘the great equalizer for Rural America’ ...”⁴²

An example of a rural area which achieved access, digital equity and digital inclusion is rural eastern Kentucky. Peoples Rural Telephone Cooperative (PRTC) completed a 100% all fiber-to-the-premises buildout in 2014, a Gigabit-capable internet available to every home and business in the counties of Jackson and Owsley, Kentucky.⁴³

FTTP would provide the best capacity for remote learning for children and students, and more reliable access to medical and other services for the elderly and disabled during emergencies or severe weather when wireless service is more likely to be interrupted. FTTP would also prevent the exclusion of those disabled or suffering from wireless RFR who cannot be near wireless infrastructure or wireless Internet. These residents should have equal access to broadband -- a necessary service -- in a manner that does not injure them and that does not otherwise put them in harm’s way. After all, people cannot adopt a technology that is not being made available to them or that is injuring them. Those suffering from wireless RFR tend to be in these Communities.

Conclusion

The CEJST should incorporate metrics of monitoring the levels of electrosmog from wireless structures and levels of fiber optics deployment in the Communities “to help Federal agencies ensure that the benefits of the nation’s climate, clean energy, and environmental programs are finally reaching the communities that have been left out and left behind for far too long.” Fiber optics deployment for FTTP would ensure the

³⁷ <https://bestneighborhood.org/tv-and-internet-hamilton-county-tn/>.

³⁸ <https://www.allconnect.com/blog/internet-speed-classifications-what-is-fast-internet>.

³⁹ <https://www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report> .

⁴⁰ https://www.broadbandworldnews.com/document.asp?doc_id=773546.

⁴¹ <https://s3.amazonaws.com/files.fiberbroadband.org/download/3555.4237?AWSAccessKeyId=AKIAIZGD7FMLIYLBZNI&Expires=1650065068&Signature=CfFGHmOkZaAovAfuGmXXs2hDpKo%3D>.

⁴² In Kansas, Rural Chanute Built Its Own Gigabit Fiber and Wireless Network,” Christopher Mitchell 10-2-21, <https://ilsr.org/chanute-rural-gigabit/>.

⁴³ <https://www.soar-ky.org/prtc/>.

best connectivity, digital inclusion, environmental equity, as well as safety for the environment and for the health of the Communities.

Respectfully submitted,

Wired Broadband, Inc.

Virginians for Safe Technology, LLC

Consumers for Safe Cell Phones

Connecticut for Responsible Technology

Manhattan Neighbors for Safer Telecommunications

Last Tree Laws Massachusetts

5G Free Rhode Island

Safe Technology Minnesota

The Leto Foundation

5G Free California

mocoSafeG.org for Montgomery County, MD

New Yorkers 4 Wired Tech



Submission for White House Environmental Justice Advisory Council

Docket ID No. EPA-HQ-OA-2022-0050

RE: Public Comment period on federal disaster preparedness and relief and community resilience

May 25, 2022

Dear WHEJAC members,

Thank you for this opportunity to provide public comment relevant to federal disaster preparedness and relief and community resilience.

Human Rights Watch is an international organization based in New York that investigates human rights abuses in over 100 countries including in the United States. Over the past two years our women's rights division has worked with several partners to better understand how the climate crisis is worsening the maternal health crisis in the US defined by inequities between Black, Indigenous, and other women of color on the one hand and white women on the other.

This maternal health crisis is rightfully a priority concern for the US government. Preterm birth rates, as just one example, have generally been rising over the past years, and are twice as bad for Black women than for white women. However, our view – echoed by many academics and health workers working in the intersection between maternal and environmental health – is that there is not yet adequate attention on the environmental health impacts on pregnant people. Epidemiological literature shows exposure to extreme heat, hurricanes, wildfire smoke and other climate change impacts and climate change-related disasters is linked with preterm birth and other adverse birth outcomes.

Like other human rights and civil rights organizations, we are excited that your questions focus on how best to protect disadvantaged communities and how resources should be allocated to make sure they can best participate in federal disaster preparedness and relief programs. We strongly support your efforts to promote an environmental justice approach to climate change-related and other disasters in the US.

However, we also request that you promote a reproductive justice approach as well and explicitly press for resources to protect pregnancy and newborn health to help prevent the climate crisis worsening the gap between those who get to have a healthy pregnancy and newborn and those who do not.

Hurricane Maria¹

¹ "Pregnancy in the Path of Hurricanes: Remembering Puerto Rico," Human Rights Watch commentary, September 6, 2019, <https://www.hrw.org/news/2019/09/06/pregnancy-path-hurricanes-remembering-puerto-rico>.

In the wake of Hurricane Maria in Puerto Rico in 2017, Human Rights Watch research found that pregnant women struggled to access care including prenatal checkups. Women near their due date when the hurricane struck struggled to locate their doctor. We spoke to Mariel Alvarez, herself a doula who was a few weeks from her own due date when Hurricane Maria crashed down on Puerto Rico. She had hemorrhaged in two earlier births, and both were early deliveries that required emergency care. As the country plunged into darkness and chaos in the wake of the storm, Alvarez grew increasingly anxious. “I was really afraid that I might die after giving birth,” she said. With broken roads, and hospitals overwhelmed as blackouts roiled the island, she gave birth at home a few weeks later. She relied on her doula skills and a friend to stem her own bleeding, which, like the first two, was excessive.

During our research in Puerto Rico, we also found that access to sexual and reproductive health care, including safe abortion care and contraceptive choice aside from condoms, although even these were sometimes hard to access, was generally lacking in the aftermath of the storm. Mothers also sometimes struggled to breastfeed without access to lactation support. Puerto Rican organizations, including Taller Salud and InterMujeres, have also drawn attention to the problem of domestic violence in the wake of the storm.

Extreme Heat as an Emerging Reproductive Justice Issue

A significant body of research over the past 15 years (please see document attached with this submission for more information) shows an association between heat exposure and preterm birth, low birth weight and still birth. A smaller body of work suggests that exposure to high temperatures may be linked to pregnancy complications and other adverse health consequences for pregnant people.²

Increasing exposure to heat threatens to worsen an already-existing maternal health crisis in the US, where rates of serious maternal illnesses are increasing in prevalence, and preterm (or premature) birth have been on the rise for several years.³ The crisis is centered by racial inequities in maternal health and birth outcomes; rates of maternal illnesses, preterm birth, low birth weight and still birth are all significantly higher for Black as compared to white women.⁴ Exposure to extreme heat and other climate change impacts worsens disparities between those who get to have a healthy pregnancy and newborn and those who do not.

The studies suggest that US government policymakers and healthcare workers will need to do more to protect pregnancy and newborn health from increasing and more intense heatwaves, and generally hotter days and nights across the US, and from other climate-related harms. Aside from sometimes including pregnant people on “vulnerable population” lists (for example, New York City,⁵ and the

² Emma V. Preston, Claudia Eberle, Florence M. Brown, et al., “Climate factors and gestational diabetes mellitus risk – a systematic review.” *Environmental Health* 19, 112 (2020): accessed May 24, 2022, doi: 10.1186/s12940-020-00668-w; Jiyeon Kim, Ajin Lee, and Maya Rossin-Slater, “What to Expect When it Gets Hotter,” *American Journal of Health Economics*, vol. 7 no. 3 (2019): accessed January 20, 2022, doi: 10.1086/714359; Yanji Qu, Wangjian Zhang, Ian Ryan, et al., “Ambient extreme heat exposure in summer and transitional months and emergency department visits and hospital admissions due to pregnancy complications,” *Science of The Total Environment*, vol. 777 (2021): accessed May 24, 2022, doi: 10.1016/j.scitotenv.2021.146134.

³ Centers for Disease Control and Prevention, What’s New, “New Releases for Birth Data,” https://www.cdc.gov/nchs/nvss/new_nvss.htm (accessed May 24, 2022).

⁴ Ibid.

⁵ “Extreme Heat and Your Health,” New York City Health, <https://www1.nyc.gov/site/doh/health/emergency-preparedness/emergencies-extreme-weather-heat.page> (accessed May 24, 2022).

National Weather Service/National Oceanic and Atmospheric Administration⁶) we have not seen any significant federal or other government efforts to address this problem.

The marginalization of pregnancy in efforts to reduce health harms from extreme heat is still prevalent. Human Rights Watch conducted a review in 2020 and found that most plans by local, state, and federal authorities in the US to respond to heat extremes and climate change miss the threat that extreme heat poses to pregnancy, particularly for low-income and Black and brown people. Human Rights Watch reviewed 105 official heat safety web pages, climate action plans, heat plans, heat advisories, disaster plans, and sustainability initiatives for 18 large US cities, including the 15 most populous, with a total of 32 million people. As of August 2020, only two of these documents, from Chicago and Philadelphia, explicitly addressed the danger heat poses during pregnancy. Since the review was conducted, New York City, Miami and possibly other cities have included pregnancy. Concerns about the dangers of heat for pets, in contrast, were found 37 times.

We would like the WHEJAC to consider recommending the following to government leadership on climate change and other environmental justice issues:

- Ensuring access for all women and girls to comprehensive sexual and reproductive health is a central part of disaster preparation and response. Ensure ongoing access to comprehensive contraceptive choice for all women and girls, access to safe abortion care for women and girls, and maternal, perinatal, and newborn health care, including lactation support. This includes, but is not limited to, people living in shelters and in displacement after disaster. Undocumented people should also be able to access emergency health services.
- Ensure that reproductive justice organizations, doulas, midwives, other community birth workers, and lactation consultants are equipped with information and access to authorities managing disaster preparedness, response and recovery and are financially resourced to provide support to pregnant people and other community members, including in response to domestic violence and gender-based violence. Grants for community-based reproductive justice organizations, birth workers and other relevant groups should include help to pregnant people and community members prepare for disasters and help families and pregnant or postpartum people during disasters and recovery periods including by linking them to emergency assistance and other resources, including for survivors of domestic violence.
- Ensure organizations receiving government grants provide reproductive justice training and implicit bias training for disaster and recovery staff. Find other ways to “mainstream” reproductive justice in disaster and recovery work.
- Fund studies to improve understanding of (a) how disasters in the US impact maternal and newborn health, (b) what interventions may better protect maternal and newborn health from disasters, and (c) inequitable exposures and impacts for already-marginalized communities.
- Reproductive justice organizations, doulas, midwives, and others serving low-income and other at-risk communities should be included in disaster planning and resilience-building, including community awareness building campaigns. However, these individuals and organizations should

⁶ “Heat Safety Tips and Resources,” National Weather Service and National Oceanic and Atmospheric Administration <https://www.weather.gov/safety/heat> (accessed May 24, 2022).

be appropriately compensated for helping prepare communities for disasters. Frontline maternal health workers like doulas do lifesaving work in low-income communities or communities marginalized by historical and current racism but are often poorly compensated.

- Public health campaigns on the dangers of extreme heat should include pregnant people, should be available in multiple languages and for people with disabilities. Subsidized assistance, for example to support access to cooling devices or improved housing, should include pregnant people as well as other populations at-risk from environmental health hazards and climate impacts. Pregnancy accommodations at work, for example additional bathroom breaks or water breaks for pregnant people working in hot indoor or outdoor environments, should be protected. Ongoing work by the Department of Labor to design a federal heat rule, the “Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings Rulemaking” process, should fully include heat impacts on pregnancy health and the final rule should be strong enough to protect pregnancy health.

Please contact Skye Wheeler, wheeles@hrw.org, 646 203 2539 for any questions.

Yours sincerely

Skye Wheeler
Senior Researcher
Women’s rights division, Human Rights Watch

For the White House Environmental Justice Advisory Council (WHEJAC)

May 11, 2022 COMMENTS of the SAVERGV Advocate for Underserved Communities

>> 1. What type of support is needed for disadvantage communities to participate in federal disaster preparedness or relief programs? (Assuming VCEs are one sort of disaster here.)

Meetings with Native tribe representatives and others (Vecinos, and Sierra Club) jointly suing Cameron County for excessive beach closures to enable SpaceX to build a till-unpermitted huge Super Heavy Starship, the largest ever from Earth, and challenging Next Decade and other companies planning LNG plants. Our topics: Evacuation planning in anticipation of not only hurricanes, but in the event of a Vapor Cloud Explosion? Our Emergency Services (fire, police, EMTs) have not been trained to respond to such needs as VCEs produce, evacuations, public information, serious burns and massive fires in which the whole sky is ignited due to pools of invisible Methane, lighter than other components of air, and lying above the other layers, trapping heat in, bringing extreme heat to a microclimate which becomes irreversibly damaged, burned beyond recovery, as are all other living things in the huge blast zone. Small fires below ignite the Methane above, exploding beyond possible remediation.

Appoint an Ombudsman to check on whether funding is getting to appropriate parties directly. Meet with *colonias* (for ideas of how, see <https://www.proyectoazteca.org>), Vecinos Para el Bienestar de la Comunidad Costera, Shrimpers, as well as the Esto'k Gna Tribal Nation of Texas, (Carrizo Comecrudo) representatives whose sacred site is in this LNG construction region at "Garcia Pasture" surrounded by an irreplaceable upland loma.

Help prevent, mitigate, and adapt to climate disasters through massive new native tree planting and use of other Eco-System Services nature provides for us which we could never afford or geo-engineer. Use the Eco-System Services planning process now in force in Houston area and surrounding forests. We have, prior to COVID, had Rio Reforestation projects where buses full of students and many community organizations came out to help plant native trees, shrubs, and replacements for invasive alien species like Salt Cedar in disturbed areas. But such grassroots programs need to be enhanced and restarted, reproduced and widely advertised as both educational and important restorations.

Help us stop all pending LNG Projects due to their huge carbon footprints, esp. Methane (main ingredient of all natural gas). Do not allow Sec'y Granholm to reach the limit of LNG permitted (30 B cubic meters) but stay with the 15 billion c.m. by end of this year, on top of 12 million c.m. of LNG already exported.

2. How can Federal disaster relief and aid programs better serve disadvantaged communities that have historically received fewer federal benefits?

Be sure the funding is getting to the neediest, and to homeowners on board with renewables. The utility companies, in March, changed the plan so that they need not truly pay back solar energy producers even if beyond the amount used, so customers cannot run a credit in their utility bill even if they have supplied electricity to the grid as agreed when their solar loans were made and the arrays and batteries were installed.

Report back to communities locally (Who is the accountability person?) whether the mere \$ 30 million for Weatherization PREPAREDNESS has been made available, so contractors can go ahead and install the 3.5 billion in the Bi-Partisan Infrastructure Bill for Weatherization Assistance. Many of our underserved minority communities have no literacy or education on

energy conservation issues, insulation, or weatherization. Their homes are not in good enough repair even to have weatherization installed. So we do need that 30 million to prepare the homes to receive the weatherization. So we need training programs for contractors. Since most contractors are small pick-up truck operations, we need network for outreach and education. Perhaps we need neighborhood networks for assessing needs, writing proposals for this assistance, (with help in English and Spanish for the illiterate).

Our general population, especially the most vulnerable, needs better insulation and other weatherization to help resist extreme storms, floods, etc. of climate change that is now worsening, with Rio Grande City (not just India and Pakistan) at 114 degrees recently already and man more 100-degree days measured in recent years! Would this be thru HUD? Which agencies with a local presence? Ann Cass and her organization, Proyecto Azteca, https://proyectoazteca.wixsite.com/proyectoazteca/our_team and others, need to be integrated into a larger loop.

- We need people to coordinate and promote collaboration on obtaining our share of the \$3.5 billion of Weatherization and the \$30 million of weatherization preparedness. As I learned from my experience in the domestic violence prevention and crisis center community, and other grant writing I have done, non-profits often have more vicious competition amongst themselves for the little funding available than profit-making corporations, who appear to cooperate better. The Dallas Fed Study had focused on 6 Border Community Counties, the results of which are largely still true. Most colonia residents are not new immigrants, but 40% live below the poverty line, with 20% more at the poverty level. The garden hose and extension cords stretched over flood-prone ground are being replaced slowly by water filtration, and improved water and sewage infrastructure projects across Texas.
https://www.youtube.com/watch?v=m3a7_BB7jwY
- Here in the Rio Grande Delta (“Valley”) of Texas, we need similar grant coordination as found in Houston, as well as Eco-System Services analyses and something like what Houston Wilderness has on their Ship Channel, applied to the Brownsville Ship Channel to deal with rising coastal waters among other problems facing the shrimpers and fishermen and - women in this region. <https://houstonwilderness.org/cgo-program>. And see also <https://houstonwilderness.org/houston-ship-channel-trees-program>, which could be used in addition to the “Mitigation Plan” filed by TX LNG for a project we are resisting. They will replace just over 40 acres of wetlands their LNG production and export facility will destroy, according to legal requirements under the 404 (USACE) Clean Water Act provisions, but this **does nothing to mitigate the GHGs**, the huge carbon and water footprint, of the LNG project. Since the scope of the USACE review and comments purports to include only wetlands considerations, atmospheric issues would not be addressed unless such a “channel tree” planting project were initiated. Though we still oppose the LNG projects (TX and RGLNG) which threaten the sacred burial grounds of our local tribe, the scope of the public discourse needs to be broadened to include the main source of pollution: Methane, a deadly GHG. Please help us to resist the 19-story violation of our sacred, fragile eco-system with habitats supporting many listed species, especially the endangered Ocelot and Aplomado Falcon and several newly listed species of birds, sea grasses, and estuarian communities.

We need support for proposing, as more adequate mitigation for LNG projects, something along the Brownsville Ship Channel like the ***Houston Ship Channel Trees & Riparian Enhancement of Ecosystem Services (HSC TREES) Program***, -- A multi-year collaborative project by Houston Wilderness and multiple private/public partners, focused on large-scale tree plantings along the 25 miles of the Houston Ship Channel, targeting native tree species that are ranked in priority based on their respective levels of air pollution absorption (including CO₂, GHGs and PM) as well as water absorption and erosion control - called "Super Trees." The **HSC TREES One-Pager can be found here**.

Help with the Weatherization Assistance funds from Bi-Partisan Infrastructure legislation. Newer "green" building techniques, better insulation, and weatherization assistance is spotty, even among the more affluent of these poorly served communities. Lower Valley Corporation and Community Development Corporation of Brownsville have gotten colonia residents involved in the process of building adequate housing. The informal economy of the Border has little security, but *pulgas* were, especially pre-COVID, a step in moving toward the formal economy. We need to hold educational sessions for the Valley communities at the *pulgas* and in other community venues, as we recover from COVID lockdowns, and to attract investors to create affordable housing. Some strong partnerships already exist with area institutions, but the federal infrastructure funds need to flood these with sustainable housing and materials information.

We need to protect everyone esp. the most vulnerable, using analyses and policy recommendations of various Eco-System Services that save money, improve air quality, lower temperatures, and reduce flood risks in the greater Houston Area, see Deborah January-Bevers' program. <https://houstonwilderness.org/ecosystem-services>.

3. What process steps and information would help eliminate these disparities?

Regular input into Brownsville Navigation District meetings, courts, public education, and local governments related to educating our largely ignorant citizenry about how climate change extremes will impact us all, and most harshly, the poorest minority communities and native peoples and their sacred sites here. Funding is needed for research and development of alternative energy and income generating projects to supplement our shrimping and fishing and eco-tourism, like wind turbines, solar arrays, wave energy (kinetic) and perhaps geothermal.

We need money from the Infrastructure \$3.5 B and \$30 million, earmarked for the retrofitting of buildings so they can have insulation installed on a sliding fee scale according to need. (As Energy Secretary Jennifer Granholm recently reported to Congress on C-Span last week) To eliminate disparities we need: Publicly available funding and **construction trades trainings** (perhaps through AGC and unions) for retrofitting buildings for storms and conservation of energy, renewables to power electricity thru wind and solar and kinetic (wave) energy. We urge you to refer these needs to HUD, and to Sec'y Granholm in Energy. But suggestions are welcome for other agencies, e.g., EPA.

4. What steps can Federal agencies and the White House take to reduce disparities in climate change impacts for communities, including, but not limited to risks from, extreme heat, flood, wildfire, drought, and coastal challenges?

Use the Eco-System Services analysis (see links above) and planning process now in force in Houston area and surrounding forests. Educate the public in massive campaigns to show them how renewables work, small scale or community based solar banking, ... wind and wave energy projects. Promote internships from local Engineering and Tech programs at Community College (TSTC) and University level (UTRGV, STC).

Thank you for your attention to our hurting needs here in the Lower Rio Grande Valley.

For SAVERGV, with appreciation for your work, and hope for our many underserved here,

Sarah Bishop Merrill, M.S., Ph.D.
Harlingen, TX

PUBLIC COMMENTS ON FEDERAL DISASTER PREPAREDNESS AND RELIEF AND COMMUNITY RESILIENCE WITH AN ANTI-TRAFFICKING LENS

The Sunita Jain Anti-Trafficking (SJI) at Loyola Maramount University Loyola School of Law and Leanne McCallum applaud the White House Environmental Justice Advisory Council (WHEJAC) in its intent to understand equity issues for marginalized communities in the context of federal disaster preparedness and community resilience. These joint comments will focus on the intersectionality of federal disaster preparedness, historically disadvantaged communities, and human trafficking.

The Sunita Jain Anti-Trafficking Initiative (SJI) at Loyola Maramount University Loyola Law School (LLS) builds upon the school's legacy of research, policy innovation, and inclusion in the law. SJI is part of LLS's Anti-Racism Center and Loyola Social Justice Law Clinics. SJI is an evidence-based community informed think tank that intentionally fills gaps in human trafficking prevention with an intersectional approach through systemic change and policy innovation. A core value of SJI is that policy recommendations must be guided by the lived experiences of trafficking survivors. Therefore, SJI supports survivor consultants whose intersectional trafficking experience reflect SJI's core values of racial justice, climate justice, immigrant justice, economic justice, and government accountability.

Leanne McCallum Desselle is a leader in the anti-trafficking field whose work centers on establishing evidence-based, human rights driven anti-trafficking responses. Leanne's expertise is informed by her professional experience facilitating multi-disciplinary human trafficking initiatives, and also her research on the topics of exploitative labor and human trafficking. Currently, Leanne is the Strategic Projects Manager for the Louisiana Alliance of Children's Advocacy Centers. The cornerstone of her role is to act as Project Manager for the Louisiana Child and Youth Trafficking Collaborative (LCYTC), a statewide program to establish multi-disciplinary teams to respond to cases of human trafficking. Previously, she worked as the Task Force Coordinator for the Greater New Orleans Human Trafficking Task Force. She has been a featured expert speaker and consultant for local and national organizations, including: the International Association of Chiefs of Police, the U.S. Bureau of Justice Assistance, the U.S. Office for Victims of Crime, Freedom Network USA, National Human Trafficking Training and Technical Assistance Center, and the HEAL Network.

THE INTERSECTION OF DISADVANTAGED COMMUNITIES, FEDERAL DISASTER RELIEF PREPAREDNESS, AND HUMAN TRAFFICKING

Preventing trafficking and preventing inequity in disaster relief assistance for disadvantaged communities is one in the same. Inequity in federal disaster relief preparedness fosters conditions that make historically marginalized communities vulnerable to trafficking. These historically marginalized were already not just vulnerable to trafficking before the onset of a natural disaster, but less likely to be identified as a victim and access the legal protections and benefits afforded

by trafficking survivors. The more effective and direct the disaster relief assistance is, the less likely someone from a disadvantaged community will be vulnerable to trafficking.

A. Background on Disadvantaged Communities & Anti-Trafficking Efforts

In order to understand how federal disaster preparedness can better serve disadvantaged communities while addressing human trafficking, it is necessary to understand the intersectionality of federal anti-trafficking efforts that disparately impact the very same disadvantaged communities. The National Action Plan to Combat Human Trafficking (hereinafter “NAP”) defines human trafficking as “a crime of exploiting a person for compelled labor, services, or commercial sex act(s)” via force, fraud, and coercion[1]. Although the U.S. government is heralded as having the most comprehensive domestic anti-trafficking legislative framework in the world, human trafficking survivors from black, brown, and non-citizen communities (especially those with intersecting identities like disability, LGTBQIA, etc.) are simultaneously rendered more vulnerable to trafficking while being excluded or lacking meaningful access to protections and benefits for survivors[2]. These communities are more likely to experience historical and systemic discrimination as well as encounter the criminal legal system and be treated as criminals and not victims due to the multi-faceted failure of law enforcement agencies (hereinafter “LEA”) in anti-trafficking efforts.

Moreover, the U.S. government’s carceral approach to anti-trafficking (and subsequent focus on the criminal as opposed to civil legal system) combined with the consistent failure to provide equal resources and prioritization to labor trafficking has resulted in two general inequities. First, the weak framework of federal worker protections for laborers in informal economies, who tend to be non-citizens from communities of color, directly makes them even more vulnerable to trafficking. Second, labor trafficking cases are under-investigated because criminal law is ill-equipped to prosecute “coercion” based trafficking claims and civil agencies like the Department of Labor (DOL), and the U.S. Equal Employment Opportunities Commission (EEOC) are not provided resources and directives to report, investigate, and prosecute labor trafficking. Lastly, the expansion of criminal and immigration enforcement systems and their exacerbating overlap have only further subjected black, brown, and non-citizen communities (and thereby survivors) to greater risk of vulnerability to trafficking, state-sanctioned surveillance, and exploitation.

B. Background on Natural Disasters and Human Trafficking

The connection between natural disasters and trafficking in the U.S. impacts two groups: the communities that live in areas that experience a natural disaster and the individuals that come to the impacted area to engage in disaster relief work (hereinafter “disasters relief workers[3]”).

In the U.S., there are multiple reports of spikes in sex and labor trafficking for residents in an area that experienced a natural disaster[4]. The NAP explains that particular factors make individuals more vulnerable to trafficking such as “difficult economic conditions, instability in housing, substance abuse issues, lack of family support to isolate victims and make them wholly dependent upon their traffickers.” In the face of a sudden on-set natural disaster, entire communities experience these issues. The International Organization for Migration explains how these exact factors show up in a natural disaster[5]:

“ A sudden-onset disaster can cause unexpected loss of land and lives, and destruction of means of livelihoods, instantly plunging those without safety nets into poverty. In the immediate aftermath of a disaster, displacement is likely to occur, giving space for traffickers to operate and exploit affected people, their desire for safety and search for means of income to help restore their lives. This may lead to either a sharp rise in human trafficking if the region already witnessed exploitation or the creation of a new “hotspot” for human trafficking.”

The Center for Disease Control and Prevention[6] has also clarified that natural disasters make people more vulnerable to trafficking because they are rendered homeless (one of the top risk factors for trafficking as reported by survivors to the National Human Trafficking Hotline[7]), disconnected from their emotional and social support networks, and unable to safely earn income and be self-sufficient.

Furthermore, natural disasters also require extensive and long-term restoration work. Disaster relief workers are individuals who work primarily in the industries of construction, debris clean-up efforts, hospitality, and maid service industries in the wake of a natural disaster[9]. This labor force is unique in that disaster restoration work requires “a large number of workers that is instantly mobile and open to arduous and dangerous work [10].” The limited data from Hurricane Katrina, Irma, and Harvey highlight that the vast majority of resilience workers moved into the effected area for the work, identify as Latino or Hispanic, and are undocumented[11]. In an extensive survey by the National Day Labor Organizing Network (NDLON) of 171 day laborers after Hurricane Ida, 83% of workforce in Hurricane Ida was undocumented. Furthermore, construction, environmental remediation, and landscaping contractors were responsible for 65% of the jobs worked by day laborers[12].

Several human rights organizations and investigative journalists[13] have documented the extensive intersectional issues disaster relief workers face because they are undocumented, new to the area and isolated from their support systems, non-English speaking, rely on their employer for basic needs like food, water, and sometimes shelter since they are uniquely in a disaster zone, and in dire need of economic security.

C. The Importance of Effective and Accessible Disaster Relief in Mitigating Trafficking

Disaster relief can provide the safety net that disadvantaged communities need in order to bypass the factors that lead to exploitation and trafficking: basic necessities like food and water, short and long term housing, financial security, connections to case management services, etc. If disaster relief efforts fail or continue to be inequitable, low income communities of color will be vulnerable to force, fraud, and coercion in order to have access to those very factors. Furthermore, if they are forced to undertake criminal activity as part of their trafficking experiences (which can range from prostitution, felony level assault, to theft), survivors from communities of color are more likely to be labeled as criminals and not victims by law enforcement and other actors in the criminal legal system. For non-citizens, racial profiling proliferates non-citizen arrests made by local LEAs and ICE, with the added burden that an arrest can trigger placement in removal proceedings or immigration detention.

No one suffers more at this intersection than young black girls [32]. They are statistically more likely to be treated as criminals and not victims in comparison to any other racial group. They are arrested at exorbitantly higher rates for prostitution, have their cases adjudicated through the juvenile justice system, and are more likely to be detained in a locked facility than their white counterparts. Black non-citizens are more likely to remain in detention longer than other migrants, pay significantly higher bonds for release, and make up 24% of all solitary confinement detentions even though they make up only 4% of those in ICE custody.

QUESTION 1

What type of support is needed for disadvantaged communities to participate in federal disaster preparedness or relief programs?

The appropriate question for WHEJACK to ask is not about the kind of support needed to encourage participation, but why *should* disadvantaged communities participate and trust agencies in the first place given the legacy of racial and economic inequity in federal disaster relief preparedness?

The legacy of slavery, segregation, racist immigration policies permeate the contemporary discussion of effective disaster relief preparedness. Historically marginalized communities (which are irrefutable black, brown, and low-income with other intersectional identities) are more likely to live in disaster zones with inadequate public transportation options as a direct result of redlining, less likely to qualify and receive insurance and federal aid, and more likely to be criminalized in criminal and civil enforcement systems for survival crimes post disaster. Furthermore, the reality style cable news television coverage on Hurricane Katrina made clear to the world "...that the U.S. has not resolved fundamental domestic disparities and inadequacies. Katrina did not create these inequities; it simply added an important reminder that they are deeply embedded and constitutive of American political, economic, and social life[14]).

However, almost twenty years after Hurricane Katrina, The New Orleans Data Center[15] tells us that the underlying factors of race and economic inequality remain the same. Low-income populations and communities of color continue to live in the parts of the Greater NOLA that are most flood-prone and prone to all forms of severe weather. They continue to be the least likely to be able to evacuate for dangerous weather even though they're most likely to experience it. As evidenced by Hurricane Ida, people from mostly white affluent neighborhoods were more likely to receive disaster relief than low-income populations from communities of color.

The trust between federal agencies and disadvantaged communities is not something to be "rebuilt," **but earned**. SJI and LMD strongly suggest that trust earning efforts be envisioned along the lines of Federal Emergency Management Agency (FEMA)'s definition of equity and guiding equity principle- to ensure that all people are helped before, during and after disasters, based on their specific needs.

SJI and LMD suggest the following:

1. Invest in long-term relationships with a variety of grassroots CBOs that prioritize intersectionality and are run, operated, and staffed by people with lived experiences on the issues in the community that they serve.

Federal disaster relief agencies and personnel must engage in long-term, ongoing, and frequent meetings with local practitioners and impacted communities *before* the onset of a natural disaster. It is necessary for federal agencies to understand the legitimacy of the mistrust of disadvantaged communities as well as the gaps that CBOs have filled when disaster relief efforts have not reached these communities. Federal agencies must understand that impacted communities are more likely to trust CBOs over them because CBOs have delivered results and are from the communities they serve.

For example, when farmworkers in wildfire regions in California were not receiving N95 masks from employers despite a local mandate, the Mixteco/Indígena Community Organizing Project distributed around 15,000 masks directly to workers, the bulk of which were donated by the local public health department[16]. Another example is the work of New Orleans Worker’s Center for Racial Justice, The National Guestworker Alliance, and Resilience Force¹. In the aftermath of Hurricane Harvey and Ida, they have engaged in grassroots worker and immigration know-your-rights sessions directly on work place sites, created pathways for undocumented disaster relief workers to testify before local and state government committees, provided laminated badges on-site to workers who lack identification to avoid harassment and potential immigration concerns, retrieved passports from Sheriff Offices so that workers could report without facing immigration consequences, contacted the Department of Labor to file wage and hour claims, and formed multi-ethnic coalitions to exert pressure on government agencies to take on civil lawsuits against corporations.

2. To encourage non-citizens to participate in relief programs, federal agencies must (a) eliminate or minimize immigration enforcement and (b) work alongside trusted CBOs to educate immigrant communities on new laws surrounding federal benefits and immigration law. These efforts will in turn mitigate trafficking while encouraging non-citizen trafficking survivors to report their victimization.

Although SJI and LMD recognize that the Biden Administration is trying to undo the punitive immigration policies under the Trump Administration, ultimately non-citizens still fear coming forward to seek state and federal benefits in a natural disaster[17].

The Trump Administration’s xenophobic rhetoric, public charge rule[18], and emphasis on deportation in removal proceedings continue to isolate non-citizen communities. For example, The Protecting Immigrant Families Coalition/BSP Research Survey makes clear that the Trump public charge rule continues to have a powerful “chilling effect” on immigrant families. Nearly half (46%) of families who needed assistance during the COVID-19 pandemic abstained from applying for assistance due to concerns over how doing so could impact their immigration status. Furthermore, more than two in five respondents believe “applying for assistance programs could

¹ See generally McCallum, L. (2020). Reflections from the Field: Disparate responses to labour exploitation in post-Katrina Louisiana. *Anti-Trafficking Review*, (15), 21–41. <https://doi.org/10.14197/atr.201220152>; <https://www.newyorker.com/magazine/2021/11/08/the-migrant-workers-who-follow-climate-disasters>

cause immigration problems,” and 34% were unsure of the consequences of using public assistance programs. Awareness was especially low among AAPI communities.

The fear of immigration consequences for seeking public assistance is only exacerbated in natural disasters which have always corresponded with an increase in immigration enforcement and surveillance.

Most major natural disasters have created a simultaneous need for cheap labor for dangerous work, which can be supplied by undocumented immigrants and an increase in DHS, ICE, and other LEA surveillance and enforcement. In the aftermath of Hurricane Katrina, DHS announced it deployed 750 officials to the Gulf Coast, which included Detention and Removal Staff as a “security effort” to enact a “zero tolerance policy” towards migrant workers[19]. Black and immigrant laborers have repeatedly reported harassment on the street while working from law enforcement throughout multiple disasters. This situation was only exacerbated when law enforcement was deputized by ICE to undertake immigration enforcement. During Hurricane Michael, the Bay County Sheriff’s Office staged a series of undercover sting operations where resilience workers were arrested for felony charges of “contracting without a license during a state of emergency,” turned over to ICE, and deported. Throughout these operations, the employers themselves were never held accountable.

As discussed in Question 4, SJI and LMD strongly suggest that immigration enforcement efforts be suspended in the aftermath of a natural disaster. This will send a clear message from the federal government that it wants to help non-citizens as opposed to subjecting them to civil and criminal enforcement.

As discussed above, federal agencies should meaningfully invest in relationships with CBOs, who in turn can continue serving as trusted messengers to non-citizen communities.

All of these efforts will mitigate the factors that make marginalized communities vulnerable to exploitation and trafficking in the wake of a natural disaster. Individuals will not feel as socially isolated, will receive government verified information by people from their own communities who they trust, have a meaningful understanding of their rights as they navigate a sudden loss of economic security, and feel safer coming forward to report victimization to at least CBOs.

3. To encourage sex and labor trafficking survivors to come forward, federal agencies must not rely on law enforcement agencies (LEAs) to identify survivors, avoid criminalizing survivors (including in the civil immigration system), work with CBOs doing grassroots know-your-rights work with marginalized communities, and work directly with former survivors on messaging and external engagement.

Despite a plethora of data indicating the failure of LEAs to identify survivors, state and federal agencies still rely on them to do so. Freedom Network, ACLU, and CAST have submitted information on this at length. USC’s International Human Rights Clinic’s Report on LEAs and sex trafficking underscores that LEAs simply arrest large numbers of sex workers who are primarily black women. Physical and sexual abuse by LEAs to arrestees from marginalized and intersectional communities (particularly black, non-citizen, and LTBQIA[1]) is well

documented[2], particularly towards sex workers. CBOs have also reported how state and local LEAs engage in abuse during investigations of AAPI massage parlors.

[1] <https://scholarship.law.wm.edu/cgi/viewcontent.cgi?article=1462&context=wmjowl>

[2] <https://www.bwjp.org/assets/documents/pdfs/webinars/dhhs-police-sexual-misconduct-a-national-scale-study.pdf>

QUESTION 2

How can Federal disaster relief and aid programs better serve disadvantaged communities that have historically received fewer federal benefits?

SJI and LMD recommend the following for relief and aid programs to better serve historically marginalized and disadvantaged communities, particularly to mitigate exploitation and trafficking:

1. Shift to an intersectional approach in understanding the multiple and overlapping identities of disadvantaged communities

In order to better serve disadvantaged communities, federal disaster relief and aid programs must understand the intersectional identities of the communities they purport to serve.

The concept of intersectionality describes the ways in which systems of inequality based on gender, race, ethnicity, sexual orientation, gender identity, disability, class and other forms of discrimination “intersect” to create unique dynamics and effects. From a policy perspective, the underlying idea is that all forms of inequality are mutually reinforcing and must therefore be analyzed and addressed simultaneously to prevent one form of inequality from reinforcing another.

The consequence of not integrating environmental justice with racial, economic, and immigrant justice is the fostering of conditions for exploitation and trafficking. For example, in LMD’s experience on the ground post Hurricane Ida in Southeast Louisiana, federal disaster aid workers were limited in their ability to identify and assist immigrant labor trafficking survivors. Despite knowing that immigrant workers were doing roofing repairs and building reconstruction under exploitation circumstances, state and federal aid workers did not have the tools or training to screen for labor exploitation, offer resources to the workers, did not speak Spanish or any indigenous language, and had limited interpretation services available. The result was unaddressed labor trafficking and exploitation of disaster relief workers after Hurricane Ida.

2. Lower the barriers for disadvantaged communities to rapidly receive financial support

SJI and LMD understand that FEMA Equity Plan does address the need to understand the barriers to receive financial support and lower them. However, there is little in the plan that addresses how individuals with limited online capacity and education will be able to get the financial support they qualify for.

For example, many FEMA applicants have to complete a Small Business Association Loan request to get reimbursement for destroyed property even if they don't want a loan, but just need financial assistance. This is an example of an undue burden that is purely administrative and harder to complete for low-wage workers, people with limited access to Wifi, Non-English speakers, and those with limited education. Obviously, these would be individuals from disadvantaged communities.

Another example is the failure of the Blue Tarp Campaign, particularly in Houston, Texas[20] and following Hurricane Ida in Louisiana. Distribution of State and Federal aid from the Blue Tarps happened at a slow trickle. Homeowners were at risk of losing insurance coverage for not conducting mitigation efforts even though they were not provided the financial aid they were promised to undertake the mitigation efforts.

Economic insecurity and loss of livelihood have always been a primary factor in rendering people vulnerable to trafficking and exploitation. The faster and more effective the federal aid in a disaster relief, the less likely disadvantaged communities will be vulnerable to the force, fraud, and coercion of traffickers.

3. Institutionalize a direct, frequent, and ongoing presence with disadvantaged communities to ensure approaches are effective and community-driven rather than prescriptive.

Disadvantaged communities should be directly asked what they need before, during, and after a natural disaster. Federal agencies need to engage in long term, frequent, and direct conversations with CBOs and community members, which in turn creates a space of trust and open communication.

4. Protections for disaster relief survivors must extend to disaster relief workers

Despite the fact that disaster relief workers are undertaking the arduous, dangerous, and hazardous labor of rebuilding America, federal disaster relief and aid programs have yet to meaningfully extend protections and benefits to disaster relief workers. Without an accessible framework for worker rights that are specific to the circumstances of disaster relief workers, the U.S. government will continue to inadvertently foster conditions that encourage trafficking and exploitation with impunity.

SJI and LMD suggest the following to ensure that disaster relief workers are protected from exploitation and trafficking:

- (i) *FEMA must coordinate with DOL, OSCHA, and EEOC to strengthen worker protections and trafficking reporting, investigation, and prosecution.*

FEMA has historically not provided cash assistance or Disaster Unemployment Assistance to people that are undocumented. However, it has not coordinated with other federal agencies (i.e. DOL, OSCHA, EEOC) which have the jurisdiction to work with non-citizen communities on worker's rights, exploitation, and trafficking. SJI and LMD believe that this coordination should be aligned with FEMA's Equity Principle of protecting workers before, during, and after a natural disaster. These civil federal agencies should be appropriated with

enough resources, training, interpreters, and other staff to (at minimum) build long-term relationships with CBOs that work with non-citizen resilience workers, deploy rapid response teams directly to natural disasters to accommodate the influx of workers, and expedite legal claims to earn the trust of the community.

(ii) *State and Federal prosecution response to trafficking must shift from a criminal to civil legal system in the wake of a natural disaster*

Despite the fact that there are more reports of labor trafficking than sex trafficking to service providers[21], labor trafficking remains woefully under-investigated. Moreover, civil agencies with jurisdiction to undertake labor trafficking claims lack the resources and directives to report, investigate, and prosecute these claims. For example, despite the fact that there were nine successful civil litigations on behalf of disaster relief workers and zero criminal cases, there was only one Spanish speaking interpreter for the entire State Department of Labor for Louisiana. The majority of labor trafficking claims are premised on the concept of “coercion” under the Trafficking Victims Protection Act, which is difficult to prosecute in a criminal legal framework[22].

(iii) *DHS must stop relying on ICE to identify labor trafficking survivors and turn to CBOs instead*

As specified in their own reports and trainings[23], the many members of federal law enforcement agencies believe that undocumented workers will readily report their victimization to an immigration, despite the fact that some of these agencies are charged with conducting arrests and raids for their very detention, deportation, and separation from their families. The U.S. government has evidence of the limitations of identifying victims of labor exploitation through ICE, yet these practices continue. Also, the U.S. government continues to prioritize ICE for survivor identification knowing that employers use this realistic fear of law enforcement and immigration retaliation to subject undocumented immigrants to labor trafficking when that is exactly what ICE does.

Government agencies continue to use words like “mistrust” and “hesitation” in describing why disaster relief workers fail to approach law enforcement agencies for help. It highlights a lack of understanding of the lived experiences of undocumented workers in the U.S. More importantly, it highlights that U.S. policy prioritizes immigration enforcement over worker rights while expecting migrant workers to readily comply with the very enforcement priorities that harm them.

QUESTION 3

What process steps and information would help eliminate these disparities?

SJI and LMD recommend the following steps to help eliminate disparities:

1. Federal Agency Trainings on disaster relief should include human trafficking survivors whose victimization resulted from a natural disaster.

Federal agencies in charge of equity should include sex and labor trafficking survivors (including disaster relief workers) at all parts of policy planning to ensure that the most vulnerable communities are included and conditions fostering exploitation and trafficking are mitigated. Survivors and their communities should be treated as experts with lived experience. They are the best individuals to convey the intersectionality of their identities, the barriers they continue to face in accessing disaster relief programs, and what solutions would be the most accessible and meaningful to them.

2. FEMA's Equity plan must specify a methodology and implementation for language access:

Although FEMA's Equity Plan addresses the need to "address any language barriers that could present administrative burden to individuals with limited English proficiency," there is no further information on how FEMA plans to do that. FEMA must thoughtfully articulate a methodology for picking the languages it chooses to provide access to, how it will verify the accuracy of the information, etc. to ensure that the language access program is effective. SJI and LMD strongly recommend including non-english speakers from disaster prone areas at every stage of the development of the language access program.

There are a plethora of examples of how language access plans have failed in understanding the communities they purport to serve. For example, during the 2017 Thomas fire, Ventura County used Google Translate to share emergency information in Spanish throughout the first days of the crisis, resulting in grievous mistakes, including translating "wildfire" into the Spanish word for "hairbrush." Issues with translation can also confuse mandatory evacuation orders, a tool crucial to moving residents to safety[24]. Another example is in Sonoma County, where more than 100,000 of the state's farmworkers are Indigenous and speak Mixtech and not Spanish, but disaster relief FAQs were provided only in Spanish[25].

3. Invest in equitable access to technology

As explained *supra*, disadvantaged communities will not have equal access to wifi, internet, etc. as wealthier counterparts. Equitable access to information about evacuation orders, safety protocols, aid applications that are online etc. will strengthen someone's connection to social and economic support, mitigating their chances for exploitation and trafficking.

4. Ensure that disaster relief websites, hotlines, online portals for application etc. remain accessible at a variety of times to accommodate a wide range of people.

Websites operated by state and federal governments with information about disaster relief aid have consistently crashed in the first week of major natural disasters like the Dixie Wildfire as well as Hurricane Katrina, Ida, and Harvey. The delay in accessing critical information about evacuation measures, safety protocols, and disaster relief aid can be prevented if federal agencies invest in a robust 24/7 technical assistance program.

QUESTION 4:

The following is a list of steps Federal Agencies and the White House can take in addressing the intersectionality of disadvantaged communities, climate change, natural disasters, federal disaster relief preparedness, and vulnerability to trafficking:

THE DEPARTMENT OF LABOR and EQUAL EMPLOYMENT OPPORTUNITY COMMISSION

1. DOL and EEOC must be funded to have enough staff, training, and resources to address labor exploitation and trafficking in the wake of a natural disaster

Neither the state nor federal DOL and/or EEOC have been funded or prioritized in a way that would enable them to investigate, prosecute, and protect labor exploitation or trafficking victims before, during, or after a natural disaster. A robust State and Federal Department of Labor that works alongside marginalized communities, workers, and survivors is necessary in order to:

- Have extensive survivor-led trainings on what constitutes force, fraud, and coercion under the TVPRA. Most agencies focus on identifying the kind of trafficking as opposed to the elements of trafficking itself
 - Evaluate what solutions worked and didn't work for different marginalized communities
 - Meaningfully extend the legal protections afforded to labor trafficking survivors under the TVPRA
 - Encourage non-citizen communities to engage with civil federal agencies for wage and hour and trafficking investigations
2. DOL/EEOC should be included in FEMA's Equity Plan as a viable solution to including disaster relief workers and non-citizen communities

The FEMA Equity Plan notably fails to mention the DOL or EEOC at all even though FEMA is the agency in charge of coordinating all federal disaster relief efforts across federal agencies.

THE DEPARTMENT OF HOMELAND SECURITY

1. ICE must expand the Protected Area Memo

ICE should expand the existing provision under Protected Areas Memorandum[26] to include “a place where disaster or emergency response and relief is being provided, *which includes all work and workers associated with disaster restoration relief ...*”. Although the “Protected Areas Memorandum” includes “a place where disaster or emergency response and relief is being provided,” ultimately the provision only protects people receiving services and not disaster relief workers. An expansion of this provision for disaster relief workers would delegitimize the coercive power of threats of detention deportation for undocumented workers. It sends a message from the federal government to workers that “their safety and well being are paramount[27],” which can potentially encourage more non-citizen survivors to report trafficking and cooperate in investigations.

2. DHS Trainings to FEMA on survivor identification should include disaster relief trafficking survivors

The 30-minute or 1 hour training[28] is done by DHS's Blue Campaign and is a general overview of what trafficking is. It is not specific to disaster relief workers, what trafficking looks like in the rebuilding process, or include appropriate referrals. It does not focus on the issues of subcontracting from larger disaster relief firms backed by private equity initiatives, the physical health issues they face as a result of disaster relief work, the trust they place in worker rights organizations and CBOs, their fear of government agencies, etc. Lack of information about resilience workers and the nuances of their exploitation make it highly unlikely that FEMA will be able to identify vulnerable populations and fill gaps in their trafficking prevention work that are applicable. Resilience workers should be part of the training from brainstorming to delivery to communicate the nuances of their exploitation and fears.

FEMA

1. Expansion of shelter and food policy for disaster relief workers

FEMA can expand its policy on shelter and food for emergency/response personnel to include disaster relief workers. Disaster relief workers exist in the same environment as the communities impacted by the natural disaster, meaning they also have limited access to functioning transportation, internet, grocery stores, etc. They are also isolated from their normal support structures coupled with reliance on their employer for basic necessities like food, shelter, and water makes workers more vulnerable to trafficking. Having another easily accessible avenue for basic necessities could mitigate potential exploitation.

2. Include human trafficking survivors in FEMA policy planning

The FEMA Equity Plan[29] cites several opportunities for community consultation. SJI and LMD strongly suggest that survivors be included at every point in the policy planning process to ensure that the needs of most vulnerable communities are meaningfully addressed. For example, survivors can be included in the following ways in the FEMA Equity Plan:

- The Equity Enterprise Steering Group (particularly in the new strategic plan subgroup)
- The restructuring of the Public Assistance Delivery Manager Program (which provides technical assistance to historically underserved communities)
- The Recovery Support Function Leadership Group which focuses on equity and recovery in disaster relief
- As leaders in FEMA's "external engagement" plan to undertake community surveys, focus groups, mailers, door to door canvassing etc. Survivor to survivor peer leadership and engagement is a powerful and effective tool in connecting with vulnerable communities that distrust federal agencies and in reaching actively trafficked individuals.

3. Specify methodology and implementation plan for language access:

FEMA must update its equity plan to clarify the specific methodology and implementation on language access to answer the following:

- How will FEMA determine the exact barriers before, during, and after a natural disaster?
 - How will FEMA assess which languages should be provided in-person for disaster field offices and via the national FEMA hotline?
 - What systems will FEMA put in place to ensure that the non-English materials are both available to potentially impacted communities, and are accurate?
 - What kind of formal evaluations will FEMA undertake with non-english speaking communities before, during, and after a disaster relief to ensure that the information provided was accessible?
4. Reporting data for FEMA's Individual Action Program should be aggregated to include Non-English speakers.
 5. Expand FEMA Equity Plan to include individuals that are not direct disaster assistance applicants but still impacted by the same natural disaster.

SJI and LMD commend the explicit emphasis in the FEMA Equity Plan to gather “feedback and recommendations” from disaster assistance applicants before, during, and after a natural disaster. However, there is no mention in the plan on how to evaluate which communities still encountered barriers in accessing disaster assistance and why. Without an explicit plan to address this caveat, trafficking survivors (and especially disaster relief workers) will not be able to meaningfully access disaster relief benefits or protections.

THE WHITE HOUSE

SJI and LMD applaud the Biden Administration in bringing an intersectional whole-of-government approach to environmental justice, trafficking, and marginalized communities. In order to reduce disparities in disaster relief and trafficking, the White House can undertake the following:

- Pathway to Citizenship for Essential Workers: Disaster relief workers qualify as essential workers. Under both Democratic and Republican administrations, lack of immigration status has always been considered a vulnerability to trafficking. The potential of immigration status would send a message to non-citizen workers that they have legal rights across the sectors of employment, immigration, and climate change. It would also send a message to traffickers (both individual and large-scale corporations) that they can no longer exploit such a vulnerable population.
- Expedite “Internet for All” programs to ensure that states prone to natural disasters have affordable internet access: As discussed *supra*, reliable internet access is essential for

federal and state agencies to provide services and for marginalized communities to access up-to-date information on immediate disaster relief services. Currently, to participate in some of the programs, states must submit a letter of intent and a planning funds budget. However, hurricane season is already underway and wildfire season is approaching in a few ways. The application process should be expedited for states prone to 2022 climate disasters.

- Include disaster relief workers on the U.S. Advisory Council on Human Trafficking[31]: The whole-of-government approach to workers rights, climate change, immigration, and trafficking should be guided by the lived experiences of vulnerable communities. The U.S. Advisory Council on Human Trafficking is supposed to directly advise the President's Interagency Task Force and the Senior Policy Operating Group. There is now way for the White House to understand the intimate and nuanced intersectionality of disaster relief and trafficking without the guidance of survivors at the highest level of government.

[1] <https://www.whitehouse.gov/wp-content/uploads/2021/12/National-Action-Plan-to-Combat-Human-Trafficking.pdf>; *see also* 22 U.S.C. § 7102(4); 18 U.S.C. § 1591; 22 U.S.C. § 7102(11); 18 U.S.C. § 1591

[2] *See generally* [\(E\)racing Childhood: Examining the Racialized Construction of "Childhood" and "Innocence" in the Treatment of Sexually Exploited Minors](#), 62 UCLA L. Rev. 1586 (2015)

[4] https://www.huffpost.com/entry/harvey-irma-and-maria-natural-disasters-and-human_b_59d55cdbe4b085c51090ad63;
<https://www.antitraffickingreview.org/index.php/atrjournal/article/view/487>

[6] https://www.cdc.gov/disasters/human_trafficking_info_for_shelters.html

[7] <https://polarisproject.org/blog/2017/09/natural-disasters-and-the-increased-risk-for-human-trafficking/>

[8] <https://nhhtac.acf.hhs.gov/sites/default/files/2020-02/Trafficking%20Prevention%20and%20Disaster%20Response%20Literature%20Review.pdf>

[9] Moreover, the racial origins of weak labor protections for disaster relief workers have historically always been overlooked. Black men and migrants have routinely been overlooked. Black men and migrants have routinely Moreover, the racial origins of weak labor protections for disaster relief workers have historically always been overlooked. Black men and migrants have routinely been forced (sometimes at gun point at the behest of the U.S. government) to undertake exceptionally hazardous and dangerous work in the aftermath of a natural disaster. In 1900, black men were forced at gunpoint by white soldiers to perform grotesque disaster restoration⁵, including dumping corpses into the sea. In 1928, 75% of deaths from the Great Okeechobee Hurricane in Florida were migrant agricultural workers, many of them black⁶. Although the structure of the disaster relief industry has transformed in both the private and public sector, ultimately the exploitation and lack of meaningful protection of black and brown essential workers endures.

[10] <https://www.newyorker.com/magazine/2021/11/08/the-migrant-workers-who-follow-climate-disasters>

[11] *Id.*

[12] <https://ndlon.org/wp-content/uploads/2022/04/Recovering-from-Climate-Disasters-Report-2.26.22.pdf>

[13] <https://doi.org/10.14197/atr.201220152>

[14] <http://jcia.aciajj.org/files/2012/02/Miller-and-Rivera-2.pdf>

[15] <https://www.datacenterresearch.org/topic/housing/>

[16] <https://www.nasw.org/article/wildfire-concerns-grow-farm-workers-remain-vulnerable>

[17] <https://www.nytimes.com/2020/03/18/us/coronavirus-immigrants.html>

[18] <https://www.nilc.org/wp-content/uploads/2020/03/Public-Charge-What-Advocates-Need-to-Know-Now.pdf>

[19] <https://www.newyorker.com/magazine/2021/11/08/the-migrant-workers-who-follow-climate-disasters>

[20] <https://www.houstonpublicmedia.org/articles/news/2016/12/29/181149/the-ordeal-of-a-houston-senior-citizen-who-lived-under-a-blue-tarp-for-eight-years/>

[22] Kim, Kathleen, Psychological Coercion in the Context of Modern-Day Involuntary Labor: Revisiting *United States v. Kozminski* and Understanding Human Trafficking. University of

Toledo Law Review, Vol. 38, No. 3, 2007, Loyola-LA Legal Studies Paper No. 2007-40,
Available at SSRN: <https://ssrn.com/abstract=1021819>

[23] <https://nhttac.acf.hhs.gov/sites/default/files/2020-02/Trafficking%20Prevention%20and%20Disaster%20Response%20Literature%20Review.pdf>

[24] <https://www.nasw.org/article/wildfire-concerns-grow-farm-workers-remain-vulnerable>;
<https://www.latimes.com/opinion/story/2021-10-28/farmworkers-immigrants-wildfires-california-climate-crisis>

[25] <https://www.latimes.com/opinion/story/2021-10-28/farmworkers-immigrants-wildfires-california-climate-crisis>

[26] https://www.dhs.gov/sites/default/files/publications/21_1027_opa_guidelines-enforcement-actions-in-near-protected-areas.pdf

[27] <https://ndlon.org/wp-content/uploads/2022/04/Recovering-from-Climate-Disasters-Report-2.26.22.pdf>

[28] There is a 30 minute training that is publically available online but FEMA policy states that the training is 1 hour. <https://nhttac.acf.hhs.gov/sites/default/files/2020-02/Trafficking%20Prevention%20and%20Disaster%20Response%20Literature%20Review.pdf>

[29] https://www.fema.gov/sites/default/files/documents/fema_equity-action-plan.pdf

[30] https://www.dhs.gov/sites/default/files/publications/dhs-case-management-pilot-program-rfi_0.pdf

[31] The United States Advisory Council on Human Trafficking, established by the **Justice for Victims of Trafficking Act** (JVTA), enacted on May 29, 2015, provides a formal platform for trafficking survivors to advise and make recommendations on federal anti-trafficking policies to the President's Interagency Task Force to Monitor and Combat Trafficking in Persons (PITF). Each member is a survivor of human trafficking, and together they represent a diverse range of backgrounds and experiences. The Council is appointed by the President for two-year terms. <https://www.state.gov/u-s-advisory-council-on-human-trafficking/>

[32] <https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/27/fact-sheet-biden-harris-administration-issues-an-executive-order-to-raise-the-minimum-wage-to-15-for-federal-contractors/>

[33] <https://www.scientificamerican.com/article/advisers-rebuke-fema-for-racial-disparities-in-disaster-aid/>; *see also* <https://19thnews.org/2021/10/after-storms-batter-louisianas-parishes-black-women-lead-the-way/>



Wireless is an Environmental Justice Issue

We recommend the following priority actions:

- Launch and develop an EPA's research program on EMFs and develop safety limits that protect people, wildlife, trees and plants so that ensuring levels of EMFs in environment are safe is an agency-wide responsibility.
- Air should be designated as a wildlife habitat.
- Levels of electromagnetic radiation and impacts to humans and wildlife must be included in all environmental assessments.
- Develop a comprehensive framework for considering cumulative impacts related to telecommunications infrastructure in communities and wireless networks in schools and the workplace
- Build the capacity of underserved communities to provide their experience to EPA related to telecommunications siting and wireless networks.
- Develop EPA's internal capacity to engage underserved communities regarding EMF impacts.
- Implement clear and accountable processes to act based on communities' input.
- Integrate participatory (community) science into EPA's research and program implementation and include EMFs.
- Ensure an evaluation of climate impacts and equity impacts for all new proposed telecommunications infrastructure by developing a framework for evaluation that communities can use locally.

European Parliament requested a research report “[Health Impact of 5G](#)” released in July 2021 concluding that commonly used RFR frequencies (450 to 6000 MHz) are probably carcinogenic for humans *and* clearly affect male fertility with possible adverse effects on the development of embryos, fetuses and newborns. 5G will [increase](#) ambient levels of wireless radiofrequency radiation. Peer-reviewed research has demonstrated a myriad of adverse effects from wireless radiofrequency radiation including increased [brain cancer](#), [DNA damage](#), [oxidative stress](#), [immune dysfunction](#), [altered brain development](#), [damaged reproduction](#), [sleep changes](#), [hyperactivity](#), and [memory damage](#). (MORE RESEARCH HERE)

Higher Environmental Levels of Radiofrequency Radiation

- Urban areas have more people and more smartphones, as well as more cell towers. The higher density of wireless networks (more wireless antennas and base stations) results in higher levels of environmental radiofrequency radiation levels.

- Cell towers have been found to be more often placed on schools in lower income areas. Wealthy communities are more aware of this issue and often immediately organize to halt proposed cell towers at schools.
- Low income families and renters have less ability to move/mitigate exposures.

Cell antennas are being put up in front of apartments and renters are not being informed nor are they a part of the decisionmaking process.



Financial inequity limits ability to reduce environmental and personal exposures

- Private schools will get private funding to install wired networks and reduce RF exposures.
- While often wealthier, educated families inform their children to decrease exposure (like keep the phone away from your brain) and have the financial means to purchase adapters and hardwire computers, people with less financial means remain uninformed about wireless radiation. Even when families in under-resourced communities are aware, they do not have the money to buy the hardware needed for safer technology and lack the resources to fully implement RF reduction strategies. Many families are struggling to get any internet access at all and are not in a privileged position to choose wired technologies over wireless in their home.

Networks Often Tested in Urban Areas/Schools

- Schools in low income areas are used as test beds for industry to try out new wireless products such as 5G and virtual reality despite no research indicating it will support academic achievement of the students.
- Urban areas are 5G Test Cities.

Occupational Exposures to Pregnant Women are Unmitigated

- As an occupational health issue, many people have limited ability to reduce RFR without risking losing their jobs.

Health care inequalities will further exacerbate health inequities

- Health care inequalities will further exacerbate health inequities as people in under resourced communities will receive unequal care for the damages from exposure to RFR.
- Communities with higher environmental exposures to toxic chemicals, heavy metals (such as lead) and air pollution will have disproportionate impacts from RFR exposure as [research](#) shows a synergistic effect between EMFs and toxic agents.
- Racial/ethnic minorities are 1.5 to 2.0 times [more likely](#) than whites to have most of the major chronic diseases. Oxidative stress is understood to play a role in the development of many chronic diseases as well as [cancer](#). Research reviews ([Schuermann and Mevissen, 2021](#), [Yakymenko et al. 2016](#)) repeatedly find that non-ionizing EMF exposure can cause oxidative stress by the increase in free radicals.
- Research links non-ionizing radiation with diseases that minority communities already have higher rates of such as [obesity](#), [asthma](#) and [diabetes](#). As another example, African American women face a significantly [higher risks](#) of having a miscarriage and [replicated research](#) links non ionizing radiation to increased miscarriage risk.
- Health care inequalities will further exacerbate health inequities as people in under-resourced communities will receive unequal care for the damages from chronic disease caused by or exacerbated by RFR and other non ionizing electromagnetic radiation exposure.

5G and the Internet of Things will increase energy consumption and exacerbate climate change

A 2022 review by the University of Sussex Business School entitled “[The energy use implications of 5G: Reviewing whole network operational energy, embodied energy, and indirect effects](#)” published in Renewable and Sustainable Energy Reviews finds that the notion that 5G is green technology is not currently backed up by a strong, publicly available, fully transparent evidence base. The researchers did a literature review to examine whole network level assessments of the operational energy use implications of 5G, the embodied energy use associated with 5G, and indirect energy use effects associated with 5G-driven changes in user behaviour and patterns of consumption and production in other sectors of the economy. The authors warn that, “the widespread adoption of unlimited data subscriptions for 5G users and the facilitation of advanced and data-intensive mobile services such as VR and more sophisticated mobile gaming could “encourage energy-intensive user practices, contribute to ever-growing levels of data traffic, and counteract the energy-saving potential of 5G efficiency improvements.”

5G requires millions of new cellular antennas called “small cells” -basically shorter cell towers- to be built in neighborhoods *directly in front of our homes*. These 5G antennas are to connect with billions of new wirelessly connected “smart” devices referred to as the Internet of Things (IOT).

Wireless companies are well aware that 5G will increase overall energy consumption

David Bruno, an expert in electromagnetic pollution, obtained a document from the National Frequencies Authority (ANFR) concerning the installation of an Orange relay antenna site in Marseille. [According to him](#), “the colossal power of 5G antennas is to be feared”. He analyzed the Orange document and found the 5G relay antennas in the 3400 to 3800 MHz band will by themselves emit electromagnetic radiation twice as strong as the sum of the relay antennas of 2G, 3G and 4G technologies combined and in the near future, people living near relay antennas will be exposed to power density levels in W / m², at least 3 times higher than those of today.”

The energy consumption will rise sharply due to the ever increasing IOT energy demands at every stage of the lifecycle of 5G equipment, from device manufacture to data centers to data transmissions, and networks.

- **70.2 million** “small cell” tower bases to be installed by 2025.
- **500 billion** devices are expected to be connected to the Internet by 2030.
- **8.9 billion** mobile phone subscriptions worldwide by 2024.
- **60% growth a year** in production of wireless peripherals (Wi-Fi/ Bluetooth speakers, appliances, wearables).
- **7 fold** increase in mobile data traffic globally projected between 2017 and 2022.

In economics, the Jevons Paradox is when technological progress increases the efficiency with which a resource is used, however demand and consumption increase as well. Thus- the end result is overall increased use of the resource, *despite efficiency gains*.

5G will impact tree health contributing to climate change.

Trees play a vital role in mitigating climate change, sequestering millions of tons of carbon that would otherwise pollute our climate. The installation of 5G equipment often requires heavy pruning and digging. This will clearly impact the canopy and root system of our trees.

Numerous news reports document that trees are being felled, heavily trimmed and roots are damaged from the 5G rollout. 5G means millions of new short cell towers PLUS more macro towers- the tall cell towers to tie together the new networks.

In Washington DC, the Sierra Club and numerous tree groups testified to City Councilmembers in opposition to the 5G rollout due to the impact to trees. Who will manage the tree trimming? Who will ensure their protection? There has been no environmental impact study to determine the impact to trees from the trimming and digging.

In 2020, forty residents and demonstrators gathered at Saint-Cadou in the town of Sizun ([Finistère](#)) to block the installation of a 5G antenna belonging to the Telecom company Free, [reports Le Télégramme](#) as loggers were proceeding to fell about twenty trees in area where the antennas were to be located.

Protesters climbed the trees. [Images here](#).

In 2021, [news reports](#) document how a federal judge [denied a request](#) from residents for a temporary restraining order to halt the cutting down of trees to make room for a 95-foot cell tower in New York. Court rulings worldwide have conformed that internet connections are more valued than trees. Precedent setting cases have ruled that property owners can be forced to trim or remove trees that are blocking their neighbours' broadband reception. In 2018 Justice Fitzgerald (New Zealand) [ruled that](#) "undue interference with a wifi signal" caused by trees could constitute an "undue interference with the reasonable use and enjoyment" of someone's land.

- [Washington DC Sierra Club Testimony](#)

Numerous environmental groups have written letters and appeals on the issue of the unfettered energy consumption and the harm to trees, bees and wildlife. Greenpeace France released a [position on 5G](#) as creating "digital pollution" that will increase carbon emissions, increase e-waste, strip the earth of natural resources and contribute to human tragedies on a global scale. A major environmental group in Spain [Ecologists in Action](#) issued a [position on 5G](#) calling for precaution and "in view of the deployment of 5G and the transformations that will accompany it, it is inevitable to ask ourselves: what kind of world do we want to live in: a hyper-digitalized, robotized, monitored, controlled and manipulated society, or a society where human relations, care, the common good and democratic debates on key issues for our future take precedence? In other words, what will we put at the center: life or the machine?"

A [Letter from Environmental Working Group To California State Officials](#) states "there is already adequate existing sound science for government to proceed with caution on the roll-out of the new technology. In particular, the results of the \$25 million National Toxicology Program study (2016) that showed tumors in rats caused by a typical amount of heavy cell phone use are to be reckoned with."

The [Green Party of California](#), the [Sierra Clubs of California](#), [Washington DC](#), and [Montgomery County Maryland](#) and [Montgomery County Maryland 350](#) have taken positions for protecting trees/environment and addressing the energy consumption of 5G networks.

- [Green Party of California](#)
- [California Sierra Club Letter](#)
- [Washington DC Sierra Club Testimony](#)
- [Montgomery County Maryland Sierra Club Letter](#)
- [Montgomery County Maryland 350 Letter on Small Cell Legislation](#)
- [Ecologists in Action on 5G](#)
- [Letter on small cell streamlining bill from Greenlining Institute](#)
- [Greenpeace France Position on 5G](#)
- [Letter from Environmental Working Group](#)

REPORTS

[High Council for the Climate Report "Controlling the carbon impact of 5G"\(2020\)](#)

[German Environment Agency 2020 Report "Fibre optic video transmission is nearly 50 times more efficient than UMTS"](#)

The Shift Project, “[LEAN ICT: TOWARDS DIGITAL SOBRIETY](#)”: OUR NEW REPORT ON THE ENVIRONMENTAL IMPACT OF ICT” (2019) [PDF Summary](#)

Cell Tower and Small Cell Safety Issues

The cell tower industry has a poor track record for safety, compliance and safety and people working on towers or buildings are at risk.

- Read [Beware the Dangers from AM Radio and 5G Transmission Sites \(PDF\)](#) published in Tree Care Industry Magazine January 2021 on the hazards faced by tree care workers in increasing proximity to the ever-expanding universe of antennas, both regular radio and 5G/wireless.
- An [October 2014 Wall Street Journal article](#) reported that “One in 10 sites violates the rules, according to six engineers who examined more than 5,000 sites during safety audits for carriers and local municipalities, underscoring a safety lapse in the network.”
- According to the US Labor Department, the rate of cell tower worker accidents has [sharply risen](#) over the last few years as towers are being built at a rapid pace with minimal regulations and worker safeguards in place . The [Occupational Safety and Health Administration \(OSHA\) is currently investigating](#) the “alarming increase in preventable injuries and fatalities at communication tower work sites.”
- [In 2013 the International Brotherhood of Electrical Workers](#) wrote the FCC in 2013 that “ensuring compliance with existing FCC RF human exposure limits by the FCC licensee is not effective and cannot/is not being enforced.” Concerned about the health of their workers and consistent reports of injuries from the lack of enforcement , they state, “When there is a hazard, the hazard creator has a duty to warn others against the hazard.” (Electrical workers are suffering internal injuries from the radiation as they are doing unrelated work but are unaware of a poorly marked antennae closeby. If you stand in front of these radiation beams you will be injured.)
- The EM Radiation Policy Institute wrote the FCC in 2013 with documentation of [Failure to Regulate Antennas and the Lack of FCC Monitoring of Compliance with FCC RF Safety Policies](#) stating that “the FCC does not monitor compliance and does not take any effective enforcement action against violators.” See examples of fires, collapse and accidents [Here](#)

Wireless networks in the workplace pose risks.

People working in retail stores, hospitals, security, transportation, construction, education and food service are increasingly using phones and wireless networks as part of the job. While people in desk jobs may be able to make changes that reduce exposure, many people have no choice in the matter. They are also not being informed by their employer of ways to reduce exposure to the phones and devices they must use at work.

Cell towers are increasingly on school properties, especially in low income areas.

- In Montgomery County, the school cell towers are concentrated on schools with higher minority and FARM (free and reduced meals) rates ([See Map showing high minority schools with cell towers clustered on the area](#)). Parents in schools with higher white and more affluent populations have organized and swiftly and successfully fought off the towers.
- For example, watch the [video of the Wooten high school parent meeting](#) where parents in a wealthier community (majority white county) who stopped a cell tower within 24 hours after the meeting with principal . Then compare that meeting to how the process unfold in schools with a more diverse population. In contrast to the more affluent white communities, parents in lower income communities need to work for months to halt school cell towers and sometimes the cell tower goes up despite their strong opposition. See a [meeting at Parkland Middle School](#) where the parent leadership and community repeatedly expressed opposition but the tower kept moving forward. The administration often ignores opposition in low income communities and the people are treated like nuisances rather than stakeholders. Also watch a video of Greenbelt MD in Prince Georges County (a majority African American county) where [parents in a cell tower meeting](#) are told that *“some of you would never be happy.”*
- Many low income areas lack the community resources to be aware that a cell tower has been proposed. For example in the county of Prince George’s County -some community meetings have had one participant attend the cell tower community meeting and some PTA’s were not notified until after leases for cell towers were signed. As research shows these towers can decrease property value by up to 20%, cell towers on school grounds change the landscape of the nearby residential community, create stigma and further lower property values.

Most people are not aware that hundreds of researchers who have published research in the field of bioelectromagnetics are calling for urgent policy action due to the mounting scientific evidence confirming adverse effects.

- 255 scientists who have published in the field signed the [EMF Scientists Appeal](#) which states “numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.”
- 419 scientists and doctors have signed the [European Union 5G Appeal](#) which states, “5G will substantially increase exposure to radiofrequency electromagnetic fields (RF-EMF) on top of the 2G, 3G, 4G, Wi-Fi, etc. for telecommunications already in place. RF-EMF has been proven to be harmful for humans and the environment.”
- Over 3,500 medical doctors signed onto a 2020 Consensus statement that wireless RF has been proven to damage biological systems at intensities below government limits ([See signatures here, PDF of Consensus Statement](#)).

- Examples of Numerous Appeals by Medical Professionals: [International Society of Doctors for Environment](#), [Cyprus Medical Association](#), [the Vienna Austrian Medical Chamber and the Cyprus National Committee on Environment and Children’s Health](#), [Belgium Doctors Appeal](#), [Canadian Doctors](#), [Cyprus Medical Association](#), [Physicians of Turin, Italy](#), [the German Doctors Appeal](#), [International Appeal to Stop 5G on Earth and Space](#), [Letter to President Trump](#), [Letter to President Biden](#) and [Chilean Doctors](#).

There have been appeals and position statements for decades. [Read a full list here](#).

- Numerous expert reports conclude that safety is not assured.
 - The [New Hampshire State Commission 5G Report](#) has 15 recommendations to protect the public
 - The Pittsburgh Law Review: [The FCC Keeps Letting Me Be: Why Radiofrequency Radiation Standards Have Failed to Keep Up With Technology](#) explains how the FCC and FDA have failed to develop adequate safety limits.
 - The Harvard Press Book “[Captured Agency: How the Federal Communications Commission is Dominated by the Industries it Presumably Regulates](#)” details how wireless companies are using the Big Tobacco playbook and how the FCC is a captured agency.

The challenge is an international one.

“Given that treatment for a single case of brain cancer can cost between \$100,000 for radiation therapy alone and up to \$1 million depending on drug costs, resources to address this illness are already in short supply and not universally available in either developing or developed countries.”

- [Swedish review strengthens grounds for concluding that radiation from cellular and cordless phones is a probable human carcinogen](#)

Appendix

Letter to Montgomery County Council that was not responded to after the county proposed a law to remove public hearings and public notice regarding 5g small cells.

Dear County Councilmembers,

Our organizations recently became aware of the potential climate implications of the Zoning Text Amendment - ZTA 19-07 - Telecommunications Towers - Limited Use.

We are concerned that the increase in the number of 4G and 5G small cell towers in neighborhoods could result in an increase in energy use and greenhouse gas emissions in Montgomery County, as well as a significant reduction in the tree canopy throughout the county. These impacts would prevent the County from achieving our goals identified in the Emergency Climate Mobilization Resolution No. 18-974 to

reduce our greenhouse gas emissions by 80% by 2027 and by 100% by 2035. Additionally, we are concerned that these same climate impacts will disproportionately worsen the negative effects on communities of color, people of low income and other vulnerable households in the County. See the [list of studies and reports](#) identifying these outcomes and concerns.

Section G-8 of the County's Climate Action Plan, which is entitled *Evaluate and Update County Planning, Policy, and Operations Activities to Reduce Greenhouse Gases* states that "Climate-related contracts should require equity-enhancing measures that proactively engage and improve the socioeconomic conditions of communities disproportionately impacted by systemic inequities such as low income, race, and/or immigration status, and communities considered most vulnerable to the impacts of climate change. This action also includes establishment of a climate impact statement to evaluate all pending bills, budgets, plans and land use decisions."

As a result, before any vote on ZTA 19-07 takes place, we ask the County Council to provide both a climate impact statement and a racial equity and social justice statement on the implications of this proposed ZTA.

Additionally, we ask that you support County Executive Marc Elrich's proposal on June 29, 2021 to convene a working group comprised of a diverse group of stakeholders, including industry, residents, municipalities and homeowner/tenant associations, non-profit organizations and executive and council staff for a limited time, perhaps 75 - 90 days, to allow for the opportunity for a more complete discussion of the issues after which their recommendations can be presented to the Council.

We appreciate your consideration of these requests. We look forward to hearing from you very soon.

Best regards,

350.org MoCo

Bethesda Green

Biodiversity for a Livable Climate

Cedar Lane Ecosystems Study Group

Cedar Lane Unitarian Universalist Church Environmental Justice Ministry

Give a Shift

Glen Echo Heights Mobilization

Montgomery Countryside Alliance

One Montgomery Green

Takoma Park Mobilization Environment Committee (TPMEC)

TAME Coalition (Transit Alternatives to Mid-County Highway Extended)

The Climate Mobilization, Montgomery County Chapter

I, Richard Moore, Co-Chair of the White House Environmental Justice Advisory Council, certify that this is the final meeting summary for the public meeting held on May 11, 2022, and it accurately reflects the discussions and decisions of the meeting.



Richard Moore

I, Peggy Shepard, Co-Chair of the White House Environmental Justice Advisory Council, certify that this is the final meeting summary for the public meeting held on May 11, 2022, and it accurately reflects the discussions and decisions of the meeting.



Peggy Shepard