

Insight ■ Innovation ■ Impact
2013 Accomplishments
Office of Research and Development



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Insight. Innovation. Impact.



Insight. Innovation. Impact. All three are at the heart of every research project conducted by the scientists and engineers at the U.S. Environmental Protection Agency's Office of Research and Development.

Together with partnerships cultivated throughout the scientific community, EPA research teams conduct the studies that provide critical insight into the links between human health and the environment. To that knowledge, they apply a collective spirit of innovation to provide timely, cost-effective tools, models, and other solutions needed to meet today's most pressing environmental challenges. Finally, their research results are incorporated in ways that have true positive impact: improving human health; taking action on climate change; lowering risks from exposures to pollution, chemicals, and other potential environmental hazards; and advancing more prosperous and sustainable communities.

This report highlights some of the many research results delivered in 2013 by EPA researchers and their partners in support of the American people. For example, Agency researchers:

- Developed the Village Green Project, a solar-powered, community-based air quality monitoring and information kiosk providing real-time data, educational opportunities, and a place to advance innovative air sensor technology.
- Released the National Stormwater Calculator, an easy-to-use, customizable tool that helps developers and other decision makers identify and incorporate "green" techniques to reduce stormwater runoff.
- Shared all the data from the Agency's innovative ToxCast program (1,800 chemicals), and launched a beta version of the interactive Chemical Safety for Sustainability Dashboard.

- Enhanced and/or developed a host of tools, models, and databases—such as EnviroAtlas, the Community-Focused Exposure and Risk Screening Tool, the Tribal-Focused Environmental Risk and Sustainability Tool, the Directory of Sustainability Indicators and Indices, and others—to support and advance safe and sustainable communities.
- Co-led the Bio-response Operational Testing and Evaluation project, a two-phase demonstration to test and advance decontamination methods used on anthrax spores inside a building.
- Increased the transparency and improved the efficiencies in the Agency's Integrated Risk Information System to meet the needs of the Agency and the public.

The list above represents just a handful of the many, many research accomplishments made by Agency scientists and engineers, and their partners during 2013. The full breadth and impact of their collective achievements would stretch far beyond the pages of a single report.

No other research organization in the world offers the overall diversity of expertise found in EPA's Office of Research and Development. Together, this community of scientists and engineers published some 379 articles in peer-reviewed scientific journals during 2013 (source: EPA Science Inventory). These papers, as well as the numerous other ways in which Agency researchers share results, each represent a story of insight, innovation, and impact.

Air, Climate, and Energy Research

Improving air quality, reducing carbon and other greenhouse gas emissions, and developing strategies to help communities and individuals address the effects of a changing climate are central to EPA's mission to protect human health and the environment. Research by EPA's Air, Climate, and Energy research program and its partners is playing a prominent role in protecting the air we breathe and providing new understandings about the relationship between air quality, climate change and energy production. Studies are advancing technology to better measure and monitor air quality, providing innovative modeling tools to help predict and respond to the impacts of climate change, and investigating the adverse health and environmental effects related to air pollution and a changing climate.

EPA air, climate, and energy research results have far-reaching impact, providing the scientific foundation for decisions and actions to protect public health and the environment.





The Village Green Project

EPA researchers are helping change the paradigm of air pollution monitoring.

For more than four decades, EPA researchers and their partners have been developing cutting-edge technologies and improving existing ones to advance novel, innovative ways to collect, monitor, and analyze air pollution data. The results of this work have supported decisions and policies that in turn have sparked dramatic improvements in the nation's air quality. Impacts, for example, include a 59 percent reduction in the emissions of six major air pollutants between 1990 and 2010, and have even increased the life expectancy of the average American by four to eight months.

Today, EPA researchers continue to usher in the kind of next-generation clean air science needed to advance that legacy of progress, and meet the challenges many communities still face due to poor air quality.

The launch of the Village Green Project, a community-based, solar-powered air monitoring system in 2013 exemplifies this research work. The pilot project, conducted in partnership with Durham County (NC), is advancing local air quality measurement capabilities for states, tribes, and communities.

EPA built the state-of-the-art monitoring system into a park bench and installed it at the Durham County South Regional. The system provides real-time data on three air pollutants (ozone, particulate matter, and black carbon) and meteorological conditions that are made available online, in real time, to the public.

The Village Green Project provides educational opportunities for citizens and students to learn more about the air they breathe as well as the cutting-edge air quality sensor and monitoring technologies being developed by EPA and others to improve the ability to measure and monitor air quality.

The Village Green Project stems from a growing national interest in harnessing new sensor technologies to gain insight into local air quality conditions and trends near schools, parks, and neighborhoods. The three main goals are to (1) engage local communities in pollution awareness; (2) increase the geographic coverage of air pollution monitoring; and (3) advance the ability of Agency researchers to measure and share air pollution information in real-time, at a minimum in cost and maintenance.

Study results will be used to advance air quality measurement tools and capabilities. The system is also expected to provide a model for communities seeking to investigate local air quality, and to identify ways to monitor and improve air pollution trends, such as reducing vehicle idling.

The data gathered at the monitoring station is available online at <http://villagegreen.epa.gov>.

The Village Green Project is just one of many achievements made during 2013 by EPA's Air, Climate, and Energy research program. Additional highlights follow.



Fenceline Monitoring Research

Fences are important features for industrial sites such as chemical plants and petroleum refineries: they provide security, keep nearby residents safe from potentially dangerous activities, and mark boundaries. EPA researchers are advancing the use of sensor technologies that will add another important benefit—monitoring air quality and detecting pollutant emissions.

EPA researchers have developed innovative techniques using sensor technologies to measure air quality around the perimeter of a building or area, often referred to as “fenceline monitoring.” The technology provides cost-effective and near-real-time air monitoring that has gained support from industrial partners and the Agency’s Office of Air and Radiation. Fenceline monitoring provides both an early warning system for leak detection and better protects neighboring communities from air pollution. EPA estimates that the results of the research will help industry save \$500 million in reduced compliance costs.



Southern Oxidant and Aerosol Study

In 2013, EPA researchers helped lead one of the largest studies in decades to explore air pollution in the United States—the Southern Oxidant and Aerosol Study (SOAS), part of the even larger Southeast Atmosphere Study.

During an intense and highly collaborative field effort using research towers, balloons, and aircraft, Agency researchers and their partners collected detailed data on atmospheric chemistry in Alabama, Tennessee, and North Carolina to learn more about how organic aerosols are formed and how they interact with volatile organic compounds to affect air quality and climate.

As part of the SOAS study, EPA also awarded more than \$4.3 million in grants to 13 academic and research institutions to learn more about air quality in the Southeast. (Also see *STAR-supported Research for Climate Change Modeling, Air Quality Management* in the “Supporting Partnerships” section of this report.)



Supporting the President’s Climate Action Plan

On June 25, 2013, President Obama announced a Climate Action Plan strategically designed to help the nation respond to the challenges posed by a changing climate. EPA scientists are providing data, tools, and information that support the three pillars of that plan: (1) helping communities prepare for the impacts of climate change, (2) reducing carbon pollution and (3) addressing global climate change on an international level.

Agency researchers are addressing many of the specific topics identified in the President’s plan, including: extreme weather events; forests health and how to better understand and calculate the role forests play in absorbing carbon pollution; identifying climate-resilient investment opportunities for communities (such as climate-ready water utilities); identifying links among climate change and public health; and promoting community resiliency through a better understanding of how natural resources (including oceans, wetlands and freshwater) help mitigate climate change effects.



Wildfire Impacts on Public Health

Research by EPA-supported scientists at the Harvard School of Engineering and Applied Sciences suggests that by the year 2050, wildfire seasons will increase in length by some three weeks, produce twice as much smoke, and will burn a wider area in the Western States. Researchers used a new method to study the connections among meteorology, fire risk forecasts, and the amount of area burned in North America. Researchers also found that the increase in fires led to a significant increase in several types of particulate matter.

In another study related to the impacts of wildfire, Agency researchers analyzing data from a major 2008 North Carolina peat fire found significant increases in local hospital emergency department visits for a number of respiratory and cardiovascular risks and symptoms. They also observed in another study that people living in poorer communities experienced greater health effects than those living in richer communities, even across similar exposures to air pollutants from the wildfire.



Healthy Heart

EPA researchers are providing new insights into the importance of air quality for human cardiovascular health. One study found that exposure to combinations of air pollutants can cause significantly greater health risks than those caused by exposure to single agents. Other research findings include that exposure to ozone may affect the cardiovascular system, and that controlling blood pressure may reduce some of the negative impacts that long-term exposure to diesel exhaust has on the cardiovascular and pulmonary systems.

EPA researchers have also expanded related outreach efforts to ensure research results have impact improving public health, especially for those with heart disease. For example, Agency clean air scientists and cardiologists published a 2013 paper in the *Journal of Cardiovascular Nursing* that provides information on how nurses can help educate patients about potential air pollution risks and actions the patients can take to protect their own health, such as monitoring local air quality forecasts through the Air Quality Index.



My Air, My Health: Sparking Innovation

EPA clean air researchers are helping to catalyze innovation by bringing the use of affordable, mass-produced sensor technologies to the realm of air pollution monitoring. In June, 2013 they joined forces with partners from the National Institutes of Health to announce the winner of the My Air, My Health Challenge, which invited innovators nationwide to design a small, low-cost sensor that integrates air quality measurements with related health data.

The winning team of David Kuller, Gabrielle Savage Dockterman, and Dot Kelly received a \$100,000 for developing Conscious Clothing, a wearable, real-time breathing analysis tool that calculates the amount of polluted air a person inhales. Such innovations will help EPA and NIH to better understand, in real time, the impacts of harmful air pollution on people's health.

Air Pollution and Metabolic Syndromes: Studying the Links

Researchers are investigating the role air pollution may have on metabolic syndrome, a group of health factors that raises the risk for heart disease and other health problems, such as diabetes and stroke. A study published in 2013 found that both young and old laboratory animals experienced temporary glucose intolerance and high blood sugar (hyperglycemia) after short-term exposure to ozone. The results indicate the importance of studying multiple age groups to learn more about the potential for air pollution to contribute to the development of metabolic diseases.

Other related findings by EPA-funded research and published in 2013 include:

- Short-term exposure to rural, coarse particulate matter leads to an increase in levels of endothelial progenitor cells, an indication of metabolic changes and an increased risk of cardiovascular disease and diabetes.
- Concentrated air pollutants and ozone in obese rodents resulted in inflammation and oxidative stress in the fat around the heart and kidney, findings that may provide a link between air pollution exposure and accelerated susceptibility to metabolic syndrome and its associated health risks.

Learn More!

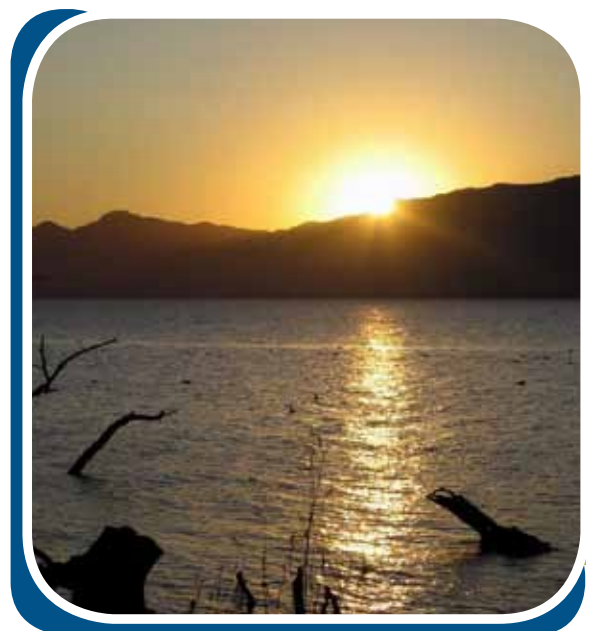
Please visit: www.epa.gov/research/airscience/.

Safe and Sustainable Water Resources Research

Across the United States, people are placing increased demands on the finite water resources that supply precious drinking water, support healthy aquatic ecosystems, and fill important societal and economic needs, including energy, agriculture, and industrial production.

EPA's Safe and Sustainable Water Resources research program provides the science and innovative technologies that the Agency—and the nation—need to maintain drinking water sources and systems, as well as to protect the chemical, physical and biological integrity of our waters. EPA scientists and engineers, together with their research partners, are addressing 21st-century challenges to water supplies and infrastructures by integrating research across social, environmental, and economic disciplines. Together they are working to provide lasting, sustainable solutions to those challenges.

This section highlights a few of the research results EPA researchers and their partners achieved in 2013 to support safe and sustainable water resources.





The National Stormwater Calculator

New EPA tool helps planners and developers tap the benefits of “green infrastructure.”

In 2013, EPA researchers launched a new tool to help city planners, developers, and property owners reduce the amount of stormwater runoff flowing from their sites. The tool, the National Stormwater Calculator, provides such decision-makers with an easy-to-use, customizable resource to identify and incorporate environmentally-friendly techniques to retain and absorb rain and stormwater.

Known as “green infrastructure,” these techniques include a host of practices, including the installation and use of rain gardens and barrels, cisterns, permeable pavements, vegetated (“green”) roofs, retaining or restoring vegetation along rivers, and retention ponds.

The National Stormwater Calculator was designed to help individuals and local communities take advantage of such green infrastructure techniques to reduce the volume and impacts of stormwater runoff. Excess and/or contaminated runoff is a major challenge to the health of the nation’s water resources; it is linked to combined sewer overflows (when stormwater is combined with untreated sewage), downstream nutrient and other pollution, reduced groundwater recharge, and flooding.

The National Stormwater Calculator incorporates data and information on annual rainfall, stormwater runoff frequencies and volumes, local soil conditions, land cover, and historical rainfall records. Users can plug in any U.S. location and select different development and green infrastructure scenarios to explore site-specific options they can incorporate to reduce runoff volumes from their areas.

As an example of how the calculator might be used, consider a developer or municipality planning a parking lot on what is currently undeveloped or vacant land. By incorporating location, project data, and other parameters into the calculator, the user can gain insight into how integrating green infrastructure aspects such as rain gardens, vegetation, and permeable pavement into the design will reduce stormwater runoff from flowing off the finished parking lot.

The National Stormwater Calculator provides a tool for identifying green infrastructure techniques at the beginning of the planning process, offering often lower cost options for meeting local standards and community goals for sustaining the health of waterways. Such forethought will have positive impact far downstream, too.

The National Stormwater Calculator release in 2013 is the first phase of the Stormwater Calculator and Climate Assessment Tool package announced in the President’s Climate Action Plan.

The National Stormwater Calculator is just one of many achievements made by EPA’s Safe and Sustainable Water Resources research program during 2013. Additional highlights follow.



Green Infrastructure Research

The National Stormwater Calculator (see previous feature story) is just one of many research solutions EPA scientists and engineers are advancing to help communities better protect their local waterways through green infrastructure practices.

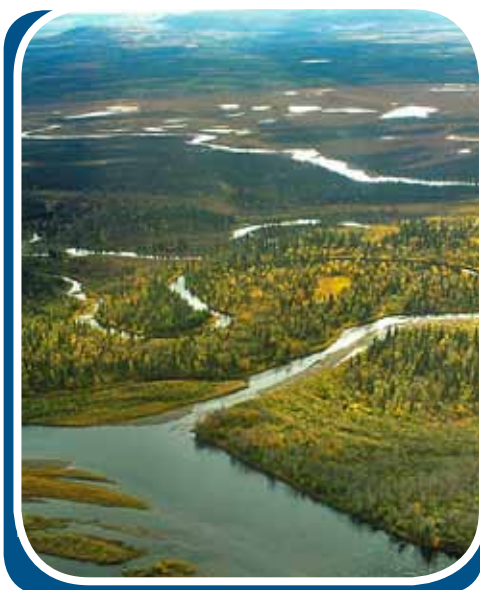
To facilitate the sharing and dissemination of best practices and performance monitoring, in 2013 Agency researchers continued to analyze, compile and assess the latest data, models, and tools on: green roofs, permeable pavements, rain water harvesting, rain gardens, bioswales, urban tree canopy, constructed wetlands, and watershed-scale practices. That information, in addition to a set of databases and reports is available at: <http://1.usa.gov./19d3Dul>.



Waters of the U.S. Connectivity Draft Report

Water trickling through a nearby creek, cascading down a desert streambed after a summer rainstorm, or overflowing from a seasonally flooded wetland are all examples of the sources of freshwater that fill the nation's lakes, reservoirs, aquifers, and rivers. Clean, healthy streams and wetlands are essential to the nation's drinking water supply. Understanding the complex and dynamic interrelationships among different types of surface waters presents many challenges to sustaining their integrity and is critical to determining how waters are protected under the Clean Water Act.

To help meet those challenges, in September 2013, Agency researchers released a draft scientific report: *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* (External Draft Review). Presented for public comment and review by the EPA Science Advisory Board, the report provides an extensive review and synthesis of more than 1,000 peer-reviewed publications pertaining to the physical, chemical, and biological connections that link streams, wetlands, and openwaters downstream to rivers, lakes, estuaries, and oceans.



Bristol Bay Assessment

Alaska's Bristol Bay watershed supports the largest sockeye salmon fishery in the world, is home to 25 federally recognized tribal governments, and contains mineral resources that — if mined — are estimated to be worth hundreds of millions of dollars annually. In 2010, several Bristol Bay Alaska Native villages requested that EPA prevent development of a large copper and gold mine they believed would threaten salmon resources. Other tribes requested the Agency not take action. To adequately respond, Agency researchers began to compile the best, most current science on Bristol Bay ecology, fisheries, and potential mining impacts.

In April 2013, EPA researchers released the second (revised) draft of *An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska*. The revisions in the draft reflect reviews of some 233,000 public comments, as well as consultation and coordination with Native tribes, and input from twelve expert peer reviewers, all in response to an earlier draft released in May, 2012. The final assessment was released January 15, 2014; for more information: <http://www2.epa.gov/bristolbay>.

Innovation to Support Water Quality Forecasting

Anyone who has ever followed turn-by-turn directions from a small device mounted atop their dashboard or used a smartphone to get real-time weather updates is familiar with the magic of portable, satellite- and/or data-driven technologies and applications. EPA researchers are tapping the collective community of innovators to bring that same kind of power and convenience to water quality forecasting.

In 2013, EPA launched the Cyano Predictive Modeling & Mobile App Challenge, a series of open, awards-based competitions to spark the development of a predictive model to forecast blooms of cyanobacteria, a kind of algae linked to fish kills and human illness. The end goal of the competitions is an easy-to-use application that will help local and federal policy makers target actions for areas most at risk to dangerous algae blooms.



EPA Models Inform Actions to Protect Gulf of Mexico

Every summer, an area of oxygen-starved water of up to 20,000 square kilometers (7,772 sq. mi) forms across the bottom of the Gulf of Mexico near the mouth of the Mississippi River, killing bottom-dwelling marine life, sparking often massive fish kills, and chasing other creatures out to sea. This zone of hypoxia is the result of an overload of nutrients.

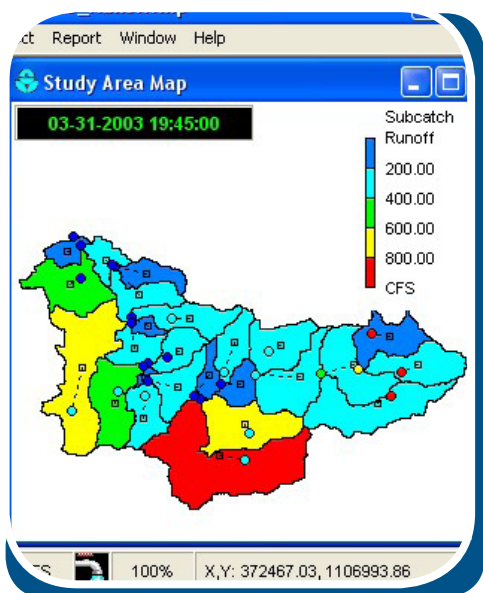
EPA researchers are building complex, three-dimensional models based on the dynamic physical characteristics of the Gulf, including ocean currents, wind data, and water temperatures. Their Gulf Ecology Model, Gulf of Mexico Dissolved Oxygen Model, and other frameworks are helping to determine how much nutrient loading needs to be reduced. The models support the design and implementation of actions to stem the flow of nutrients and combat the formation of the summertime "dead zone."



Watershed Management Support Tool

EPA released the Watershed Management Optimization Support Tool in 2013, a publicly available, user-friendly resource for local water resource managers and planners. Agency modelers developed the tool to help local water resource managers explore the costs, benefits, and other tradeoffs of a wide-range of potential options, including low impact development, land conservation, and green infrastructure.

The tool facilitates the evaluation and identification of lower cost, environmentally sensitive techniques to improve the sustainability of infrastructure projects and the communities they serve. It is a particularly important resource for projects potentially supported by Congress's "State Revolving Funds." Congress has set aside 20% of these funds specifically for the development of "Green Project Reserves," which include green infrastructure and land conservation measures.

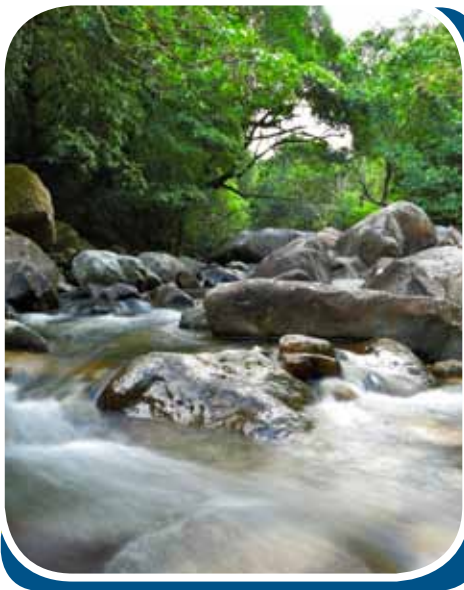




EPA Hydraulic Fracturing Study: Progress and Outreach

EPA researchers are conducting a focused study on the potential impacts, if any, of hydraulic fracturing on drinking water resources. An explicit component of the study design is that the research be conducted through a transparent, peer-reviewed process with significant stakeholder input.

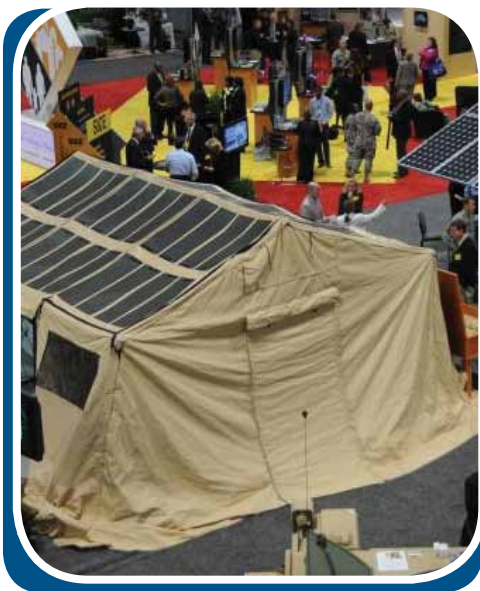
EPA released its progress report, *Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources* in late 2012. The study will culminate in an assessment report, which has been designated a “Highly Influential Scientific Assessment” and, like other EPA studies, will receive peer review in accordance with the Agency’s Peer Review Handbook. Throughout 2013 EPA continued enhanced technical engagement and stakeholder outreach efforts to gather feedback through a series of technical workshops and roundtables on key elements of the study effort, including analytical chemical methods, well construction and operation, subsurface modeling, wastewater treatment and related modeling, water acquisition modeling, and case studies.



Assessing Climate Change Impacts on Watersheds

In 2013, EPA researchers released the final “20 Watersheds Report,” more formally entitled *Watershed Modeling to Assess the Sensitivity of Streamflow, Nutrient, and Sediment Loads to Potential Climate Change and Urban Development in 20 U.S. Watersheds*. It describes watershed modeling conducted in 20 large, U.S. drainage basins (6,000 to 27,000 sq. mi.) to characterize the sensitivity of streamflow, nutrient (nitrogen and phosphorus) loading, and sediment loading to a range of potential mid-21st-century climate futures.

The report provides information useful to those seeking to produce strategies and to take actions designed to reduce risks and mitigate some of the likely impacts that a changing climate will have on their water resources.



Building from Net Zero

EPA researchers formed a partnership in November, 2011 to provide innovative science and technologies to support the Army’s Net Zero initiative, a program focused on developing strategies to reduce energy and water consumption, and waste on military bases.

In 2013, Agency researchers continued to support Net Zero’s impacts by advancing three research projects: (1) reusing non drinkable wastewater for irrigation and cleaning; (2) studying the connection between water use practices and water savings technologies; and (3) testing and advancing decontamination methods using dirty water from cleaning military vehicles that have returned from training exercises. (See more about Net Zero on page 25.)

Learn More!

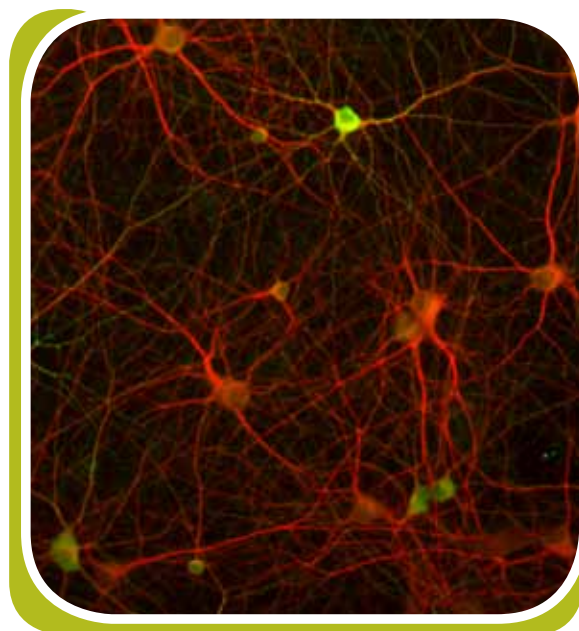
Learn more about EPA safe and sustainable water resources research: www.epa.gov/research/waterscience/

Chemical Safety for Sustainability Research

Chemicals are a lynchpin of innovation in the American economy, and moving toward a more sustainable society requires designing, producing, and using chemicals in safer ways. EPA's chemical safety research is designed to meet this challenge in ways that promote human and environmental health, protect vulnerable species and populations, and support the Agency priority of reducing risks associated with exposure to chemicals in commerce, the environment, products, and food.

EPA chemical safety researchers lead the development of innovative science to support the safe, sustainable design and use of chemicals and materials. They are developing efficient and effective methods to accelerate the evaluation of thousand of chemicals; using complex system science to advance the understanding of the relationships between chemical exposure and ecological and human health effects; providing accessible data and interactive web applications to support scientific discovery and chemical safety decisions; and engaging with stakeholders to facilitate the translation of research to improve chemical safety policy and regulatory decisions.

Results of EPA's chemical safety research help the Agency address the impacts of existing chemicals and materials as well as anticipate impacts of new chemicals and emerging materials.





Accelerating the Pace of Chemical Screening

EPA released wealth of safety data, launched online interactive dashboard

EPA scientists are harnessing advances in exposure science, molecular and systems biology, chemistry, toxicology, mathematics, and computer technology to usher in a new generation of faster and more efficient chemical testing. They are also developing new ways to share the data that are transparent and accessible. A major part of this effort is EPA's Toxicity Forecaster (ToxCast) project.

Using ToxCast, EPA screened 1,800 chemicals in more than 700 rapid, automated chemical screening tests called "high-throughput screening assays." The chemicals screened were from a broad range of sources including industrial and consumer products, food additives, and "green" substances with the potential to replace existing chemicals.

On December 17, 2013, EPA publicly released all of the ToxCast data for these 1,800 chemicals and launched a beta version of the interactive Chemical Safety for Sustainability Dashboards (iCSS dashboard) that is being developed to improve the user experience in accessing chemical data.

ToxCast is a multi-year effort launched in 2007 that uses high-throughput screening technologies to expose living cells or isolated proteins to chemicals. The cells or proteins are then screened to identify those that exhibit changes in biological activity that may indicate potential for negative health effects.

The vision of the iCSS dashboard is to provide an easy-to-use, customizable, interactive online resource that enables users to explore the ToxCast data and integrate selected chemical data in support of decision making. iCSS dashboard users can select chemicals and data of interest, explore and score the selected chemicals and associated data, and then analyze the data to determine how they can be used to better inform decisions made about the safety of chemicals.

As part of EPA's efforts to use advances in computational toxicology research, EPA scientists also completed a proof of concept high-throughput exposure prediction model (ExpoCast) for more than a thousand chemicals. In 2014, EPA researchers will continue this research to be able to improve these exposure predictions. The vision is to be able to combine ExpoCast exposure predictions with the hazard predictions from ToxCast to develop rapid risk-based prioritization for chemicals.

Making ToxCast data publicly available through EPA's Web page and the iCSS dashboard is part of the Agency's commitment to make its science and research results transparent and useful. It also is facilitating the ability to engage stakeholders outside EPA to solicit feedback about how advances in computational toxicology research can be used to accelerate the pace of chemical testing.

The high-throughput chemical screening conducted as part of the ToxCast program uses robotics and other cutting-edge technologies. The robotics technology is made available through a federal research partnership called Toxicity Testing in the 21st Century, or "Tox 21." A collaboration uniting EPA, the National Institutes of Health, and the U.S. Food and Drug Administration, Tox 21 is screening tens of thousands of chemicals using these automated robotic technologies.

Innovative methods like ToxCast and ExpoCast have the potential to significantly reduce the number of required animal-based laboratory toxicity tests while quickly and efficiently screening thousands of chemicals for potential health effects.

The above features just a few of the many achievements made by EPA's Chemical Safety and Sustainability research program during 2013. Additional highlights follow.



EPA Launches ToxCast Data Challenge

In coordination with the release of chemical data on 1,800 chemicals (see Chemical Safety for Sustainability 2013 feature story), EPA researchers launched public challenges inviting the science and technology community to explore how the new data can be used to predict potential health effects.

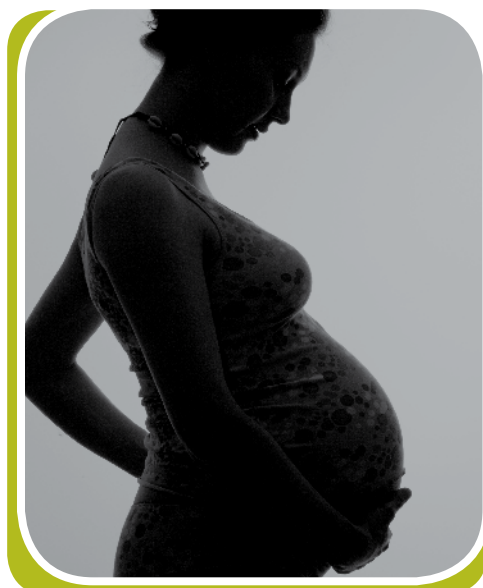
The first Predictive Toxicology Challenges, were made available through the TopCoder and InnoCentive crowd-sourcing technology platforms. They invite scientists and engineers to use the ToxCast data and develop a predictive algorithm. The goal of the algorithm is to predict the lowest chemical dose that would show adverse effects in animals. Winners will receive prize money to help fund their own planned research, and their solutions will help EPA determine innovative ways to use ToxCast data to inform decisions made about the chemical safety.



Protecting Vulnerable Populations

When evaluating the safety of a pesticide application, one of the most difficult challenges is to know how they affect nontarget, wild populations, such as birds. The National Academy of Sciences indicated that without this type of information, existing pesticide risk assessments were missing important ecological risks.

To address the challenge outlined above, EPA scientists linked information on toxicity data, species-specific life history data, and pesticide application timing to predict the reproductive success of bird populations. The scientists created the Markov Chain Nest Productivity Model, or "McNest," an accessible, easy-to-use, model that risk assessors and stakeholders can use to predict the extent of ecological impact of pesticides. The success of this effort demonstrates how complex data from a variety of sources can be integrated to improve the quality, effectiveness, and efficiency of EPA decisions.



Growing Knowledge: EPA's Virtual Embryo Project

EPA scientists are carrying out an innovative research program to "virtually" explore how chemical exposures might affect the intricate growth processes within an embryo. Through their Virtual Embryo Project (v-Embryo™), they are developing methods to use high-tech computer modeling and vast collections of data and biological knowledge bases to develop prediction techniques to improve the understanding of how environmental influences may impact early development.

In 2013, v-Embryo scientists published results of a model they developed to explore how exposure to certain chemicals might interfere with the healthy development of blood vessels in a developing embryo. Another advancement of EPA's computational toxicology research, the scientists demonstrated the utility of using such computational approaches for simulating developmental biology and predicting chemical toxicity. Their paper, *A Computational Model Predicting Disruption of Blood Vessel Development*, was published April 4, 2013, in "PLoS Computational Biology."



Adverse Outcome Pathway Wiki

EPA scientists partnered with colleagues from the Organisation of Economic Co-operation and Development, the U.S. Army Engineer Research and Development Center, and the European Commission's Joint Research Centre to develop "AOPWiki," a user-friendly, open-source, Wiki-based interface for sharing information and facilitating collaboration on adverse outcome pathways (AOPs).

An AOP is a conceptual framework that helps toxicologists, public health officials, and others better understand the links between chemical exposures and changes at different levels of biological organization (from molecules within cells to bodily systems) that might result in adverse health risks. The access to the wiki is currently limited to those invited by the OECD to provide their expertise. Those interested in gaining access to the AOP Wiki are invited to visit <http://bit.ly/1lg15Cp>.



Harmonizing Green Purchasing Practices

In 2013, the Agency announced draft guidelines on Product Category Rules (PCR) that provide specific requirements and guidelines for calculating and reporting environmental impacts across the full life cycle of a product. Agency researchers developed the guidelines using life cycle analyses to meet the challenge of providing clear, comparable information about the environmental impacts of different products. PCR is a voluntary, international effort with more than 40 participating organizations dedicated to improving the ongoing guidance document.

The release of the draft guidelines stems, in part, from an international initiative—co-led by EPA and involving more than 30 organizations in 11 countries—to help purchasers select the most environmentally-friendly and safe products. The European Union will use the guidance to develop rules for environmental labels as part of its Product Environmental Footprint program. There has recently been an increase in demand in the U.S. for standardized environmental information for building products, in part because of new LEED 4.0 green building standards that incorporate credits for products with such labels.



Protecting Growth and Development

Exposures to excess hormones or hormone-like substances known collectively as "endocrine disrupting chemicals" (EDCs) can disrupt development and the functioning of the endocrine system in humans, fish and wildlife, leading to adverse effects that could include infertility and childhood disorders. Learning more about EDCs has been a high priority for EPA researchers since the early 1990s. They have developed a two-tiered testing approach. Tier 1 identifies chemicals that have the potential to interact with the endocrine system. Those chemicals flagged for potential effects are subjected to more in-depth analysis to determine endocrine-related effects at different levels of exposure in Tier 2.

Agency researchers continued to advance insights in to EDCs throughout 2013. For example, EPA researchers provided guidance and protocols to EPA's Endocrine Disruption Screening Program for Tier 2 endocrine disruption tests used to evaluate chemicals for ecosystem risk and used new ToxCast data and Quantitative Structure-Activity Relationship models (QSAR) to prioritize chemicals for their potential for endocrine disruption.

Advancing the Safety of Nanomaterials

Nanomaterials, those between one and 100 nanometers in size, exhibit unique properties and are increasingly entering the marketplace in products that include paints, fabrics, cosmetics, treated wood, and electronics. As part of a large U.S. and international research collaboration, EPA researchers are leading the effort to understand the unique and novel properties of nanomaterials and determine whether they are safe for humans and the environment as they are used in products.

EPA researchers are studying what nanomaterials are, and how they act, travel, and change. Results in this area over the past year have included: characterizing the surface properties of silver nanoparticles and how these properties affect their fate in containment systems; developing high-throughput methods for characterizing nanoparticle transport through soils and sediments; and the release of the report: *Comprehensive Environmental Assessment Applied to Multiwalled Carbon Nanotube Flame-Retardant Coatings in Upholstery Textiles: A Case Study Presenting Priority Research Gaps for Future Risk Assessments (Final Report)*.

The Next Generation of Risk Assessment

Advances in molecular systems biology, improved understanding of gene-environment interactions, reports from the National Research Council, and volumes of new toxicity data from the United States and Europe are rapidly changing the landscape of chemical risk assessment.

In September, 2013 EPA researchers released the draft report, *Next Generation Risk Assessment: Incorporation of Recent Advances in Molecular, Computational, and Systems Biology*, for public comment and peer review. NexGen is a multi-year program aimed at developing and evaluating novel approaches to risk assessment that takes full advantage of new molecular, computational, and systems biology research and methods. The report summarizes the state-of-the-science in this area and provides case studies. Beginning in 2014, EPA will enter the next phase of this effort, using novel data streams generated by ToxCast and related research to enhance and accelerate EPA's risk-based chemical evaluations.

Learn More!

Please visit: www.epa.gov/research/chemicalscience/.

Sustainable and Healthy Communities Research

How can communities and individuals meet their current needs without compromising the ability of future generations to meet their own? And more specifically, how can they balance the protection of our shared environment—air, water, land, and natural ecosystems—in ways that sustain both human health and economic stability? Providing the science and engineering to answer those questions is the focus of EPA’s Sustainable and Healthy Communities research program.

EPA researchers engage community stakeholders, individuals, partner agencies, and other decision makers to help identify the long-term environmental and related health challenges they face. The scientists and engineers then use that insight to design and implement programs that provide the decision-support tools, information, and models needed to meet those challenges. The impact of their work is exemplified in a host of science-based strategies and models available to decision makers, and in the investments these EPA partners are making today for a prosperous, healthy, and sustainable future.





Ecosystems Services Research

EPA researchers identify and quantify ecosystem benefits.

When it comes to the benefits communities derive from ecosystems, the marketplace often does not capture and reflect true value. The benefits not accounted for include things such as the flood and erosion control that mangrove forests and other wetlands provide, the recreational opportunities citizens enjoy from having access to open water and forests, and the natural cycling and absorption of excess nitrogen, phosphorous, and carbon that keeps the climate and other systems stable and productive.

As a result, managers, community planners, and other decision makers tasked with protecting the long-term health and sustainability of their communities lack an accurate way to calculate and incorporate environmental costs and benefits into their strategies and actions.

EPA researchers are working to change that scenario. Working closely with local communities, they are finding ways to quantify the benefits people derive from natural ecosystems, what they refer to as "ecosystem services." In 2013, this important work continued in three different regions: Tampa Bay (Florida); the Pacific Northwest, and California.

Agency scientists have partnered with local governments, other research entities, planning organizations, and citizen and business groups to identify and assess the values the Tampa Bay estuary and other local environments provide to the surrounding community. Together, these experts and stakeholders are helping identify environmental assets that decision makers can use when establishing plans to guide development and land use in the area.

For example, as part of the overall project, an EPA study of nine mangrove wetlands and 18 freshwater river and marsh sites, each with differing levels of human disturbance. With these results, Agency researchers are now building a dynamic model to illuminate how disturbances to such wetlands affect associated

ecosystem services such as absorbing excess nutrients, a key factor related to water quality across the Tampa Bay watershed, like many others.

Another EPA ecosystem services research project is unfolding some 3,000 miles away from Tampa Bay, in select inland and coastal communities of the Pacific Northwest (primarily Oregon). The goal of the Pacific Northwest Demonstration Project is to develop nationally-applicable models and decision support tools that will quantify the production and value of ecosystem goods and services.

To achieve this, an EPA team is designing the research by first engaging individuals and groups in the region representing a breadth of relevant expertise and user priorities. That effort is helping ensure that the end products (models and tools) will help local communities better understand the long-term consequences that their decisions may have on ecosystem services and community health and stability.

A team of EPA scientists, together with partners from state, federal, and private organizations, is developing a detailed map identifying California "EcoRegions," areas defined by the type, quality, and quantity of their environmental resources.

With funding from EPA's Regional Applied Research Effort (RARE), the scientists analyzed spatial patterns of geology, physiology, vegetation, climate, soils, land use, wildlife, and hydrology across California to identify 177 ecoregions. Such maps provide vital information for evaluating and predicting ecosystem response to disturbance, both natural and human-related.

Ecosystem services research is just on of the many achievements made by EPA's Sustainable and Healthy Communities research program during 2013. Additional highlights follow.



First School Building-focused HIA Launched

In 2013, EPA researchers launched the first school building-focused Health Impact Assessment (HIA) to help inform renovations at the Gerena School in Springfield, Massachusetts, where 20 percent of the attending students have asthma. The school is located directly under a highway, adjacent to active train tracks, and has experienced a history of indoor air quality issues related to moisture and old ventilation systems.

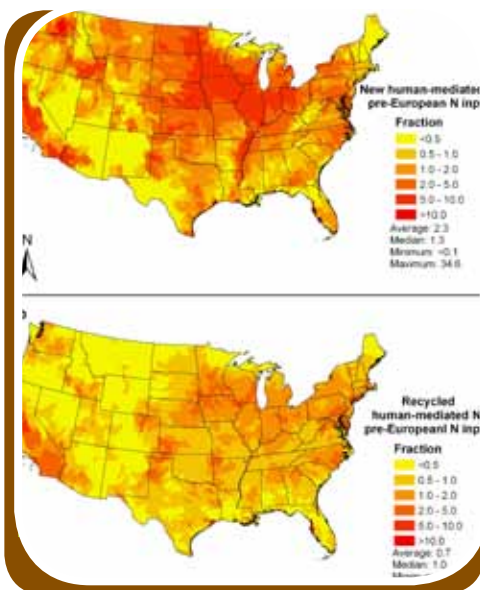
HIAs are decision making tools that help managers explore options on how proposed decisions may impact health. This first school building-focused effort is informing EPA external stakeholders and providing an opportunity for researchers to learn how to incorporate their science into the Health Impact Assessment process. This collaborative project is helping the City of Springfield identify renovation and improvement options to best address environmental problems facing the school and reduce potential negative health impacts such as exacerbation of asthma.



Health Impact Assessment Helps Inform Green Street Project

The community surrounding Proctor Creek in Atlanta faces a host of challenges, including pervasive street flooding, repeated sewage backups, derelict properties, illegal tire dumping, and bacterial contamination (*E. coli* and other fecal coliforms) in the creek itself. Having limited resources, the community is working to identify solutions that will address multiple problems at once.

One promising solution, the “Boone Boulevard Green Street Project,” is incorporating green infrastructure elements such as permeable pavement, bioretention systems, and planter boxes to reduce stormwater runoff and associated pollution. EPA researchers launched a Health Impact Assessment to support this work. Together with local and Agency partners, the researchers are assessing green infrastructure options to identify those that minimize adverse health impacts and maximize environmental and public health benefits. Results of the study are informing the Boone Boulevard-Green Street design, led by the City of Atlanta’s Department of Watershed Management.



Mapping Reactive Nitrogen Sources

In March, 2013 EPA researchers and partners presented results of a study showing that activities such as the use of agricultural fertilizers and the combustion of fossil fuels were increasing the annual input of nitrogen into the nation’s environment by three times the levels experienced before the turn of the 20th century. That is an increase of some 25,000,000 metric tons, equivalent to 75 Empire State Buildings. This nitrogen contributes to water pollution and harmful conditions for fish.

The researchers calculated the above estimate as part of developing a clearer picture of reactive nitrogen inputs to U.S. lands and waterways. The researchers synthesized decades of nitrogen research and created a series of maps illustrating both human and natural sources of nitrogen. The research helps partners, such as states, prioritize watersheds for reducing nutrient pollution and to develop nutrient criteria for protecting their waters. The maps will inform decisions that will positively impact water resources and drinking water quality threatened by excess nitrogen.



Advancing Community Sustainability

Agency researchers developed a searchable database of indicators and indices that community planners and others can use to assess the sustainability benefits of their programs and plans. They also produced a corresponding framework document as a reference to guide the selection and use of sustainability indicators.

The “Directory of Sustainability Indicators and Indices (DOSII)” provides information on measures for evaluating the sustainability goals and progress of programs, projects, and activities related to air, water, energy, products, communities, human health risks, and national security. In addition, Agency researchers are building on this product to develop an interactive Web-based tool (e-DOSII) to extend the indicator and indices database search capabilities to communities and others.



Assessing Performance of Groundwater Remediation Barriers

EPA researchers are advancing techniques and technologies to help local communities meet their most urgent groundwater issues and challenges. For example, Agency scientists and engineers are conducting studies on groundwater remediation technologies to support the Agency’s Office of Solid Waste and Emergency Response.

Recent research includes a study on the long-term (15 years) performance of a Permeable Reactive Barrier installed to treat groundwater contaminants (hexavalent chromium and the chemical trichloroethylene) at the U.S. Coast Guard Support Center located near Elizabeth City, NC (pictured, left). The results are the longest available data record of performance of a Permeable Reactive Barrier, providing significant insight into the longevity of such techniques.



Engineering and Technical Support

EPA’s Engineering Technical Support Center provides engineering expertise to EPA program offices and remediation teams working at Superfund and other cleanup sites across the United States. Center personnel provide site-specific scientific and engineering support to remedial project managers, on-scene coordinators, and other remediation personnel.

In 2013, researchers released *Innovative Science and Technical Support for Cost-Effective Cleanups: Five Year Summary Report for 2007-2012* (EPA/600/R-13/093). The report summarizes a variety of projects that Agency experts have supported, addressing an array of environmental scenarios, including: remote mining contamination, expansive landfill waste, sediment remediation by capping, and persistent threats from abandoned industrial sites. It highlights how EPA scientists and engineers have advanced remediation practices through the construction and testing of cutting-edge pilot projects and new technologies, and shares significant developments in environmental engineering.



EnviroAtlas and Community Sustainability

EPA researchers released for beta testing the EnviroAtlas, a multi-scale (national to community), Web-based mapping, visualization, and analysis tool designed to help communities and policy-makers make decisions that affect sustainability. The Atlas provides the first-ever picture of the distribution of ecosystem services for the mainland United States, and includes more than 200 data layers. The community component provides additional data at a finer resolution for six areas: Durham, NC; Portland, ME; Tampa, FL; Pittsburgh, PA; Milwaukee, WI; and Phoenix, AZ.

More than 500 registered testers are providing feedback on the beta version and helping identify potential decision making uses. EnviroAtlas has been selected to be part of "Ecolnforma," a White House initiative to create a publicly available database on the nation's biodiversity and distribution of ecosystem services. The EnviroAtlas is available at <http://enviroatlas.epa.gov/enviroatlas>.



Tools to Support Community Health and Sustainability

EnviroAtlas is just one of a suite of accessible, Web-based decision-support resources that EPA scientists are developing to help communities. Two innovative tools have been developed to help communities identify risks and access relevant scientific information and data that illuminate the connections between ecosystems and public health. The Community-Focused Exposure and Risk Screening Tool (C-FERST) is a community mapping, information access and assessment tool to inform environmental public health decisions; the Tribal-Focused Environmental Risk and Sustainability Tool (Tribal-FERST) is a web-based, geospatial environmental decision-support tool developed specifically for Federally Recognized Tribes.

C-FERST and Tribal-FERST (available as password-protected beta versions) have been piloted in multiple communities and underwent external peer review in 2013. Agency researchers conducted C-FERST training for stakeholders in Springfield, MA, and Tacoma, WA, and collaborated with the Pleasant Point Passamaquoddy Tribe (Maine) and the United South and Eastern Tribes (USET) to apply Tribal-FERST. EPA New England (Region 1) partners initiated a C-FERST training pilot in preparation for a 2014 public release.



A Decade of Tribal Environmental Health

For more than a decade, EPA extramural grants and fellowships programs have been supporting tribal-focused research to inform decisions, reduce health risks, and help ensure the well-being of tribal and Native Alaskan communities.

In 2013, the Agency released a report highlighting the many accomplishments and impacts of those programs: *A Decade of Tribal Environmental Health Research: Results and Impacts from EPA's Extramural Grants and Fellowships Programs*. The report highlights how research conducted by EPA grantees and their partners have enabled tribal communities to identify solutions and take action. The overall impacts have reduced health and ecological effects from: the consumption of water and water-based resources, chemical contaminants, and the effects of climate change. Tribes have also enhanced their ability to conduct community-level risk assessments. The research has supported policy changes and the creation of tools to help tribal communities maintain their traditional lifestyle, health and well-being.



Science to Support Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" states that every federal agency should make environmental justice part of its mission, "by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." EPA is fully committed to fulfilling that mandate.

EPA scientists and engineers provide critical support and coordination on Agency environmental justice activities. Two particularly noteworthy 2013 achievements in this area include: 1) releasing the draft report *Technical Guidance for Assessing Environmental Justice in Regulatory Analysis*; and 2) supporting the Science and Research Work Group under the National Environmental Justice Advisory Council, which issued recommendations about research programs and the science needed to address and prevent environmental inequities. Note: *EnviroAtlas*, *C/T-Ferst*, (see previous page) and the *Community Cumulative Assessment Tool* are part of Plan EJ 2014, an Agency roadmap for environmental justice.



Decision Support Framework Supports Community Action

EPA researchers are advancing an open-source, web-based decision analysis framework to help objectively identify and sort through diverse and often complicated issues, including the benefits of ecosystems ("ecosystem services"). Watershed and other managers, community members, risk assessors, and other stakeholders will be able to use the framework to help make decisions with linked environmental, economic, and societal impacts. Focused on sustainable systems and communities, *Decision Analysis for a Sustainable Environment, Economy, & Society (DASEES)* is designed to facilitate common understandings in the development of rigorous, inclusive, defensible, and transparent solutions.

DASEES (available as a password-protected beta version) is being piloted in Guánica Bay, Puerto Rico. Agency researchers in collaboration with EPA Region 2 partners are working with multiple communities to create and evaluate the use of multiple land practices across the watershed that will collectively reduce sediment and contaminated stormwater runoff from reaching the Bay. In addition, EPA New England (Region 1) partners are working to integrate brownfield re-development guidance into the DASEES Web-format to facilitate collaboration and usability.



Advancing Watershed Management to Protect Coral Reefs

Tropical coral reefs are the largest living structures on the planet, the habitats of some of the most biologically diverse natural communities, and among the most threatened of marine ecosystems. For several years, EPA researchers have been working with the Agency's Office of Water, communities surrounding Guánica Bay, Puerto Rico, and other partners to develop a watershed management plan that reduces land-based contributions, such as contaminated stormwater runoff and nutrient pollution, so as to better protect the Bay's coral reefs.

In 2013, EPA researchers presented another key milestone in that effort with the publication of research results from studies they conducted using decision analysis structuring tools, like DASEES (described above). Using these tools, the researchers were able to explore a complex set of diverse tradeoffs to advance a proposed water management plan addressing multiple objectives, including maximizing ecological integrity, maximizing economic benefits, maximizing social well-being, minimizing threats to human health, meeting political and legislative requirements, and maximizing learning objectives.

Learn More!

EPA Ecosystems Research: www.epa.gov/research/ecoscience/

Homeland Security Research

EPA is the lead federal agency for decontamination operations and for protecting water systems following incidents involving chemical, biological, and radiological substances. Scientists and engineers in the Homeland Security research program provide the knowledge, data, and tools that form the scientific foundation for meeting those responsibilities.

EPA homeland security research results help communities across the country advance their emergency response and remediation capabilities and take action to become more resilient in the face of natural disasters, acts of terrorism, or other large-scale disruptions. Results provide water utility managers, laboratory technicians, emergency personnel, risk assessors, and other Agency partners with the information, protocols, and techniques they need to take action.





Advancing Anthrax Decontamination

EPA researchers and their partners are developing anthrax decontamination techniques.

In 2001, shortly after the 9/11 terrorist attacks, letters tainted with anthrax-causing *Bacillus anthracis* spores were mailed to two U.S. Senators and a handful of major television network newscasters. Although that mail never reached its intended targets, 22 people who came into contact with the envelopes were infected; five died. Adding to the toll, at least 17 buildings were confirmed to have been contaminated with anthrax spores, requiring extensive and expensive clean up and decontamination efforts.

Today, the nation stands significantly better prepared to respond to acts of bio-terrorism than it did just over a decade ago. As the lead federal entity for responding to biological, chemical, and radiological contamination events, EPA has played a major role in that achievement.

That important work continued throughout 2013 with research efforts such as the Bio-response Operational Testing and Evaluation (BOTE) project. Co-led by EPA scientists and their partners at the Department of Homeland Security (DHS), BOTE is a two-phase demonstration project to test and advance decontamination methods that can be used after anthrax spores have been released into a building.

Researchers tested three technologies: (1) fumigation with vaporized hydrogen peroxide, (2) fumigation with chlorine dioxide, and (3) a bleach spraying technique.

To advance the research from the laboratory to real world conditions, they released a nonlethal, anthrax surrogate (*Bacillus atropeus*) in a two-floor test facility they designed to mimic typical living and workspaces, with rooms set up like office spaces or small apartment dwellings.

The researchers tested all three decontamination methods under varying conditions, and evaluated the potential for recontamination risks that might occur due to spores reentering the air during cleanup activities. They also examined costs including the damage they might cause to the facility or to computers and other electronic equipment and waste management operations from related cleanup activities.

In the second phase of the BOTE study, partners from several government agencies conducted a joint exercise testing the coordinated response of health officials, law enforcement personnel, and decontamination (environmental) responders.

Because BOTE included partnerships among several government agencies, the methods developed and lessons learned have been shared throughout the homeland security community, continuing to expand the impact of EPA research efforts.

BOTE was just one of many accomplishments achieved by EPA homeland security researchers during 2013. Additional highlights follow.



Advancing Anthrax Clean Up and Decontamination

In the aftermath of an attack involving the release of *Bacillus anthracis*, the bacteria that causes anthrax, emergency responders and cleanup personnel will depend on EPA's Environmental Response Laboratory Network (ERLN), which is a host of different, independent analytical laboratories located across the country.

To unite ERLN efforts in ways that advance the nation's response capabilities, EPA researchers have provided a standardized set of analytical procedures in the *Protocol for Detection of B. Anthracis in Environmental Samples during the Remediation Phase of an Anthrax Event*. This single, open-access resource presents a consistent set of directions and key components that labs need to conduct accurate, comparable, rapid analysis in support of clean up and decontamination efforts.



Helping Individuals Clean Up Radiation Contamination

Among the biggest challenges following an incident involving radiological agents, such as those released from the Chernobyl and Fukushima nuclear power plants, is the massive number of homes and businesses that can be affected. Although millions of people may need to evacuate immediately following a radiation emergency, contamination levels in many areas might be low enough for individuals to clean up after only a short time.

EPA researchers are developing effective, low-tech cleanup methods and strategies for low-level radioactive decontamination. They have tested widely available household cleaning products, standard laundry practices, and plain water for removing cesium contamination from typical surfaces found in homes and businesses, and from clothing. Results revealed that such simple house cleaning activities, when combined with measures to avoid unintentional exposures, can have impact in helping people safely return to their homes and businesses following a radiological incident.



Net Zero Partnership Advances Water Decontamination

EPA scientists and engineers have turned an industrial-size vehicle cleaning operation at the Fort Riley military base in Kansas into a research program. There, they set up a field station to use wastewater to test oxidation and disinfection techniques. The work is advancing the kind of response and decontamination methods that would be needed following a terrorist attack or other incident involving biological, chemical, or radiological agents.

The project is one of the benefits flowing from EPA's partnership with the U.S. Army to support its Net Zero Program, a sustainability initiative to reduce energy consumption, water use, and waste production. (See more about Net Zero on page 11.)



Enhancing National Lab Response Capability

To advance homeland security preparedness and assist chemical laboratories' ability to respond to a terrorist attack or other incident involving chemical weapons, EPA chemists have been developing methods for detecting low concentrations of nerve agents, such as sarin, VX, soman and cyclohexyl sarin, and the blister agent sulfur mustard.

Working with partners from the Lawrence Livermore National Laboratory, Agency researchers completed several studies to examine the shelf life of ultra-dilute concentrations of chemical warfare agents. Their research results, some of which are presented in the report *Stability Study for Ultra-Dilute Chemical Warfare Agent Standards*, include the first standards on the stability and shelf life of extremely low concentrations of chemical agents. It provides information that labs can use to calibrate instruments, a critical first step to analyzing chemical warfare agents in an emergency.



Protecting Drinking Water Supplies

EPA is the lead federal agency for protecting water systems. Agency researchers and their partners are working diligently to prevent or minimize any actual or attempted contamination event of the nation's drinking water supply and distribution system. To do so, they are developing and advancing water monitoring and early warning technologies and software that provide system-wide, real-time surveillance.

Throughout 2013, researchers continued to advance software technology designed to help water utility personnel monitor the delivery of safe, clean water. Examples include EPANET-MSX, which provides for the modeling of multiple, interactive contaminant species, and EPANET-RTX, for real-time water quality monitoring. Another is CANARY Event Detection Software, which was piloted in Cincinnati, New York, Los Angeles, Philadelphia, San Francisco, and Singapore.



World's First Water Security Test Bed Developed

EPA homeland security researchers developed an innovative Water Security Test Bed, a 200-foot by 400-foot, aboveground grid constructed of 30-year-old pipes. The system replicates the piping structure and flow of a typical municipal drinking water network.

Constructed in partnership with the Department of Energy's Idaho National Laboratory in Idaho Falls, the innovative Test Bed provides a working laboratory to advance water security and decontamination research. Over the next several years, researchers will use surrogates for various biological, chemical, and radioactive materials to conduct experiments advancing monitoring, decontamination, and treatment of water system infrastructure and water supplies. These will likely include testing chlorination and flushing protocols, advanced oxidative processes, and emptying and fumigating the pipes. Future plans include connecting the system to a lab built to resemble a residential bathroom, providing the capacity for researchers to explore human exposure risks from contaminated water entering a home.

Learn More!

EPA Homeland Security Research: www.epa.gov/nhsr/

Human Health Risk Assessment

EPA's Human Health Risk Assessment research program produces state-of-the-science research results that provide insight into the intricate and complex relationships between human health and our environment. The program plays a unique role in serving the needs of EPA programs and their partners by integrating and evaluating scientific information into assessments and other products that can be used as a foundation for regulatory decisions that positively impact human health.

Examples of products developed by researchers in EPA's Human Health Risk Assessment research program include: scientific assessments describing the human health effects of environmental chemicals and chemical mixtures; comprehensive assessments of the health and environmental effects of the six criteria air pollutants, which are the scientific foundation for the National Ambient Air Quality Standards; tools and reports that help exposure assessors understand how and to what extent humans are exposed to environmental contaminants; and tools and methods to modernize human health risk assessment.





Advancing IRIS

EPA researchers enhance stakeholder engagement, increase transparency for the Integrated Risk Information System.

A critical part of EPA's work assessing the potential health effects posed by chemicals in the environment is the Integrated Risk Information System (IRIS). Through IRIS, Agency scientists evaluate and present comprehensive information concerning the human health effects that might result from exposures to contaminants in land, water, and air. IRIS assessments are used throughout the country and beyond to guide environmental cleanups, set health standards, and take other important actions.

In 2013, EPA researchers continued to advance a multi-year commitment consistent with recommendations from the National Research Council to improve and strengthen the IRIS program. The Agency announced important changes to improve assessments, increase transparency throughout the program, and incorporate efficiencies in the process in order to produce more assessments each year.

These improvements included the release of preliminary materials and public meetings to discuss those materials early in the assessment development process. The preliminary materials communicate EPA's process for determining which studies are most important for the assessment. The early public engagement also helps EPA ensure important studies have not been omitted, and helps identify potential scientific controversies early on.

The improvements also included using a more systematic approach to reviewing and selecting studies. Additionally, the Agency implemented new "stopping rules" so IRIS assessments are not delayed by ongoing research on scientific debate after certain points of the process have passed.

IRIS researchers also continued to implement design changes to the presentation of assessments, making the technical information they contain more accessible and understandable. The Agency revealed

an improved, clearer, more concise document structure. For example, all future IRIS assessments will include evidence tables summarizing critical scientific literature and exposure-response figures that graphically depict biological responses at different levels of exposure for studies.

EPA's Science Advisory Board (SAB), established by Congress in 1978 to advise the Agency on technical matters, held the first meeting of the new-established Chemical Assessment Advisory Committee. The charter of the Chemical Assessment Advisory Committee is to provide expert advice regarding Toxicological Reviews of environmental chemicals available on IRIS.

In addition, EPA researchers held a series of public meetings and workshops throughout the year to engage stakeholders and solicit input, part of larger efforts to increase transparency and improve IRIS assessments. They kicked this off with a public stakeholder meeting to facilitate discussion on the IRIS program in general. The first of its kind for the program, the meeting attracted more than 400 individuals participating either in person or by webinar. Additionally, IRIS program researchers held a public planning and scoping workshop to solicit stakeholder needs, evaluate the current science, and identify the potential impacts of an inorganic arsenic assessment. The workshop was fully available by webinar and telephone.

In August, EPA hosted the workshop "Applying Systematic Review to Assessments of Health Effects of Chemical Exposures." It provided a forum for examining the state-of-the-science of systematic review methodology and for exploring recent developments and different frameworks used to synthesize various evidence types for evaluating causality between chemical exposure and adverse health effects. Experts from EPA, other government agencies, academia, and private industries attended the workshop.



EPA Releases Final IRIS Assessment for Methanol (noncancer)

In September 2013, EPA researchers released the final (noncancer) IRIS assessment of methanol, a High Production Volume chemical used as a basic building block for numerous other chemicals with a diverse number of applications and uses. Many of its derivatives are used in the construction, housing, and automotive industries. Consumer products that contain methanol include varnishes, shellacs, paints, windshield washer fluid, antifreeze, adhesives, and de-icers. People may be exposed to methanol by breathing it when using solvents and other products containing methanol. People in certain occupations, such as those working in methanol production or end-product manufacturing, may also be exposed by breathing methanol.

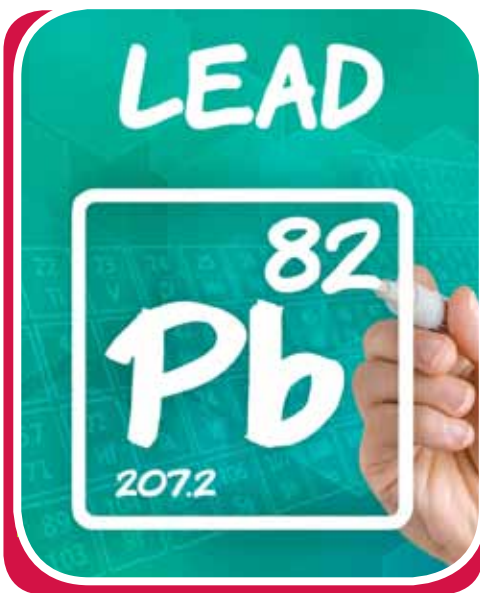
The methanol health assessment addresses the human health effects other than cancer that may result from chronic exposure to the chemical. It provides information on the amount of methanol that someone can inhale every day over a lifetime that is unlikely to have an adverse health effect, a measurement known as an “inhalation reference concentration” (RfC). The assessment also provides a reassessment of the oral reference dose (RfD), the amount that can be ingested every day over a lifetime that is unlikely to have an adverse health effect.



EPA Releases Final IRIS Assessment for Biphenyl

In August 2013, EPA researchers released the final IRIS assessment of biphenyl. Biphenyl is an organic compound used in the production of polychlorinated biphenyls (PCBs) before they were banned in the late 1970s. Today it is used in the production of pesticides, as a dye carrier for coloring polyester, and as a heat-transfer component in industrial processing applications. It is found at multiple Superfund and other hazardous waste sites, is on the list of Hazardous Air Pollutants (HAPs), and is classified as a High Production Volume chemical. People may be exposed to biphenyl by breathing it after it is released when things such as garbage or cigarettes are burned. People may also be exposed to biphenyl by eating food or drinking water that is contaminated with the chemical.

The assessment describes the health effects that may result from exposure to biphenyl and includes an oral reference dose (RfD) for the chemical.



Final Integrated Science Assessments for Lead and Ozone

The average American breathes more than 11,000 liters of air (a small tanker truck worth) daily, making it easy to understand why clean air is critical to public health. To help ensure that Americans have clean air, interdisciplinary teams of EPA scientists review, synthesize, and evaluate the most policy-relevant science to produce Integrated Science Assessments. These assessments, in turn, provide the scientific foundation for informing National Ambient Air Quality Standards (NAAQS) for six criteria pollutants—ozone, particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead—considered harmful to human health and the environment.

In 2013, EPA released its most recent reviews of the science on the health and ecological effects of two criteria pollutants: the *Integrated Science Assessment for Lead (Final Report)* and the *Integrated Science Assessment of Ozone and Related Photochemical Oxidants (Final Report)*. The reports provide concise reviews, syntheses, and evaluations for the Agency’s review of the lead and ozone NAAQS, respectively.



Exposure Toolbox Launched

EPA scientists developed an innovative, Web-based exposure assessment “toolbox.” The EPA-Expo-Box (short for EPA Exposure Toolbox) is an encyclopedia-like resource of exposure assessment information and tools complete with links to databases, models, guidance documents and other resources. The site is organized by topics important to assessors, such as exposure assessment approaches, chemical classes, environmental media, routes of exposure, and life stages and populations.

EPA-Expo-Box is the first comprehensive, one-stop-shop providing step-by-step guidance to people conducting a chemical exposure assessment. Its online format provides free, and open access to users, enabling EPA researchers to quickly and easily add new resources as they become available.



Advancing Data-driven Regulatory Risk Assessment

In January 2013, EPA researchers announced the availability of the proceedings *Report of the State-of-the-Science Workshop: Evaluation of Epidemiological Data Consistency for Application in Regulatory Risk Assessment*. The workshop was co-sponsored by EPA, the National Institute of Environmental Health Sciences, and the National Institute for Occupational Safety and Health, with additional support provided by Health Canada.

The workshop included well-recognized experts from a variety of fields from academia, industry, government, and the public interest sectors. This report provides a summary of selected epidemiology methodological issues discussed by the workshop participants and provides the key findings and recommendations for future approaches to evaluating epidemiological data in regulatory risk assessment.



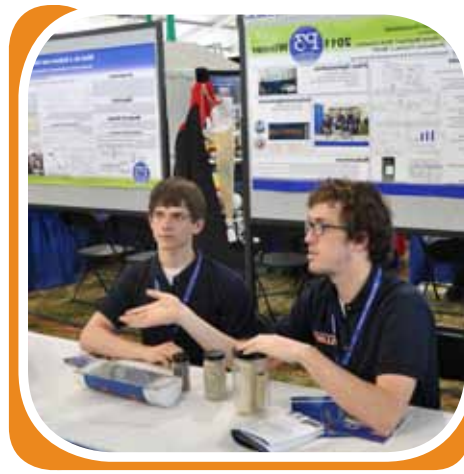
Improving the Risk Assessment of Chemicals in Breast Milk

In October 2013, EPA released the final report, *Improving the Risk Assessment of Persistent, Bioaccumulative, and Toxic Chemicals in Breast Milk*. The document provides a summary of discussions held at an Agency-sponsored workshop in Research Triangle Park, NC, in October 2012.

Workshop participants discussed approaches to improve risk assessment of persistent, bioaccumulative, and toxic chemicals that accumulate in breast milk. The workshop and report highlight ways to identify data gaps and uncertainties, and suggest solutions. Ultimately, the work will improve the risk assessment of chemicals that accumulate in breast milk. Health experts continue to agree that breast milk is the healthiest option for infants, and EPA’s efforts will help to protect this vital resource.

Learn More!

Human Health Risk Assessment Research: <http://go.usa.gov/ZesQ>



Supporting and Building Partnerships

The Agency's extramural research program funds research grants, graduate and undergraduate fellowships, and large research centers.

EPA supports some of the nation's leading scientists and engineers in the pursuit and dissemination of high-quality research. Additionally, Agency researchers cultivate and maintain partnerships with research colleagues at colleges and universities around the world, federal and state human health and environmental agencies, and other entities throughout the scientific community.

The Agency's extramural research program funds research grants, graduate and undergraduate fellowships, and large research centers. Research in numerous environmental science and engineering disciplines are funded through the Agency's Science to Achieve Results (STAR) program. Through a competitive solicitation processes (Requests for Applications), followed by independent, peer-reviewed selection processes, the program engages and supports the nation's best scientists and engineers in targeted research

that complements EPA's own intramural research program, as well as collaborative research efforts with other federal agencies.

EPA is also one of 11 federal agencies that participate in the Small Business Innovation Research (SBIR) program. Through this program, EPA awards contracts to support novel concepts for products and technologies that will help spur economic growth while advancing a more sustainable future.



Protecting Children's Health for a Lifetime

2013 marked the 15th year of collaboration between EPA and the National Institute of Environmental Health Sciences (NIEHS) to support some of the nation's leading children's environmental health researchers.

The EPA/NIEHS Children's Environmental Health and Disease Prevention Research Centers program engages scientists, pediatricians, epidemiologists, other research specialists, and local community representatives to reduce children's health risks, protect them from environmental threats, and promote health and well-being in the communities where children live, learn, and play.

Since the establishment of the program, more than 20 multidisciplinary Children's Centers have received grants to support science aimed at meeting some of the most pressing health challenges facing the nation's children, including asthma, autism, attention deficit hyperactivity disorder, neurodevelopmental deficits, childhood leukemia, diabetes, and obesity.

In total, since 1998 more than \$140 million of EPA funding has been devoted to supporting those efforts, matched by a similar amount of funding from NIEHS.

This investment in the nation's most valuable assets has returned critically important dividends. Children's Center researchers have published a host of key findings on diverse research subjects important to protecting children's health. Many of those findings were highlighted during an EPA-hosted event celebrating 15 years of Center achievements and to encourage collaborations with EPA-funded Pediatric Environmental Health Specialty Units around the country.

In addition, Children's Center researchers have pioneered innovative thinking about how to understand and address children's environmental health issues and how to prevent adverse health impacts. Because the program has been strategically designed to include community engagement, mechanisms for communicating and sharing important findings early in the research processes, and

mentoring new investigators, the program will have considerable and significant positive impact on the field of children's environmental health for many years to come.

Collectively, those impacts have made the Children's Centers program an exemplary model of how collaborative, interagency federal research support can effectively improve community and public health for children and other vulnerable life-stages and populations.

To continue to build upon a 15-year legacy of achievement highlighted EPA and NIEHS funded eight new Children's Environmental Health and Disease Prevention Research Centers in 2013.

Institution	Project Title	EPA Anticipated Funding*	Total Anticipated Funding with NIEHS*
Dartmouth College	Children's Environmental Health & Disease Prevention Research Center at Dartmouth	\$4,060,713	\$8,121,426
Duke University	Neurodevelopment and Improving Children's Health following EtS exposure (NICHEs)	\$3,907,780	\$7,723,223
University of Michigan	Lifecourse Exposures & Diet: Epigenetics, Maturation & Metabolic Syndrome	\$3,651,990	\$7,303,980
University of Illinois, Urbana-Champaign	Novel Methods to Assess the Effects of Chemicals on Child Development	\$3,962,727	\$7,925,454
University of California - Davis	The UC Davis Center for Children's Environmental Health and Disease Prevention	\$3,827,820	\$7,655,640
University of California - San Francisco	The UCSF Pregnancy Exposures to Environmental Chemicals (PEEC) Children's Center	\$3,312,848	\$6,625,696
University of California/Stanford University	UC Berkeley/Stanford Children's Environmental Health Center	\$4,765,843	\$9,531,686
University of Southern California	Southern California Children's Environmental Health Center (SC-CEHC)	\$4,146,875	\$8,293,750

*Total funding is subject to change based on availability of funds, research progress and other factors.

STAR-Supported Research for Climate Change Modeling, Air Quality Management

In partnership with the National Science Foundation and the National Oceanic and Atmospheric Administration, EPA awarded more than \$4.3 million in grants to 13 institutions to study how certain types organic compounds form in the atmosphere. The grants were further supplemented by additional support from Southern Company (a southern regional power producer), and the Electric Power Research Institute for a total of more than \$20 million.

Organic aerosols are solid and liquid particles suspended in the atmosphere. They impact climate by affecting the amount of solar radiation that reaches the earth. They have also been linked to air quality and related health effects. Research performed by the grantees will help the Agency and others improve air quality management systems and advance climate change models. For more information, please see "Southern Oxidant and Aerosol Study" on page four of this report.

Recipient	Project Title	Amount
Georgia Institute of Technology	The role of nitrate radicals (NO ₃) in aerosol life cycle: Secondary organic aerosol formation and aging of atmospheric organic aerosols	\$300,000
University of North Carolina at Chapel Hill	Impacts of Anthropogenic Emissions in the Southeastern U.S. on Heterogeneous Chemistry of Isoprene-Derived Epoxides Leading to Secondary Organic Aerosol Formation	\$300,000
Carnegie Mellon University	Sensitivity of Organic Aerosol Concentrations and Forcing to Anthropogenic Emissions	\$399,998
University of Wisconsin-Madison	Assessing anthropogenic impact on secondary pollutant formation in the South Eastern US via airborne formaldehyde measurements	\$194,183
Georgia Institute of Technology	Cloud Condensation Nuclei Measurements During the SENEX 2013 Campaign: Observations, Analysis and Impacts	\$185,790
Reed College	Anthropogenic influence on biogenic VOC oxidation: the role of NO _x pollution in secondary organic aerosol production in the Southeast U.S.	\$299,995
University of California, Irvine	Understanding regional oxidation capacity by comprehensive observations to constrain hydroxyl radical sources and sinks during the Southern Oxidant Aerosol Study (SOAS)	\$299,895
University of Iowa	Sources and Radiative Properties of Organosulfates in the Atmosphere	\$300,000
Washington University in St. Louis	Novel Measurements of Volatility- and Polarity-Separated Organic Aerosol Composition and Associated Hygroscopicity to Investigate the Influence of Mixed Anthropogenic-Biogenic Emissions on Atmospheric Aging Processes	\$298,747

Recipient	Project Title	Amount
Stony Brook University	Emission, Fate, and Contribution of Biogenic Volatile Organic Compounds to Organic Aerosol Formation in the Presence of Anthropogenic Pollution: Measurements and Modeling during SOAS	\$399,964
University of California, San Diego	Using Particle Functional Group Composition to Identify and Quantify the Effects of Anthropogenic Emissions on Biogenic Secondary Organic Aerosol	\$400,000
Western Michigan University	The Role of Oxidation of BVOCs in SOA Production in the Southeastern U.S.	\$387,483
Research Triangle Institute	Aerosol Optical Properties and Biogenic SOA: Effect on Hygroscopic Properties and Light Absorption	\$398,318
Rutgers University	Organic aerosol formation in the humid, photochemically-active Southeastern US: SOAS experiments and simulations	\$399,928
		Total: \$4,564,301



EPA's Small Business Innovation Research Awards

EPA is one of 11 federal agencies in the Small Business Innovation Research (SBIR) program, established by the Small Business Innovation Development Act of 1982. The Agency's participation is designed to help support and facilitate the development of new technologies with potential to solve priority environmental problems while they spark economic growth.

In 2013, EPA awarded 26 small businesses with "proof of concept" contracts (Phase I) to research the scientific merit and technical feasibility of proposed technologies. In addition, seven companies that received similar Phase I contracts in 2012 were awarded additional contracts (Phase II) to bring their products towards commercialization and implementation.

EPA Phase I SBIR Awardees for 2013

Small Business	Project Title	Amount
National Recovery Technologies LLC	Automated Identification and Sorting of Rare Earth Elements in an E-Waste Recycling Stream	\$79,968
Faraday Technology, Inc.	Environmentally Conscious Electrochemical Machining for Zero Discharge and Metal Recycling	\$80,000
Radiation Monitoring Devices, Inc.	Solid State Sensor for Inspection of Prestressed Concrete Pressure Pipe	\$80,000
HJ Science & Technology, Inc.	Handheld Microfluidic Device for Cyanobacteria Toxin Detection and Monitoring	\$79,957
ACEA Biosciences, Inc.	Development of Pathway Selective Cells and Assays for Sensitive Detection of Environmental Toxicants via High Throughput Label-Free Cell-Based Screening	\$78,881
Advanced Diamond Technologies Inc.	Remediation of Oil Contaminated Ground and Surface Water Using Sulfate Nanofiltration Combined With High Efficiency On-Site Generation of Peroxodisulfate Using Ultrananocrystalline Diamond Electrodes	\$79,967
Applied Environmental Technology	Energy and Nutrient Extraction From Onsite Wastewater	\$79,938
ArunA Biomedical, Inc.	Developmental Neurotox Assay Using Scalable Neurons and Astrocytes in High-Content Imaging	\$79,993
KWJ Engineering, Inc.	Ultra-low Power CO ₂ Sensor for Intelligent Building Control	\$80,000
NexTech Materials	Sulfur Tolerant Catalysts for Biomass Tar Removal	\$80,000
Providence Photonics, Inc.	Development of Real-Time Flare Combustion Efficiency Monitor	\$79,854
Physical Sciences, Inc.	A Low-Cost Rare Earth Elements Recovery Technology	\$79,985

Small Business	Project Title	Amount
Compact Membrane Systems, Inc.	Enhanced Processing of Green Solvents	\$80,000
NEI Corporation	Self-Healing Corrosion Resistant Coating: An Enabling Technology to Allow Use of Alternate Water for Cooling	\$79,999
TDA Research, Inc.	Encapsulating Waste Disposal Methods	\$80,000
Electro Mechanical Associates, Inc.	Diesel Engine Efficiency and Emissions Improvement via Piston Temperature Control	\$79,996
Precision Combustion, Inc.	Fuel Flexible Low Emissions Burner for Waste-to-Energy Systems	\$79,895
Ecovative Design, LLC	Growth of a Fungal Biopolymer to Displace Common Synthetic Polymers and Exotic Woods	\$80,000
Imaging Systems Technology, Inc.	Efficient Water Purification Using TIO ₂ and Novel Activation Method	\$80,000
Liquid Lignin Company	Environmentally Friendly Borate-Based Wood Preservative	\$80,000
RegeneMed, Inc.	3D Breast Tissue Co-Cultures for Screening Mammary Carcinogens	\$80,000
Verrix	Automated Monitoring of Wastewater Treatment Efficiency	\$79,998
Enviro Utilities Inc.	Electrolytic Reactor for N Removal from Existing Septic Tanks	\$79,749
Instrumental Polymer Technologies, LLC	Soy-Capped Polycarbonate Dendrimers for Tough, Sustainable Water Based Wood Coatings	\$80,000
Solidia Technologies	Use of Supplementary Cementitious Materials in High Performance, CO ₂ Sequestering Construction Material	\$80,000
EP Purification, Inc.	Low Cost, Efficient Microchannel Plasma Ozone Generator for Point of Use Water Treatment	\$79,915
		Total \$2,078,095

EPA Phase II SBIR Awardees for 2013

Small Business	Project Title	Amount
Synanomet LLC	Novel Lignin-based Magnetite Nanocomposites for Removal of Phosphate from Contaminated Waters	\$299,987
GVD Corporation	Environmentally-benign Polytetrafluoroethylene (PTFE) Coatings for Mold Release	\$298,009
Aerodyne Research Inc.	Size-Selecting Aerosol Characterization Instrument	\$300,000
Electron Energy Corporation	Cost-effective Rare Earth Element Recycling Process from Industrial Scrap and Discarded Electronic Products to Valuable Magnetic Alloys and Permanent Magnets	\$300,000
Fluidic microControls, Inc	A 10-Kilowatt, Rankine Cycle, Waste-to-Energy Conversion Module Utilizing Ultra Micro Turbo-Alternators	\$300,000
NanoSonic Inc.	Voc-free, Highly Flame-resistant HybridSil® Insulation Coatings for Next-Generation Thermal Insulation and Energy Efficiency	\$300,000
Okeanos Technologies, LLC	Cost Effective Seawater Desalination with FICP Element Arrays	\$292,350
		Total: \$2,090,346



P3 — Sowing the Seeds of a Sustainable Future

On June 19, 2013, EPA announced the winners of the coveted P3 Award for Sustainability. EPA's People, Prosperity and the Planet (P3) award competition was held at the 9th Annual National Sustainable Design Expo. Established in 2004, the two-phase competition is focused on supporting innovative designs that benefit people, promote prosperity, and the planet.

for chance to move onto Phase II, which includes the P3 Award and up to \$90,000 in additional support to further develop their design and potentially bring it to the marketplace. In 2013, out of 40 Phase one college and university teams, seven were named P3 Award winners.

Teams that receive funding (up to \$15,000) during Phase I are invited to Washington, DC to showcase their research projects

2013 EPA P3 Award for Sustainability Winners

Institution	Project	Amount
Cornell University	AguaClara Stacked Rapid Sand Filtration – A Robust Filtration Process For Sustainable Drinking Water Infrastructure	\$90,000
Cornell University	Pyrolytic Cookstoves and Biochar Production in Kenya:	\$87,841
Georgia Southern University Research & Service Fdn., Inc.	Low Temperature Combustion with Reduced PM and NO _x Emissions, Achieved by n-Butanol in-Port Injected in an Omnivorous Diesel Engine	\$90,000
Loyola University of Chicago	A Sustainable and Interdisciplinary Solution to Biodiesel Production Wastewater	\$90,000
Radford University	Synthetic Humic Acid Materials for Improved Water Purification	\$89,975
San Jose State University	3D Printing Sustainable Building Components for Facades and as Window Elements	\$89,940
University of Massachusetts - Lowell	'Greener' Surfactants from Bio-based Waste as Efficient Alternatives to Nonylphenol Ethoxylates	\$90,000
		Total: \$627,756

2013 P3 Phase I Winners

Institution	Project Title	Amount
Brigham Young University	Greenplex - A Sustainable Urban Form for the 21st Century	\$15,000
Clemson University	Clemson Vanishing Firefly Project: Using a Mobile Phone App as Education and Research Tools for Sustainability	\$15,000
Cornell University	Proposed Process for Management of Textile Waste from Redesigned Secondhand Clothing Production in Haiti: No-Waste, Recycling, and Repurposing	\$15,000
Cornell University	Sustainable Water Treatment Facility for Communities with Arsenic Contaminated Groundwater	\$15,000
Cornell University	"Smart" Turbidimeters for Remote Monitoring of Water Quality	\$15,000
DePaul University	Community-based Soil Quality Assessment as a Tool for Designing an Urban Green Infrastructure Network to Manage Stormwater Runoff	\$15,000
Embry-Riddle Aeronautical University	Develop a Concentrated Solar Power-based Thermal Cooling System via Simulation and Experimental Studies	\$15,000
Florida International University	On Track to Carbon Neutral Buildings	\$15,000
Iowa State University	Developing Sustainable Products Using Renewable Cellulose Fiber and Biopolymer Composites	\$15,000
Kansas State University	From Garbage to Gourmet: Sustainable Waste Prevention and Mushroom Cultivation from Used Coffee Grounds	\$15,000
Miami University - Oxford	Using Sand and Moringa Oleifera Protein for a Sustainable Water Filter	\$15,000
Mississippi State University	Innovative in-situ Microwave/Ultrasonic Reactor for Algal Biomass Harvesting and Biofuel Production	\$15,000
Missouri University of Science and Technology	A Climate-Responsive Adaptive Control for a Combination Passive Solar Shading and Natural Ventilation	\$15,000
Northern Arizona University	Evaluating and Designing Ultra-low Cost Solar Water Heating Systems	\$15,000
Northern Kentucky University	New Technologies for Rapid Water Quality and Bioassessment of Agricultural Streams by Citizen Scientists	\$15,000
Oklahoma State University	Improved Biosand Methodologies for Sustainable Clean Water Solutions in Northern Honduras	\$15,000
Old Dominion University	Flash Hydrolysis of Microalgae for On-site Nutrients Recovery and Biofuels Production	\$15,000
Oregon State University	Biosorption of Dyes from Textile Industry Effluents Using Macroalgae	\$15,000
Purdue University	Biowall's Impact on Indoor Air Quality and Energy	\$15,000
Rochester Institute of Technology	Implementing Practical Pico-Hydropower	\$15,000
Rochester Institute of Technology	Development of an Improved Arboloo to Promote Sanitation in Rural Environments	\$15,000
Rowan University	Low Cost Portable Percussion Well Drill and Bailer	\$15,000

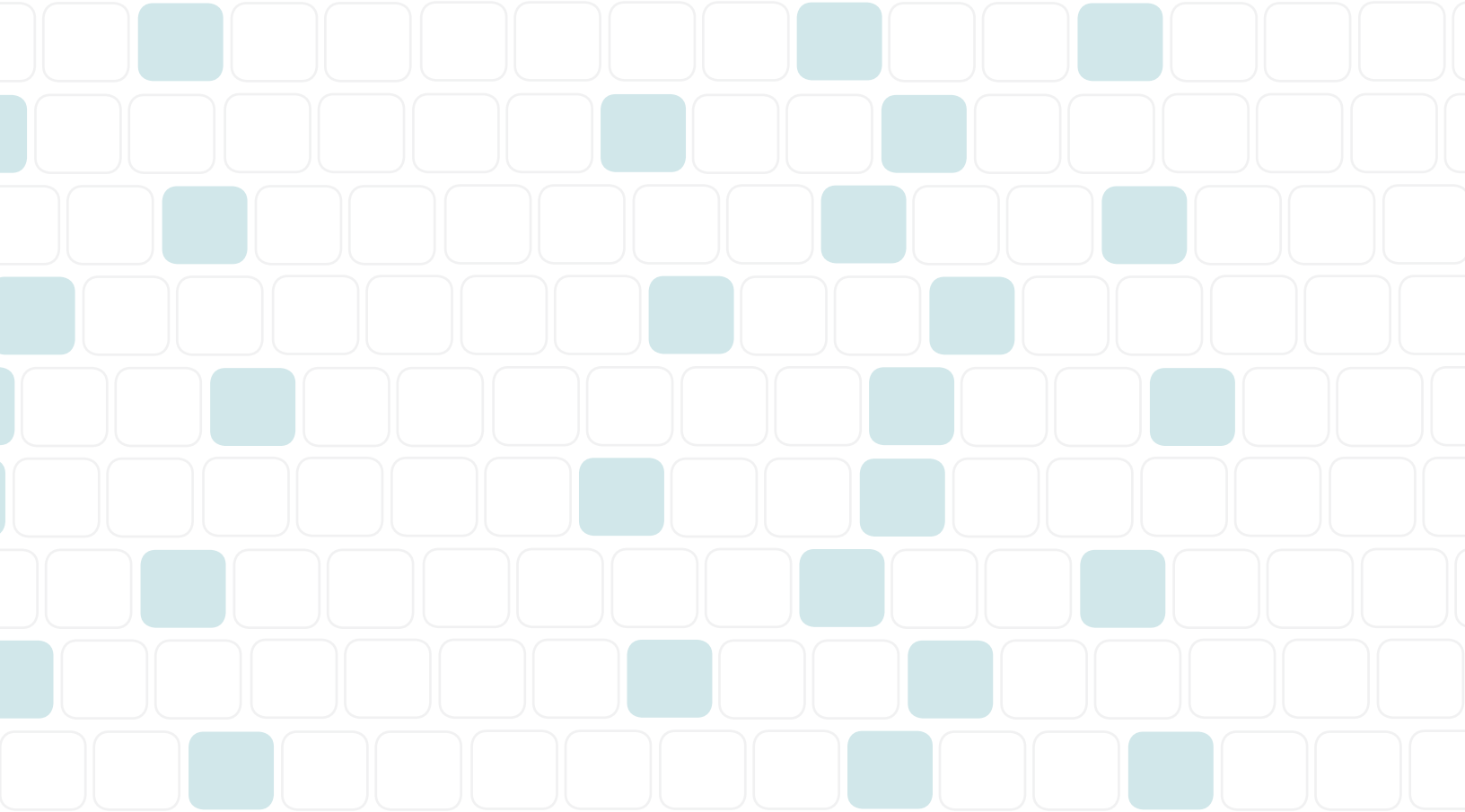
Institution	Project Title	Amount
SUNY Stony Brook	Ocean Wave Energy Harvester with a Novel Power Takeoff Mechanism	\$15,000
University of Arkansas, Fayetteville	Drinking Water System for Developing Countries/Disaster Relief Made with Local Materials	\$15,000
University of California, Davis	Small-scale Ecosystem Engineering: Development of Household Level Greywater Treatment Systems	\$15,000
University of California, Riverside	Exploring a Proof of Concept in Ocean Current Energy Extraction	\$15,000
University of California, Riverside	Test Protocol for Evaluating Smog Reducing Roof Tiles	\$15,000
University of Delaware	Environmentally Friendly Leather Tanning Using Enzymes	\$15,000
University of Illinois, Urbana-Champaign	Improved Biosand Filters by Enhanced Monitoring and Data Collection Methods	\$15,000
University of Kansas, Lawrence	Biostabilization of Rammed Earth for Reduction of Waste and CO ₂ Emissions	\$15,000
University of Maryland	Solar-Powered Membrane System for Emergency Drinking Water Supply	\$15,000
University of Massachusetts, Lowell	Sustainable Packaging Solutions Based on Biodegradable Plastics	\$15,000
University of Nebraska, Lincoln	Energy Node Locator Platform Development: Using Real-Time Monitoring to Conserve Energy	\$15,000
University of Rhode Island	Sustainable Sanitation Strategies for Peri-Urban and Rural Developing Communities	\$15,000
University of Tennessee, Knoxville	Green Oak as a Sustainable Building Material	\$15,000
University of Tennessee, Knoxville	Eco-friendly Additives for Biodegradation of Agricultural Mulches	\$15,000
University of Wisconsin	Exchange Network for Expanded Polystyrene Bio-Shipping Containers	\$15,000
University of Wisconsin	Sustainable Wastewater Treatment: Nutrient Upcycling of Ammonia into Fertilizer	\$15,000
Western Kentucky University	Highly Insulated Glazing Systems Using Liquid Fills	\$15,000
Worcester Polytechnic Institute	Rain or Shine: Rainwater Harvesting Systems for Dependable, Safe Drinking Water in Rural Guatemala	\$15,000
		Total: \$600,000

GRO Fellowships: Supporting the Next Generation of Scientists

2013 marked the 30th year that EPA's Greater Research Opportunities (GRO) fellowship program has been supporting undergraduate students in environmental fields of study. The goals of the program are to bolster the next generation of environmental leaders, inspire and train diverse communities, and boost excellent research and development.

Thirty-three students from across the country received fellowships in 2013, for a total of \$1.65 million. Each GRO student receives

a total of \$50,000, which covers a monthly stipend, academic support, and support for an internship at an EPA laboratory between their junior and senior year in college. Students who are eligible for the fellowship must have two years remaining in their undergraduate careers.



United States Environmental Protection Agency

Office of Research and Development

Washington, DC 20460

EPA601/K-14/001

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