## Questions received from the Household Energy Webinar, September 22, 2020

**Question: Future budget to continue this effort?**
**Response from EPA presenters:** We have not had funding for external research in a number of years, and funding for internal research will be based on budget availability and EPA prioritization.

**Question: Future of ambient air particulate monitoring?**
**Response from EPA presenters:** Please see EPA's web site for information:
www.epa.gov/air-research/air-measuring-and-monitoring-research

**Question: How can we get better information about the research and development in this sector?**
**Response from EPA presenters:** Suggest the following web sites:

- EPA: www.epa.gov/air-research/clean-cookstove-research
- EPA STAR grants: https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/recipients.display/rfa_id/563
- Clean Cooking Alliance: www.cleancookingalliance.org/research-and-evaluation/
- NIH: www.fic.nih.gov/About/Staff/Policy-Planning-Evaluation/Pages/clean-cooking-implementation-science-network.aspx
- USAID: www.usaid.gov/what-we-do/economic-growth-and-trade/promoting-affordable-efficient-cookstoves
- World Health Organization: www.who.int/airpollution/household/en/
- SNV: https://snv.org/sector/energy/topic/improved-cookstoves
- EnDev: https://endev.info/content/Countries_-_Improved_Cooking

**Question: I'm interested in knowing the current easy to use and affordable instruments for measuring Black carbon. Also, any information on black carbon studies and researchers in Sub-Saharan Africa would be great. Does EPA have any ongoing programs in Africa on indoor air quality?**

**Response from EPA presenters:** Different methods for measuring black carbon all have pros and cons, and the method should be carefully evaluated before being used. One of the lowest cost methods for filter sample analysis:
https://bc.nexleaf.org/bc/
Another relatively low-cost method for filter sample analysis:
https://mageesci.com/mproducts/sootscan-model-ot21-optical-transmissometer/
Elemental carbon is frequently used as a surrogate for black carbon. Filter samples can be sent to a laboratory for thermo-optical analysis using an instrument such as this:
www.sunlab.com/lab-oc-ec-aerosol-analyzer/
Sorry, we don't have good information on black carbon studies and researchers in Sub-Saharan Africa. A challenge in African countries, as well as in many other countries, is that black carbon is not a regulated pollutant, so researchers tend not to be supported for work by government funding. Researchers from outside Africa often partner with NGOs or health agencies in Africa, though.
EPA has ongoing work to help implement ISO standards in Africa and around the world. Implementation and Laboratory Testing workshops were held in Kampala, Uganda in 2019 with 11 countries in Africa

represented, and in Kathmandu, Nepal in 2018 with 10 countries in Asia represented. Future workshops are being planned for French-speaking countries in Africa and for Latin America, with ongoing virtual meetings leading up to in-person workshops.

**Question: Our research has suggested that a minimum of 850C is needed to combust $PM_{2.5}$ in the limited residence time (0.2 seconds) in short cooking stoves. Can we agree on this number as a starting point to designing better stoves?**

**Response from EPA presenters:** EPA has not conducted specific research to better understand combustion for stoves, but the U.S. Department of Energy has conducted research on combustion and technology development: https://vimeo.com/159161968
In general, important factors for good combustion are temperature, residence time, mixing, and air/fuel ratio. In our study of LPG stoves, we noted that fuel and air are pre-mixed before combustion. From operation of our dilution tunnel system for measuring emissions, we've seen that air at different temperatures does not easily mix, and this is well known in the HVAC (heating, ventilating, and air-conditioning) field. With solid-fuel stoves, the relatively hot fuel gases do not easily mix with the relatively cold air before and during combustion. It is a difficult engineering challenge to design a practical solid-fuel stove that has clean combustion and is affordable.

**Question: Tami, do you have methods that you suggest to collect data on fuel at country level which you will not consider to be "academic"? In our part of the world, most of the research is undertaken by academics and students. How then can this be attained?**

**Response from Tami Bond:** Let me clarify what I meant by "academic." Many academic studies, not from Africa, have presented conclusions about the health and air quality benefits that might come from improving household energy. Because there is a lack of information on fuel consumption, these studies are illustrative, but not really tied to what a person or program could do. You could do more studies with more breakdowns of wood, LPG, stoves, etc, but until you have a better understanding of what fuel is consumed and where that occurs, it is just an intellectual exercise. This is what I mean by "academic:" more studies that are based on poor data do not add realism. But if you are gathering real fuel consumption data, that is quite useful, whether or not you are in an academic institution.

**Question: The work that EPA has supported through grantees has been invaluable for our sector. Equally important is the stove testing that EPA does in-house. The Clean Cooking Alliance depends on EPA's stove testing data for our Clean Cooking Catalog, and there is an urgent need for new test data using the new ISO protocols and tiers of performance. Does EPA plan to scale up this testing in the immediate and long term?**

**Response from EPA presenters:** As Wyatt Champion briefly discussed, we have an ongoing project to test five representative stoves/fuels using the new ISO protocol and compare results with previously published work using the old testing protocol. We are aware of the need for more research; future research activities will be based on budget availability and EPA prioritization.

**Question: Finally connected. No French channel, please? Regards, Gustave Matayabo Engr DRC.**

**Response from EPA presenters:** Sorry we had no French channel for the webinar.
FYI, the ISO Standard 19867 for laboratory testing of cookstoves has recently been translated into French and will soon be available.
Also, workshops are being planned for francophone Africa on ISO standards implementation and laboratory testing.

**Question: Several speakers have referenced "Tier 3" stoves-- does this refer to IWA or ISO tiers? For what metric?**
**Response from EPA presenters:** Good points – when tiers are referenced, we should always specify the tier metric (CO emissions, $PM_{2.5}$ emissions, efficiency, safety, durability) and the tier system. ISO IWA 11:2012 has been withdrawn and has been superseded by ISO 19867-3: 2018 Voluntary Performance Targets. For example, under ISO 19867-3:2018, a stove may be Tier 4 for CO emissions, Tier 3 for $PM_{2.5}$ emissions, Tier 2 for efficiency, Tier 5 for safety, and Tier 1 for durability.

**Question: Hi, let me know if you are in collaboration with CERERK, a scientific center in RE and cooking solution testings in Kinshasa, Democratic Republic of the Congo**

**Response from EPA presenters:** EPA has not worked with CERERK. However, we would be interested in learning more about the center. What kind of tests you conduct, what testing protocols you use, what equipment you use, and whether you test stoves that are made/sold beyond the DRC?, etc… We would be interested in having you join the network of testing centers in Africa.

**Question: As the Clean Cooking Alliance begins its next stages of our standards work – standards implementation – we are working with countries to adapt and adopt the ISO cookstove standards that were published in 2018. In order to do this successfully, however, we need more lab testing data of various stove/fuel combinations using the Voluntary Performance Targets. This will allow countries to benchmark the stoves available in their markets allowing them to adapt the standards to meet their needs. Does the EPA have any future plans to continue testing stoves in the lab using the new standard?**

**Response from EPA presenters:** Please see response above.

**Question: We are about to start programmes on environmental standards in the University of Lagos. The programmes includes (a) Short Courses (b) Certification courses (c) Master's degree in Environmental Standards. The programme will be blended with about 70% online. Is it possible to have collaboration with EPA? or have direct collaboration with resource persons?**

**Response from EPA presenters:** EPA does not work with individual universities on environmental standards or any type of environmental programming or curricula. Our best recommendation is to get in touch with a university in the U.S. that has a program similar to the one you want to develop and reach out regarding a partnership. We encourage you to visit our new air quality learning management system APTI-Learn (www.apti-learn.net/LMS/EPAHomePage.aspx), which is in the process of updating many of its most popular courses. Most of these are available on-line at no charge. There is also quite a bit of information available across EPA's website on various environmental topics. One example is the

area focused on international air quality management: www.epa.gov/air-quality-management-process. All EPA standards are available at our website.

**Question: As Terry, James, and Wyatt mentioned, size distributions may shift for improved cookstoves and thus release more ultrafine particles. Are there any plans to incorporate UFP measurements as emissions standards?**

**Response from EPA presenters:** ISO 19867-1: 2018, Laboratory Testing, does not include UFP (ultrafine particle) measurements, but ISO standards are typically revised every five years, and UFPs could be considered in the future. UFPs are generally more difficult and costly to measure than $PM_{2.5}$.

**Question: Dr. Hays: Is there concern that the volatile OC on quartz filters may not show up on Teflon filters?**

**Response from Michael Hays:** Yes, quartz-fiber filters tend to adsorb gas-phase OC (organic carbon) along with condensable and filterable particle OC. The gas-phase fraction captured on this filter is commonly referred to as the positive adsorption artifact. To account for the adsorption artifact in our experiments, we use what is often referred to as the 'quartz-behind-Teflon' method of sampling. Thus, we use two quartz filters: (i) one as a front quartz filter sample which adsorbs gases and captures particle matter; and (ii) a second, parallel quartz filter positioned directly downstream of and in-series with a PTFE (Teflon) filter. This second filter captures only the gas-phase and therefore allows us to account for the adsorption artifact associated with the front quartz filter.

**Question: Hi My name is Saif W. Mohammed Ali. My Question to Dr. Michael: I am wondering if Dr. Michael shows which degree of polynomial has been used in the curve fitting for his curve titled by "Volatility determination fiber position" because I see that R2 is very low and his curve fitting was not fitted properly. I think he should have used higher polynomial degree to get proper R2. Thanks.**

**Response from Michael Hays:** Thank you very much for your inquiry, Saif. A simple linear regression was used in the slide titled 'PAH Measurements', and we agree that the relationship between molecular weight and filter artifact fraction does not appear to be linear. Although, we do believe the downward trend observed is correct in theory because artifact contribution should decrease with increasing molecular weight owing to the corresponding decrease in compound vapor pressure. A single regression model---polynomial or otherwise---is unlikely to adequately depict/explain the erratic behavior observed (i.e., *R*) due to the multiple sampling and measurement possibilities for these experiments. Variable filter mass loads, filter property and adsorption site differences between front/back quartz filters, changing condensate compositions and emissions stream concentrations, etc., can produce a wide range of artifact fraction concentrations. So, this is not a simple, repeatable nor a robust calibration. Thus, finding the perfect mathematical expression to describe this relationship is subject to vary, is specific only to the tests shown here, and is not widely applicable.

**Question: Hi, I am Saif again. My question is that when you studied the effect of the indoor emissions, have you taken the trade-off between the indoor emission and the overall emission in your regards? I mean, if you would use new technologies to reduce the indoor pollution, I think that the**

**new technologies would need more electrical power, because 80% of power comes from thermoelectrical power plant. Thus, I think the overall emission keeps increasing. I am wondering if Dr. Tami answers my question?**

**Response from EPA presenters:** EPA's LCA (life cycle assessment) work was designed to answer research questions regarding these types of trade-offs. For more information, please see:
https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=339679
https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=322551

**Response from Tami Bond:** It is true that the electricity provided to stoves causes emission at power plants. These emissions should be included in a life-cycle comparison. The indoor exposure would probably still be much less than that of household stoves for two reasons. First, power plants usually have much better combustion, so the particulate matter emitted per MJ is lower. (This may not be true if the power plant is burning high-sulfur coal.) Second, the power plant is usually located far away from the households, so the emissions are not breathed as much.

**Question: How did the price of LPG affect the use of the LPG stoves?**

**Response from Rob Bailis:** We didn't subsidize LPG cylinder refills - only the initial connection, which we either provided for free or at a subsidized rate. In a region with very little access to LPG prior to our intervention, we found during the initial round of selections that participants who received a free LPG connection were more likely to select a clean option (LPG or Induction) over any of the biomass stoves we offered. We also found they were more likely to choose LPG over induction stoves (both results were weakly significant $p < 0.1$). Ultimately, nearly all of the participants who were able to choose selected LPG as did all of the control households. We describe the result of the initial selections in this paper. There are studies that provided free LPG for a limited time. This study from Peru used free LPG to measure how much poor households would use if cost was not a constraint. The "GRAPHS" study in Ghana provided 18 months of free LPG to study impacts on pregnancy outcomes. You can see a list of pubs here.
Also, please see a recent publication, "Jointly modeling the adoption and use of clean cooking fuels in rural India," published Open Access in *Environmental Research Connections*.

**Question: Is the presentation recorded and will it be available later?**
**Response from EPA presenters:** Yes, the recorded webinar will be sent to everyone who registered.