U.S. Environmental Protection Agency Board of Scientific Counselors

Air, Climate and Energy Subcommittee

Virtual Meeting Minutes

October 12 – 14, October 27, and November 12, 2021

Dates and Times: October 12, 2021, 11:00 a.m. to 6:15 p.m.; October 13, 2021, 11:00 a.m. to 5:30 p.m.; October 14, 2021, 11:00 a.m. to 6:00 p.m.; October 27, 2021, 2:00 p.m. to 5:00 p.m.; November 12, 2021, 2:00 p.m. to 5:00 p.m. Eastern Time

Location: Virtual

Meeting Minutes

Provided below is a list of the presentations and discussions that took place during the meeting with hyperlinked page numbers. The minutes follow. The agenda is provided in Appendix A, the participants are listed in Appendix B, and the charge questions are provided in Appendix C.

Tuesday, October 12, 2021

The meeting generally followed the issues and timing as presented in the agenda provided in Appendix A of this meeting summary.

Convene Meeting

The meeting convened at approximately 11:00 a.m., Eastern Time.

Welcome and Opening Remarks

Tom Tracy, Designated Federal Officer, Charlette Geffen, Chair, and Sandy Smith, Vice Chair

Mr. Tom Tracy welcomed the participants and provided a brief overview of the meeting structure. He stated there were no public comments at this time. Dr. Charlette Geffen welcomed the attendees, and the BOSC members introduced themselves with name and affiliation.

Office of Research and Development Welcome

Wayne Cascio, Office of Research and Development Acting Principal Deputy Assistant Administrator for Science

Dr. Wayne Cascio introduced himself and welcomed the participants to the meeting on behalf of the Office of Research and Development (ORD). He thanked the subcommittee for their review of the ORD Strategic Plan and provided an overview of the Executive Order that directs ORD to focus efforts on revitalizing communities and the development of an environmental justice (EJ) tool. He explained the next three days would feature descriptions of ways ORD has implemented the Strategic Plan and discussion of scientific implementations.

Overview of Air, Climate and Energy Board of Scientific Counselors Sub-Committee Meeting Format and Charge Questions

Bryan Hubbell, National Program Director, ACE Research Program

Dr. Bryan Hubbell, National Program Director (NPD) of the Air, Climate, and Energy (ACE) Research Program, provided an overview of the meeting and presentation structure. He introduced the ACE program team, including the core NPD team, and explained connections to centers, offices, and regions, and program support staff. He discussed the process of planning, implementing, and delivering the ORD Strategic Plan. He stated the purpose of the meeting is to emphasize the implementation phase of the research cycle. He discussed the Strategic Plan program structure and highlighted the research areas on which the meeting will focus. He provided an overview of the Meet the Scientists sessions and read the text of Charge Question 1, Charge Question 2, and Charge Question 3.

Update on Board of Scientific Counselors Executive Committee PFAS Research Discussion

Susan Burden, Office of Science Advisor, Policy and Engagement

Dr. Susan Burden elaborated on Board of Scientific Counselors (BOSC) Executive Committee per- and polyfluoroalkyl substances (PFAS) research discussions. She provided definitions of PFAS, perfluorooctanoic acid (PFOA), and perfluorooctane sulfonate (PFOS) chemicals. Studies indicate some PFAS are persistent in the environment, some are bio accumulative in organisms,

and some are toxic at relatively low levels. She provided an overview of the September 29-30 BOSC Executive Committee meeting and the materials resulting from that meeting. She stated next steps include follow-up working sessions and completion of the report, which is expected in November of 2021.

- **Viney Aneja:** Why are we so focused on PFAS now, considering it has been in the environment for the last 60-70 years?
    - **Susan Burden:** ORD has been doing research on PFAS for a while, but most of it is focused on PFOA and PFOS. Several years ago, our researchers identified GenX in the Cape Fear River, which led to a recognition of the need to study broader PFAS chemicals.
    - **Bryan Hubbell:** The detection of PFAS in water systems is a major concern. There is a lot of interest from states and others on how to dispose of PFAS chemicals.
- **Art Werner:** This seems similar to the concerns about polychlorinated biphenyls (PCBs) a few decades ago. How similar is it? Did we learn anything we can use now?
    - **Susan Burden:** I do not have experience with PCBs. This question has appeared in different contexts, so there is awareness of these similarities.
- **Michael Kleiman**: The approach is almost laughable. Our processes identify compounds, and industry modifies those compounds. Characterizing and grouping is a major rationale. This is not the only compound of concern we will encounter.

Charge Question 1: Science Needs Related to Air Toxic Sources and Emerging Contaminants (Research Areas 2 and 4)

Bryan Hubbell, ACE National Program Director

Dr. Bryan Hubbell introduced the discussion topic of air toxins and hazardous air pollutants. He discussed chemicals of emerging concern, meaning chemicals with relatively recent environmental and health concerns. The two major chemicals of concern are PFAS and Ethylene oxide (EtO). He stated air toxic concerns merge with EJ concerns. EPA is trying to address concerns dealing with exposures to air toxins, such as benzene and formaldehyde, which are contributing to elevated cancer risks. PFAS concerns involve studying exposure to these chemicals and resultant adverse human health effects. Concerns about EtO include their use in medical and dental sterilization, fumigation, and chemical synthesis, and their carcinogenic nature. He provided an overview of research activities involving PFAS, EtO and air toxins. He read Charge Question 1 and introduced the program implementation.

Approaches for Addressing Scientific Challenges and Key Uncertainties in Characterizing Air Toxics and Contaminants of Emerging Concern

Alice Gilliland, Acting Center Director, Center for Environmental Measurement and Modeling (CEMM)

Dr. Alice Gilliland, Acting Director for CEMM, provided a summary of on-going research relating to Charge Question 1. There are several complex and evolving scientific challenges in

this area, including changes in measurement technologies, Federal Reference Methods (FRM) and Federal Equivalent Methods (FEM) versus sensors, and time-integrated sampling versus real-time, continuous measurement technologies. She discussed research implementation challenges and air toxins and emerging pollutants of concerns in Research Areas 1 and 2. She explained the research objectives, challenges, and implementations for source emissions of air toxins in Research Area 2, which focuses on ambient near-source and fence line measurements. For Research Area 4, she provided an overview of research objectives and associated challenges, such as achieving real-time, continuous measurements of low-level concentrations, characterizing "background" concentrations and interferants, and the limited chemistry and deposition data available to inform model development. She discussed insights that could be helpful for addressing the charge question.

- **Charlette Geffen:** Are the slides from your presentation available?
    - **Tom Tracy:** The slides are accessible on the BOSC intranet site now. Access for the subcommittee is via the BOSC SharePoint site.

Research to Understand Source Emissions and Ambient Concentrations of Air Toxics and Contaminants of Emerging Concern

Tiffany Yelverton, CEMM
Richard Shores, CEMM
Alan Vette, CEMM
Chet Wayland, Office of Air and Radiation (OAR)

Dr. Tiffany Yelverton introduced herself, the panelists, and provided an overview of the timeline for the panel session.

Mr. Richard Shores introduced himself and discussed the Air Methods and Characterization Division (AMCD), which focuses on research and solutions with key goals of addressing environmental challenges and protecting health concerns. AMCD solutions include development and application of innovative approaches, improvement of problem-solving capacity, and the formation of successful alliances with stakeholders. The Agency conducts substantial field and laboratory work in this research area. He discussed AMCD programs investigating EtO sources, uses, and emissions and the EtO Integrated Risk Information System (IRIS) assessment. He stated no method developed to date is sensitive enough to measure low levels of commonly uncontrolled EtO emissions and sources. He then summarized PFAS air emissions measurement considerations and challenges, describing methods and destruction key points, with a focus on the mitigation of PFAS. He described technology application programs designed to demonstrate the utility of combining a variety of data types to help better understand emissions, engage communities and increase transparency, and help EPA regions evaluate air pollution. The Kansas City field measurement program incorporates Next Generation Emission Measurements (NGEM), address new approaches for difficult sources, hybrid measurement systems, and crowdsourcing odor. NGEM traditionally are point source, but this new approach opens new effective decision-making opportunities for AMCD. He challenged the panel to facilitate nongovernmental partnerships and regulatory solutions on which the Agency can focus.

Dr. Alan Vette discussed the Atmospheric Chemistry, Fate and Transport of Air Toxics and Contaminants of Emerging Concern division, which focuses on modeling air toxins in the Community Multiscale Air Quality Modeling System (CMAQ). CMAQ has the capacity to stimulate transport and fate of several Hazardous Air Pollutants (HAPs) while simulating Criteria Air Pollutants (CAPs). He discussed an approach for predicting HAPs, including chemical mechanism for CAPs and reactive tracers, with a key focus on deposition and air concentrations. He noted applications of CMAQ air toxic capacity providing information on emissions concentrations, deposition to watershed, and risk to human health. Goals for future applications include modeling semi-volatile HAPs and runtime options allowing source apportionment for HAPs built on the Integrated Source Apportionment Method (CMAQ-ISAM). He described the Community Regional Atmospheric Chemistry Multiphase Mechanism (CRACMM) for improving air quality modeling. He then described use of PFAS Wet Deposition Measurements to collect samples that work with National Atmospheric Deposition Program (NADP) sites targeting PFAS by developing CMAQ for modeling air transport and fate of PFAS emissions, with a focus on GenX. In modeling PFAS, they use computational chemistry to better understand the physical and chemical reactions. He concluded by discussing use of the SPECIATE 5.1 database.

Mr. Chet Wayland discussed the value of current research, including benefits from the Clean Air Act and identification of multiple toxic pollutants. A new emphasis on EJ and communities is needed to address the emergence of pollutants, such as PFAS, and those regulated at different risk levels. Technologies for studying EtO and other emerging pollutants found in communities need to have the capability of measuring pollutants in real time. ORD has prioritized air toxins research by providing data on an annual basis. It is critical to have accurate source, fence line, and ambient measurement approaches and to define new ways for reviewing, evaluating, and approaching air toxins research via community collaboration.

- **Art Werner:** We cannot control unmeasurable pollutants. EtO has been a HAP forever. What sources are regulated, and are the regulations effective?
    - **Chet Wayland:** What changes when the IRIS levels change? There were sources emitting EtO, but they were below the risk level. When the risk level dropped, there were suddenly many more sources contributing to this problem. As the health science changes, we must be able to adapt our measurement methods.
- **Art Werner:** Why are there not NADP sites across the country?
    - **Alan Vette:** We have attempted to expand NADP's reach to measuring more PFAS, but lack of available resources to cover costs has prevented us from doing more.
- **Louie Rivers:** Can you explain more about the working process?
    - **Alan Vette:** We have good relationships with industries that allow us to initiate conversations. The Keymore Facility opened their doors to us. It did not happen overnight, and the standard North Carolina Department of Environmental Quality (DEQ) was involved. Keymore understood participation and cooperation would

benefit them. We developed a great relationship with them for modeling compounds.

- **Cara Keslar:** Are there other test methods (OTMs) for PFAS or EtO? Is there a wet method?
    - **Chet Wayland:** There is an OTM-45 method for PFAS published on the website, but I am not an expert on the method.
    - **Cara Keslar:** Did you work with the Occupational Safety and Health Administration (OSHA) to understand the methods others use for monitoring?
    - **Tiffany Yelverton:** We have not considered the OSHA limits since the initial assessment. Typically, they do not include lower measurements, but hopefully they will catch up. They are still operating at a 1 parts-per-million (ppm) per hour limit.
    - **Richard Shores:** The regulatory authority in North Carolina cooperated well with EPA. We have examined EtO source methods, but the work is still at a development stage. Everyone is working diligently on finding a solution.
    - **Tiffany Yelverton:** Many of our researchers are well versed on EtO and PFAS.
- **Sandy Smith:** Would you provide more details on the challenges you have seen in collaborations with industries, specifically in field testing source techniques?
    - **Richard Shores:** I am interested in people's successful ideas. Often proprietary secrets and procedures keeping them in business are stumbling blocks for us. Understanding their input values is key. Eben Thoma has been masterful at getting past proprietary information.
- **Bart Croes:** One of the things we have studied is emissions from break and tire wear. Have you conducted any such work?
    - **Tiffany Yelverton:** We absolutely have worked on that issue. We can follow up with references if you are interested.
    - **Chet Wayland:** Many people do not view brake and tire wear as a huge source, but as we move toward an electric fleet, this will still be an issue.
    - **Bryan Hubbell:** We have thought about this for our next plan of research. Especially in vulnerable communities, we need to make sure we are prepared for all emerging contaminants.
- **Jeff Arnold:** Many are interested in how HAP emissions are characterized, but obtaining access to emissions data and characterizing it is difficult. Is there an integrated attempt to evaluate reaction details for the new HAPs? As we begin to use CMAQ for the long term, I worry about characterizing carbon-containing compounds as inert. Does the HAP mechanism include evaluating CMAQ in a climate mode?
    - **Alan Vette:** Revisiting reaction rates for HAPs involves studying reaction rates and expanding the chemistry around volatile chemical products (VCPs) as one category. We have on-going and plan future chemistry and chamber work in this area. We rely on recent data already in the literature. I wish we had the bandwidth to do more, but the reality is that we must prioritize some of them. For the second question, describing something as inert is all in a matter of time. From a modeling

standpoint, we have developed a time series run using CMAQ over a 16-year time period, and it has created a few results. We have worked on expanding CMAQ capabilities for use regionally, nationally, and hemispherically. We have developed a monitoring system review at global applications.

- **Jennifer Hains:** I was curious about your communication strategies, such as warning people about safety. Can you elaborate?
    - **Chet Wayland:** Great question. How do we explain for the public what it means when we measure a pollutant on an hourly basis or communicate exposure over years? We recognize there is a need to include expertise around risk communication so we can effectively communicate issues to the public.
    - **Bryan Hubbell:** We are thinking about how to bring more social scientists and developers together, because bringing together all social scientists and experts is critical.
- **Connie Senior:** I am interested in learning more about how CMAQ handles emissions from transportation sources. What are the challenges associated with characterizing community level exposures? I am not familiar with how CMAQ handles transportation emissions.
    - **Alan Vette:** Understanding community level exposures and air quality and exposure estimates is challenging. CMAQ relies on the NEI (National Emissions Inventory), so I would defer to Chet for that information. For the most part we rely on the NEI.
    - **Chet Wayland:** We use models from vehicle miles traveled. We have the capability to process link-based data, but it might be difficult to conduct linkages on the national scale using a national model. All the transportation sectors are important, and the mobile component continues to grow in importance.
    - **Tiffany Yelverton:** We work use the MOtor Vehicle Emission Simulator (MOVES) model and the MOVES 3 database.
- **Charlette Geffen:** When I think about the data challenge, I wonder about the extent to which you use artificial intelligence machine learning techniques to manage data and whether your research agenda includes such techniques?
    - **Alice Gilliland:** From historical collaboration with the Centers for Disease Control and Prevention (CDC), we have created data fusion models to depict ozone surfaces. We invest in data fusion methodologies because there many applications and remote sensing tools for evaluating considerations.
    - **Chet Wayland:** We work with the CDC on data fusion and send them ambient air datasets for use in air studies.
    - **Sherri Hunt:** We have some grantees using artificial intelligence (AI), which allows us to incorporate such expertise into our work.
    - **Alan Vette:** We have something in the portfolio that discusses machine learning. We have limited experience with machine learning modeling techniques, but we are interested in exploring it further. We hope to have the ability to hire additional staff members with such expertise in the future so we can further explore the area.

  - **Charlette Geffen:** I am curious about the process of matching laboratory studies to field validation. Do you link or create geographic source studies to the real world?
  - **Alan Vette:** Laboratory studies capitalize on field efforts. It is opportunistic. We evaluate laboratory findings when conducting field studies. We have moved away from using tracers from laboratory studies because we determined it was not as viable an approach.
- **Sandy Smith:** What about planning and strategies around prioritization of adding HAPs?
  - **Alan Vette:** We only have 9 gas phase HAPs in the chemical mechanism. Our highest priority is adding to the model HAPs of a particular regulatory concern. For many HAPs, adding them to the chemical mechanism might not help us understand atmospheric chemistry pathways because they have ground that has already been tailed.
- **Jeff Arnold:** The opportunities are narrower with atmospheric tracers. Recently we have found it easier to work in the model. We have learned a lot by using process analysis, so I am hopeful these experiments in model development will inform other experiments. How much mass balance and process evaluation will the new mechanism include?
  - **Alan Vette:** The logistics of detecting these compounds is daunting. We can use the model to gain insight and ask questions answerable via observation work. Current plans include developing a draft mechanism and comparing it to mechanisms within CMAQ to understand better how it will improve outcomes, such as particulate matter (PM) and ozone, and mechanism performance. We must add process analysis to the new mechanism to ensure we obtain the right answers to the right questions.
  - **Tiffany Yelverton:** We will vet new mechanisms via an iterative process by which we check everything. It is not introduced into the regulatory model used for applications.

Meet the Scientists, Session #1:

Room A

Air Toxics – Source Measurement and Methods, Session-Lead

Wyat Appel, CEMM

PFAS Methods Development

Jeff Ryan, CEMM

Fenceline Measurements and Methods Development

Eben Thoma, CEMM

PFAS Incineration

Jonathan Krug, CEMM

Room B

Air Toxics – Ambient Measurement and Methods, Session-Lead

Mike Hayes, CEMM

VOCs/Odor Explore App

Rachelle Duvall, CEMM

EtO Ambient Measurement and Methods Development

Ingrid George, CEMM

Air Toxics Ambient Measurement and Methods Development

Tamira Cousett, CEMM

Room C

Air Toxics Modeling and Databases, Session-Lead

Donna Schwede, CEMM

Incorporating PFAS into the CMAQ Model

Emma D'Ambro, CEMM

Updates to the SPECIATE database

George Pouliot, CEMM

Adding VCP Chemistry to CMAQ

Havala Pye, CEMM

Public Comments

Tom Tracy, Designated Federal Officer

Mr. Tom Tracy asked for public comments. There were none.

Clarification Questions from BOSC SC

Charlette Geffen, Chair and Sandy Smith, Vice Chair

Ms. Sandy Smith asked whether participants had any questions about the charge questions. No participant needed clarification. She asked subcommittee members whether they had any clarifying questions for EPA staff members.

- **Cara Keslar:** Much of our discussion centered on measurement methods. How do we disseminate methods to OAR and state and local folks and laboratories?
    - **Tiffany Yelverton:** There is no set path. We publish some of our methods together with OAR. Sometimes it is seamless, and we work together to publish a method. Sometimes we publish ahead of time, but there are many options for best practices in a less formal fashion to disseminate to the public faster.
- **Myron Mitchell:** How do we organize and emphasize information? Is information available about how these studies relate to each other and what programs need to

accelerate and advance?

- **Bryan Hubbell:** We are in the current planning process. We cannot focus on every chemical, so we need to focus on the ones that are most important. We need to gain stronger advancements in EtO and PFAS. We need to get out into the field and push forward past the challenges. We have good hopes of working together with communities and building connections, and we are still working with our partners to prioritize other air toxins. There is continuing concern for reactive toxics and concern for metal HAPs.

- **Art Werner:** In February we talked about portable monitors in neighborhoods where there were many questions about them. We have not yet discussed them. How are they associated with these challenges?
  - **Bryan Hubbell:** In developing good standards this is going to be a challenge. We are not ready to create proclamations.
  - **Tiffany Yelverton:** For EtO, using a low cost and community-based option is important, but we are still trying to develop a quality-based standard. There is a limit to what we can accomplish.
- **Cara Keslar:** Alice asked that we discuss the differences between FRM, and FEM sensors. Are there insights regarding those related to this charge question?
  - **Alice Gilliland:** What kind of insights balance those and meet the priority needs and requests?
  - **Tiffany Yelverton:** We talked about sensors and performance targets. Sensors are incredibly valuable when we want community involvement, but in order to measure quality we must compare that to FRM, FEM, and regulatory grade measurements. We were asking about the appropriateness for either option and when or where to use it as a best practice.
- **Sandy Smith:** In the attribution page of one of the presentations, there was a listing of the project members, including a member form the program office. That made me wonder how program office staff members stay in tune with projects relevant to their areas?
  - **Bryan Hubbell:** Research coordination teams attend meetings where they can discuss and collaborate. There are also several different meetings with partner groups on various topics. They are very active and there is a lot of coordination. It sometimes depends on the specific research topic.
  - **Alice Gilliland:** I can think of many methods partnerships we have with a history of collaboration.
  - **Sandy Smith:** How do partners stay involved as the research progresses?
  - **Tiffany Yelverton:** There are instances where our partners are providing measurements and are in the laboratory with us.
- **Connie Senior:** On PFAS reference gases, what are the prospects? Is finding a reference standard for PFAS a limiting factor for making measurements?
  - **Tiffany Yelverton:** It is a limiting factor, but our researchers are working tirelessly to resolve that issue. For PFAS there are a lot of challenges. For EtO we are working monthly to evaluate degradation or any interactions. It is a combination of us helping vendors realize the standards of better quality. In the past it has typically taken 2-5 years.

  - **Connie Senior:** I did not know OTM-45 was self-validating, so I hearing that.
- **Art Werner:** How cooperative are the industry emitters of PFAS and EtO, and has that changed over the years?
  - **Tiffany Yelverton:** Building relationships is difficult and time consuming, but it is something we are doing. We would love to hear new suggestions.
  - **Bryan Hubbell:** You might want to speak with Tim Watkins.
  - **Alan Vette:** We have had success in partnering with the industry on vaccine problems. Typically, there is resistance early on and a lack of willingness to work together. Some things are going to happen from a regulatory standpoint, and industries come to the realization that it is better to work together and guide EPA.
- **Michael Kleinman:** A big issue with PFAS involves fire retardants. Would it be possible to partner with fire departments and create field studies examining such emissions?
  - **Bryan Hubbell:** There have been attempts with the Department of Defense (DOD) to work together with the firefighting industry. There have been opportunities in California to work together, but working with DOD has been more effective.
- **Sandy Smith:** I know DOD has worked on legacy fire sites, some of which have been investigated and reinvestigated due to PFOS. What is happening with these legacy sites?
  - **Tiffany Yelverton:** I cannot answer that specifically. In the next planning cycle, we asked ORD to examine novel ideas. We could investigate it in the future.
- **Michael Kleinman:** Should there be a centralized proficiency test for select compounds to build confidence about the accuracy of measurements?
  - **Bryan Hubbell:** The performance targets we have for sensors are similar to what we would develop eventually for PFAS.
- **Sandy Smith:** What planning is happening with the Odor application? How are you using information from the application, and how are you responding to odor detection reports?
  - **Bryan Hubbell:** We will make sure to use proper communication approaches and will include it in the next Strategic Plan. We are planning several outputs focused on empowering communities, including environmental literacy. This would be a great opportunity to build connections with communities and start conversations within these areas. We will not roll out an application without thinking its impact.
  - **Sandy Smith:** Is ORD involved in training?
  - **Bryan Hubbell:** That is an on-going conversation we are having about tools and the appropriate way to conduct training. These tools have a very clear research aspect to them, but as we have seen with smoke sensors and other tools, the public becomes dependent, so there must be some consideration to training, support, and application.

Closed Session for BOSC Subcommittee Discussion

The working session specifically focused on Charge Question 1. Mr. Tom Tracy noted that each charge question group should assign co-champions and discussed the timeline of report. Ms. Sandy Smith added that the working session would discuss the strengths and recommendations of Charge Question 1.

- **Bart Croes:** Is there a process for anticipating problems? Could you explain what you are doing with the Science to Achieve Results (STAR) grant program?
    - **Bryan Hubbell:** The National Academy Committee focuses on innovation and selecting novel scientific approaches in which we should invest. There is a separate group responsible for thinking about future problems. Sometimes we prepare way ahead of time. For example, we began developing our energy modeling tools 12 years ago so they are currently available. Sensory work is another example. The STAR grants take a while to set up, and we try to think about them as something we will need in the next 3-5 years.
    - **Bart Croes:** That program worked well with in-house capabilities. My sense was there was a hiatus with the development of these grants.
    - **Bryan Hubbell:** We are trying to be responsive, but it takes time to process the grants. If Congress provides additional funding, we plan to add money to the STAR grant fund.
- **Jeff Arnold:** Timelines do not always work out, and sometimes products do not meet the specified needs. I appreciate the extra time we have with this bench level science.
- **Sandy Smith:** Who works in the laboratory, and who works remotely?
    - **Bryan Hubbell:** There are many people working in laboratories. There are challenges with getting back into field work due to COVID-19, but with PFAS there are additional concerns about exposing individuals. Great justification is needed for travel authorization due to travel restrictions still in place. We have been able to place people where they need to be, but people would like to return to working in the field. Our folks have also been productive while working from home, especially our modelers.
    - **Art Werner:** Have you been able to apply travel funds elsewhere?
    - **Bryan Hubbell:** Yes, we used some travel funds last year for COVID-19.
- **Sandy Smith:** How are your staffing levels?
    - **Tim Watkins:** We have uncertainty with the full-time equivalent (FTE) staff, but we are optimistic our budget will help us hire quickly. We have struggled in the past with hiring for certain disciplines, but that is something we must work through.
    - **Bryan Hubbell:** If we do obtain more funding from Congress, they specifically asked us to hire experts on climate and mitigation options. We need to fill our expertise in our energy model.
- **Jennifer Hains:** Thinking about how we aim for diverse candidate pools, during COVID we hired a liaison. Have you tried something similar to ensure communication with the communities?
    - **Bryan Hubbell:** We are trying to figure out how to hire in an appropriate way and develop ways to build relationships with a community liaison.
    - **Tim Watkins:** We have diversity hiring panels who redact information that might lead to bias. We hope to use them for most hiring processes, and we hope to engage with communities to help us attract diverse candidates.

- **Bryan Hubbell:** What were the challenges with setting up the PFAS field studies?
    - **Tim Watkins:** There were COVID challenges, but because PFAS is a high priority we were able to obtain approval when needed. For destruction of PFAS, we want to test waste treatment processes and hazardous waste incinerators. There are challenges in communicating with communities with EJ concerns. We do not want to transfer the problem, but we are trying to understand the efficacy of a high temperature environment for removing PFAS. We found working with states is critical.
    - **Jennifer Hains:** Is there going to be pushback to waste energy?
    - **Tim Watkins:** There could be. We had a situation where we had to cancel the study.
- **Art Werner:** What other things are you measuring besides PFAS? It would be nice if we had some data on other pollutants.
    - **Tim Watkins:** When we conducted PFAS testing, we studied products of incomplete destruction and combustion. Nontargeted methods help us identify a broader form of PFAS. We need to make sure facilities can treat products of incomplete combustion.

Adjourn

The meeting adjourned at 5:45 p.m., Eastern Time.

Wednesday, October 13, 2021

Welcome – Day 2

The meeting reconvened at approximately 11:00 a.m., Eastern Time

Welcome and Opening Remarks

Tom Tracy, Designated Federal Officer, Office of Science Advisor, Policy, and Engagement
Charlette Geffen, Chair
Sandy Smith, Vice Chair

Charlette Geffen welcomed the participants and provided an overview of presentation topics for the Day 2 meeting.

Charge Question 2: Science Needs to Understand Climate Change Impacts (Research Area 6)

Andy Miller, ACE Associate National Program Director for Climate

Dr. Andy Miller introduced Charge Question 2 and provided graphics on how the world is changing and warming. The changes are greater than any other changes on a historical level, and it is no longer a future issue. We are experiencing the impacts of climate change today, through changes in mean and extreme air temperatures causing heat stress and deaths, worsening air quality, and changing ecosystems. There are also extremes in precipitation that are resulting in serious implications for infrastructure design, flood resilience, and supplies of clean water. Dr.

Miller stated we have already experienced the coolest and calmest years we will experience for the rest of our lives.

He then provided an overview of the program's organizational structure, noting they are working with other agencies to discover and disseminate new information. He discussed climate impacts to ecosystems, especially coral reefs, and provided an overview of a report focused on adaptation. Ecosystem impacts trickle down to impact individuals, communities, and broader human systems. Sea level rise is occurring, and the work EPA is doing in this realm is focused on coastal infrastructure and ecosystems. The impacts of salt water on estuaries and wetlands are an important part of EPA's research. Climate change is directly and indirectly impacting human health through multiple pathways, and EPA is responsible for reducing impacts on several exposure pathways, going beyond traditional markers of health to consider well-being. They incorporate non-chemical stressors, location, historical and disproportionate impacts of social and legal structures, EJ, and other exposures into a single framework to evaluate health in a more comprehensive way. Dr. Miller concluded by providing an overview of BOSC ACE research and how it supports decision-making processes. He discussed collaborative activities connecting various research areas, internal research programs, and external agencies.

- **Louie Rivers:** How are you operationalizing the idea of well-being?
    - **Andy Miller:** It is difficult to balance understanding of the physical or clinical consequences of health with other measures, such as equality of housing, equality of neighborhoods, and ability to respond to events at a community level.
    - **Bryan Hubbell:** Our current round of research addressed this to a lesser extent, but the current Strategic Plan addresses it more fully. We are conducting workshops to help us understand the broader impacts of climate change, including mental and emotional responses. We are looking for better ways to involve social scientists.
    - **Louie Rivers:** I like the idea of researchers having specific metrics beyond health they can use to measure well-being. I am glad to hear you are expanding focus in this area.
- **Myron Mitchell:** How does coordination of various projects occur between groups? How much of this is driven from the top, and how much is driven from the bottom?
    - **Andy Miller:** It is a mix. In some ways, important collaboration is driven from the bottom. From the top down, we identify ways in which we want connections. Specific research activities are driven from the bottom. We do what we can to encourage and make connections and facilitate the principal investigator level engagement.
    - **Myron Mitchell:** Are there extra resources for conducting a cross-project synthesis?
    - **Andy Miller:** We are clear about where we want specific engagement. We do not set aside specific resources for each type of research.
- **Jennifer Hains:** Focusing on the well-being piece, how can the BOSC help?
    - **Andy Miller:** Provide additional encouragement for this kind of work. Explain why it is important and areas on which we should focus.

- **Bart Croes:** I was interested in what you presented on high-tide flooding. Are there federal activities helping with these efforts? Are you planning to study the interesting research about COVID-19, pollution, and wildfires?
    - **Andy Miller:** EPA has an indicators webpage containing essentially historical data. The federal agencies are looking at developing an information system that will provide access to information on several climate-related endpoints.
    - **Bryan Hubbell:** Our grantees have been publishing work on the relationship between wildfires, pollution, and public health. As we move forward into the next Strategic Plan, we are considering researching air quality and COVID-19. We are following up on the idea that COVID-19 could have made individuals vulnerable.
- **Sandy Smith:** In Research Area 6, we have talked before about EPA's corner of the larger climate change research agenda and the need to plan and conduct broader research. Our charge question also asks a broader question. Are there challenges to conducting broader research?
    - **Andy Miller:** I do not think so. We have tried to be flexible by including more detail in the description of a research area. We understand partners might ask questions a specific definition might not cover. Research starts in the research areas. Flexibility is important, and we try to stay within bounds while still responding to partner needs and research opportunities.

Approaches to Understand and Prepare for Climate-Driven Impacts

Tim Watkins, Acting Center Director, Center for Public Health and Environmental Assessment

Dr. Tim Watkins discussed approaches for understanding and preparing for climate-driven impacts, focusing on research in CEMM and the Center for Public Health and Environmental Assessment (CPHEA). He provided background on, context for, and examples of ORD research in ecology and climate science. He introduced discussion topics for the Meet the Scientists sessions, including hydroclimatic change effects on stormwater management, adaptation planning frameworks for resilient natural resources, and climate change impacts on forested watersheds driven by drought and wildfires in western United States. He then discussed the needs, approaches, and goals of each topic and the scenarios, impacts, and actions ORD has taken to improve research. He concluded by stating ORD and EPA are leaders in multiple aspects of climate science and work together with other agencies to assess and respond to climate change. ORD has several on-going projects investigating the impacts of climate change on ecosystems and communities and solutions for adaptation.

- **Viney Aneja:** What does "climate smart solutions" mean?
    - **Tim Watkins:** You will hear more from a Meet the Scientists presentation, but the phrase essentially means recognizing vulnerabilities up front in planning decisions and trying to integrate them into research activities.
- **Viney Aneja:** How do the hydrological issues you mentioned differ from the vast amount of work already completed?
    - **Tim Watkins:** I am not sure I can adequately address that. We are coordinating with the United States Geological Survey (USGS) and Global Climate Change program, and we are not looking to duplicate their work but rather to partner with

them. Through our collaborations we are trying to build connections with USGS and other air, water, and media programs.

Research to Understand Climate Impacts and to Enable Resilience

Peter Beedlow, CPHEA
Britta Bierwagen, CPHEA
Chris Weaver, CPHEA
Stephanie Santell, Office of Water (OW)
Dan Brown, Region 10
Jeremy Martinich, Office of Administration and Policy (OAP)

Dr. Peter Beedlow provided an overview of on-going ORD research the panel would discuss.

Dr. Jeremy Martinich introduced himself and shared information on OAP's collaboration with ORD. These collaborations have been going on for several years and ensure high numbers of OAR staff members understand the research. ORD has increased and is heavily investing in research focusing on climate topics. He discussed successful collaborations with and strategic contributions from ORD that have been critical to OAR processes and have helped quantify climate change impacts in the United States. He then described the work of Chris Nolti and Tania Spero using the MMAP model to detect changes in fine particulate matter (PM 2.5) and analyze them for mortality and morbidity endpoints. He discussed other key models, including Integrated Climate and Land-Use Scenarios (ICLUS) and Locating and Selecting Scenarios Online (LASSO). Lastly, he noted the greenhouse gas inventory, which is a formal accounting of greenhouse gas emissions of the United States. The work of ORD researchers in collaboration with OAR to provide better information on addressing the methane research gap is critical. The need for ORD research on climate is greater than ever.

Dr. Britta Bierwagen discussed the work CPHEA is doing, with a focus on foundational scenarios, such as the ICLUS work, whether it be developing population and land use models, using integrative assessment, or examining climate change impacts and vulnerabilities from the point of view in EPA endpoints. Various research planning cycles have included attempts to understand adaptation planning better and how implementation of adaptation options improves resilience across programs and supports decision making. Dr. Bierwagen then described recent collaborations between the Agency and partners on the development of a series of products to understand vulnerability impacts and adaptation options. CPHEA Physical Scientist Tom Johnson studies the impacts of precipitation changes on the design of stormwater management practices. His work helped with the development of best practices and a screening level assessment of the impact of climate change on stormwater management practices. Similarly, CPHEA Aquatic Ecologist Jordan West uses the Climate SMART tool to study how climate impacts different management practices associated with coral restoration in the Pacific, Puerto Rico, Hawaii, and Chesapeake Bay and how changes in temperature and precipitation might impact current management plan practices in the future. This has emphasized how one can think about the implications of climate change on planning cycles, decision making, and resource resiliency.

Dr. Chris Weaver introduced himself and his work in Research Area 6. He provided a perspective of the broader aspects of work connecting with ORD's mission. Climate change has

the potential to affect everything, everywhere, and complicate EPA's ability to meet their mission. Research across ORD informs ACE work involving high profile regulatory assessments, including integrated science assessments of nonclinical and health-related effects related to the environment. He noted the this work connects to air quality assessments through pathways, such as wildfires, where climate change in the western United States makes wildfires more intense and directly impacts life, property, and air and water quality. One recent CPHEA analysis conducted in collaboration with CEMM scientists indicated California wildfires have led to large amounts of lead in the air. Such issues will grow in importance as climate change increases, therefore it is important to consider them when working to improve air and water quality. Dr. Andy Miller and Dr. Tim Watkins alluded to how scientists have played a disproportionate role in the research agenda and structure of the National Climate Assessment, which examines the intersection of climate issues with society and public health welfare. Several CPHEA authors from Dr. Weaver's division are authors of the Fifth National Climate Assessment.

- **Bart Croes:** Even though methane is not included in this charge question, it might be related. Is methane an active area of investigation in better understanding emissions?
    - **Jeremy Martinich:** In the Air Office it is important to understand and address that issue through various air and gas rules. Understanding emissions science is important. We have inventory and research processes in areas across the United States.
    - **Bart Croes:** Studies conducted in California show a disagreement in what we observe as air emisions. Work is not being done properly.
    - **Jeremy Martinich:** There is always a need to characterize better, understand emissions, and test whether assumptions are right or wrong.
    - **Tim Watkins:** We do use sensor technology in characterizing methane emissions in studies of reservoir management. We have conducted fieldwork in that area under the current Strategic Plan and will continue.
- **Louie Rivers:** How do we use information produced by your scientists, and how do we make those connections?
    - **Chris Weaver:** There are formal mechanisms that have smoothed out the approaches. The author team was limited in their ability to develop comprehensive chapter content, but some work by individual agencies is included in the National Climate Assessment. There is a call for agency and interagency reports, datasets, or tools at the beginning of the National Climate Assessment. The disadvantage is sometimes there is a delay and information might not be current. If your author team reaches out, we can put you in contact with the relevant groups.
- **Jeff Arnold:** Has your branch changed the science inputs you take for these assessments?
    - **Chris Weaver:** We are trying to understand the impact of criteria air pollutants on health and welfare, and these reviews provide standards under the Clean Air Act, which is intended to provide levers in regulating anthropogenic emissions leading to poor air quality. Causal relationships linking pollutants to effects on ecology and health are changing with climate change. We are thinking through ways in which we might need to restructure these air quality regulatory

assessments to account for other climate change aspects.

- **Jeff Arnold:** Would you say there is going to be an increased emphasis on considering these things in the mix rather than one-by-one? Is that information of interest, and are you examining these climate actors?
- **Chris Weaver:** We have been able to do it on the ecological side. Scientifically, it can be helpful to do that. Climate effects of these pollutants have always been a part of these assessments, and we are equipped to do both at the same time and compile the literature, because it can be the same literature for both climate and air quality effects. I am interested in pursuing it, and my division is set up to do it.

Ms. Stephanie Santell discussed coordination between ORD and the ACE program. It is important to continue the conversation about which resource investments could lead to more action on the ground and in the Agency. The work with ACE is critical in understanding how climate change impacts health and welfare. The OW values participation on the relevant research coordination teams to discuss progress and course adjustments needed moving forward. OW's areas of focus are on the ecosystem realm, extreme events, changing precipitation patterns, water quality, vulnerable communities, working with communities effectively, and land management, modeling, and monitoring. ORD has provided input on questions to prepare waste and stormwater management, as well as best practices around urban stormwater, agriculture, and forestry. There has been great research conducted on the impact of wildfires on water supplies, ecosystems, and ecological functions of resources. Research on nontraditional ecological restoration activities is not readily available, so seeing the benefits of these activities and the connection between changing land use and water quality is important for urban programs. Disadvantaged communities experience climate and water stress more than others. OW includes a focus on environmental and social justice and targets research benefitting communities most in need with the highest risks. OW wants to be mindful of the climate mitigation and adaptation component with which ACE has assisted and incorporate climate change in program processes and activities. There are many benefits arising from research frameworks that can help staff better include the latest climate science in their operations. Great areas of work to continue are in sewer overflow communities, determining how changing temperatures impact aquatic life, watershed scale assessments, and advancing methods to tie together climate, land use, and other forms of data to create a wholistic approach. The ability to map and overlay these various sets of data to obtain a more complete picture of adaptation and mitigation is extremely helpful.

Mr. Dan Brown introduced himself and described his forest work with EPA Region 10. Pacific Northwest forests are vital to the economy and provide high quality drinking water for human consumption and species. ORD engages in bottom-up work, particularly in the Regional Applied Research Effort (RARE) program, to predict climate change using shade models to assess the effect of restoring shade and reduce solar stream exposure. Cold water refuge restoration is necessary for salmon survival. These measures alone are not enough to counteract the effects of climate change. Other ORD work important to forest management uses the Visualizing Ecosystem Land Management Assessments (VELMA) model to assess green model infrastructure options and inform land management decisions, which are important for drinking watersheds. ORD recently published an assessment on the impacts of prescribed fire versus wildfire and the importance of smoke management plans that are protective of public health and helpful in managing wildfire severity. On the water quality side, ORD researchers published data

on how post wildfires can increase nitrate disinfection byproducts in drinking water supplies. ORD requires this data to understand future wildfire and climate change scenarios that inform forest management and restoration decisions. In addition to burning watersheds, wildfires burn drinking water systems, which emphasizes the need for understanding better the risks experienced by wildfire interface communities. We need a better understanding of the linkages of climate-driven factors and the formation of harmful algal blooms (HABs).

- **Art Werner:** Can you discuss adaptation techniques to mitigate this over time?
    - **Dan Brown:** We do not know. I think the cold-water refuge is an important piece to this. Humans and many of our species can evolve fast enough to adapt, so we need to maintain cold-water refuges to help us survive.

Meet the Scientists, Session #2:

Room A

Water Quality and Aquatic Resources, Session-Lead

Darrell Winner, CPHEA

Stormwater Best Management Practices

Tom Johnson, CPHEA

Adaptation Planning Frameworks

Jordan West, CPHEA

Regional Watershed Resilience

Naomi Detenbeck, CEMM

Room B

Ecosystems Effects, Session-Lead

Peter Beedlow, CPHEA

Coldwater Fish Refugia

Joe Ebersole, CPHEA

Nutrient Transport

Jana Compton, CPHEA

Room C

Scenarios and Impacts, Session-Lead

Tanya Spera, CEMM

Global Change Explorer

Phil Morefield, CPHEA

Storm IDF curves

Anna Jalowska, CPHEA

Public Comments

Tom Tracy, Designated Federal Official, Office of Science Advisor, Policy, and Engagement

There were no public comments.

BOSC Subcommittee Questions and Answers

Charlette Geffen, Chair
Sandy Smith, Vice Chair

- **Louie Rivers:** What resources do scientists have for this work?
    - **Bryan Hubbell:** We have been trying to improve the resources available for community engagement and have been working hard to identify methods and approaches to improve engagement by scientists. There are resources on the EPA intranet site as well. There is a growing body of resources and experience in these research topics.
    - **Sherri Hunt:** When we wrote the current Strategic Plan, there were plans for synthesis and translational pieces. This is something we hope to do better in the future.
    - **Bryan Hubbell:** There are two high level and translational science projects that focus on building community relationships. It takes time to build and maintain these relationships. The scientists track and record all engagements within communities to help us understand what works and what does not. It is very important but also requires substantial resources to implement.
- **Sandy Smith:** From the opposite perspective, we have heard so much about the tools ORD is developing on a granular and local scale with more results for specific locations. How would a local government agency staff member navigate what is available and might be useful to them to use in their own communities?
    - **Bryan Hubbell:** We have our smart search to help locate appropriate tools. The other challenge is accessing data. Centralized sites allow individuals to access several tools. The White House announced yesterday that there will be more tools and different access options.
    - **Sherri Hunt:** Our researchers are trying to make their data more available. The team working on low-cost sensors has been collecting data, and it is available for individuals who want to use it for research. It is not publicly available, but one can reach out to these researchers and obtain it.
    - **Andy Miller:** The President's announcement today highlights this is a challenge not unique to EPA This is a much broader issue of how to communicate the information we have to individuals who are unsure where to start.
- **Jeff Arnold:** Involve bench scale scientists and have reward structures for researchers who have done a substantial amount of research and outreach.

  - **Darrell Winner:** I coordinate and lead the reviews within CPHEA. We changed the reward structures revised policies a few years ago. We reward individuals, but there is room for improvement.
  - **Jeff Arnold:** This is a classic issue. It is good the reward structures have changed. Is there work to establish general principles for defining the dividing line between ORD's work and work by the programs?
  - **Sherri Hunt:** It is challenging, and there is probably not a standard. Often ORD conducts work not already happening. We try not to overstep our bounds, but our job is to put science into the right hands.
  - **Jeff Arnold:** I think the panel would be more concerned about you being drawn across that boundary into uncomfortable actions for which ORD is not well prepared or being set up for success dependent upon training and interests.
- **Bart Croes:** Is the work now a part of the program divisions? Who has control over research on extreme heat?
  - **Bryan Hubbell:** We do have projects where we produce projections of excess ozone deaths. Going forward, we have an interest in studying PM, changes in wildfires, and secondary impacts. In terms of heat, we are not doing any work on a large scale, but we are figuring out our role in studying heat interactions.
  - **Darrell Winner:** One of the folks on the panel tomorrow will be discussing work on a rare project to apply results to multi-pollutant decision making. Our internal work has been an important component of our understanding of the impact of climate change on air quality.
- **Charlette Geffen:** My understanding is that the National Institutes of Health (NIH), through the National Institute of Environmental Health Sciences (NIEHS), will be standing with the climate and health program. Are you in dialog with them?
  - **Bryan Hubbell:** Yes, we have been reaching out to them and the CDC. We have not reached out directly to NIH but will follow up.
  - **Andy Miller:** We have strong connections with them, and there is a meeting set up with them in the upcoming weeks. We are planning close interactions with the Health and Human Services (HHS) office.
  - **Charlette Geffen:** I think there are increasing opportunities to leverage resources and connections.
- **Bryan Hubbell:** You heard a lot of discussion today about climate issues and other ecosystem resources. Going forward, we are working on expanding climate related work in Safe and Sustainable Water Resources (SSWR), and there will be additional work in the Sustainable and Healthy Communities (SHC) Research Program. We are coordinating across programs to ensure we assign work and allocate funding appropriately.
- **Myron Mitchell:** One thing we have not discussed is COVID-19. Air, climate, and energy are the focus, and there is a lot of emerging information about air quality issues. Should we include this or avoid it? Is this an opportunity to keep EPA's research relevant?

- **Bryan Hubbell:** I sent a list of publications related to this. We have conducted some work in this area, and EPA continues to do work on COVID-19. There is interest, but our program is still investigating how to implement this.

Closed Session for BOSC Subcommittee Discussion

The working session involved discussion of Charge Questions 1 and 2.

- **Louie Rivers:** How are we thinking about using the drafting time tomorrow?
  - **Sandy Smith:** In the past we have arranged breakout sessions with just the members of the charge question teams. This allows them to select a champion, begin work on the templates, and initiate discussion. We first review the strengths and suggestions and then identify two actionable recommendations on which everyone agrees. Tom Tracy can help arrange meetings for the groups. We have ideas for a timeline, with an executive committee meeting for the reports in January and the polished report due in December.
  - **Charlette Geffen:** We have two other meetings set for October 27th and November 12th where we can reconvene as a full committee. In the meantime, it would be useful if you could schedule other meetings and determine your group's main scribe. You can also add comments into your charge question document so you can work asynchronously as well.
- **Myron Mitchell:** It would be helpful to have a contact person in our groups who is not technologically challenged.
  - **Charlette Geffen:** Tom Tracy, can you help identify a technical support person as a contact?
  - **Cara Keslar:** We had a problem last time in setting up meetings with smaller groups. At the last minute the contractor had to provide separate meeting links if their staff were unavailable.
  - **Connie Senior:** Are we allowed to set up our own charge question group meetings?
  - **Charlette Geffen:** If we keep the number small, we should be okay with the Federal Advisory Committee Act (FACA) rules, especially if you have a champion leader for your group.
  - **Sandy Smith:** That is a good reminder about our need to involve Tom Tracy for any exchanges with the whole subcommittee.
  - **Tom Tracy:** The charge question work groups can meet on their own. If you want the whole committee to meet, that is different. In terms of obtaining technical assistance, you can contact me or our contractor managers. We are setting up some team meetings, but I prefer you organize on your own. If you do not have a meeting platform, we can gladly assist.
- **Jeff Arnold:** There is a universal disdain for SharePoint. If we set up our own meetings, are we still in compliance with FACA if we use Google Docs instead?

  - **Tom Tracy:** We used to have Google Docs, but we have now moved entirely to Microsoft. We are encouraging everyone to comment on the charge questions, so you can use Google Docs, but then add it back to SharePoint.
  - **Louie Rivers:** To resolve any problems with SharePoint, I empty my computer's cache before logging into SharePoint.
- **Charlette Geffen:** Tomorrow each subgroup can select their champion and finalize their strengths and suggestions.

Adjourn

The meeting adjourned at 5:30 p.m., Eastern Time.

Thursday, October 14, 2021

Welcome – Day 3

The meeting reconvened at approximately 11:00 a.m., Eastern Time

Welcome and Opening Remarks

Tom Tracy, Designated Federal Officer, Office of Science Advisor, Policy, and Engagement
Charlette Geffen, Chair
Sandy Smith, Vice Chair

Mr. Tom Tracy welcomed the participants.

Charge Question 3: Science Needs for Impacts of Changing Energy Systems (Research Area 5)

Sherri Hunt, ACE Principal Associate National Program Director

Dr. Sherri Hunt welcomed the participants and provided an overview of the presentations focusing on Charge Question 3. She discussed emissions and sources of emissions in the United States and how energy use and production is changing. She noted transportation sector shifts include the emergence and increasing use of electric vehicles, vehicle ownership versus ride sharing services, teleworking, and other factors. Transportation emissions are complex and differ across the country. She discussed the environmental impacts of biofuels, the complexity of their effects, and the great variety in processes. The ACE Research Program develops tools to inform partners about the positive and negative consequences of alternative potential ways to accomplish policy goals. She provided an overview of Charge Question 3 and stated ORD scientists from CPHEA and CEMM are addressing these scientific challenges. She introduced the panelists by name and affiliation.

Approaches and Research to Understand Impacts to Changing Energy Systems

Darrell Winner, CPHEA
Rebecca Dodder, CEMM
Marcus Sarofim, OAP
Shutsu Wong, Region 1

Darrell Winner introduced the panel discussion.

Dr. Rebecca Dodder presented the current work by CEMM on energy systems modeling. She stated the team works collaboratively on multiple frameworks and across modeling platforms and provided a list of on-going partnerships and collaborations for current research efforts. She provided background information on the charge question and highlighted key context points. While the charge question focuses on modeling, the presentations also discuss energy and transportation. She discussed the goals of net-zero energy, which include limited and targeted use of fossil fuels, transition toward zero or negative carbon-electricity, end user electrification, use of alternative fuels in hard to electrify sectors, less materials use, carbon dioxide removal, and use of an integrated systems approach. Uncertainties include regional differences, path dependencies, technological challenges, varying infrastructure needs, and other factors, such as EJ. She provided an overview of why energy system modeling approaches are needed and discussed the geographic scope of models and select applications, including GCAM-USA, EPAUS9r-TIMES, and COMET-NYC. She discussed development, delivery, and support of energy system models for extension beyond resource extraction to power plants, refineries, and all end-user sectors. She concluded by discussing energy and transportation work, which is important from both modeling and measurement perspectives. Current transportation measurement work is focusing on mobile source emissions and how fleets change over time.

Ms. Shutsu Wong discussed multi-pollutant air quality planning in Region 1. Region 1 covers six states and for the project being discussed, focused on New York, New Jersey, and Connecticut. She provided background information on program efforts and collaborations. She described planning challenges, including limited ozone management options, understanding policy interaction, accounting for co-benefits, providing state partner assistance, and improving management strategies. She discussed their use of the GLIMPSE modeling tool to support Connecticut's ozone attainment planning efforts and GLIMPSE tool enhancements. She concluded by discussing next steps and future project directions.

Dr. Marcus Sarofim discussed the work of his branch on carbon dioxide and methane reduction in the United States. He discussed their use of CERA analysis to examine climate change impacts on different sectors and their collaborations with the Office of Air on air quality. He described downscaling of models in ORD analyses of the changing climate and air quality to achieve the optimal resolution needed to run the Weather Research and Forecasting (WRF) model. After downscaling, the CMAC and BenMAP models help evaluate particulate matter and ozone maps and identify changes in depth. He discussed the need for flexible analysis and his branch's move toward using an impact-by-degree framework to examine the effects of temperature increases by degree, which provides valuable information on temperature changes and impacts at degree thresholds. Use of different models can alleviate climate sensitivity issues and result in quick turnaround of analyses. ORD ran many CMAC runs every 25 years, and OAP mapped those to provide a liner relationship. They repeated the analysis with a second scenario of nitrogen oxides (NOx) emissions to demonstrate climate penalty decreases as traditional air pollutants reduce. This is important for development of a natural projection of greenhouse gas emissions. He noted the value of collaborations with ORD involving both traditional and new frameworks and explained the branch's desire to leverage ORD's expertise in efforts to study interactions between temperature and air quality sensitivity so as to observe all sorts of endpoints, such as mortality and morbidity, and better understand social vulnerability and EJ. Such collaborations will be relevant to future analysis over the next couple of decades.

- **Annette Rohr**: Is ORD thinking about the incorporation of hydrogen and related environmental issues?
  - **Rebecca Dodder:** I think the Office of Transportation and Air Quality coordinates that work. It has had a focus characterization of the full supply chain of hydrogen. I am not sure if other parts of the energy system besides transportation incorporate hydrogen. The capabilities are there, but we need supporting data for the technologies.
  - **Annette Rohr:** You talked about measurement capabilities and combustion capabilities in the laboratory.
  - **Rebeca Dodder:** Yes, but we have not delved into those issues from the measurement side.
- **Cara Keslar:** Can you explain the purpose of the gray boxes in the presentation slides?
  - **Rebecca Dodder:** The four boxes represent end-use, or how much energy the vehicle converts to vehicle miles traveled. The rejected energy is the heat from the vehicle that does not serve much purpose. It basically indicates end-use efficiency and energy losses.
- **Cara Keslar:** We often hear about the increased use of energy for server banks and crypto currency mining. How is ORD thinking about the different ways we will use energy in the future?
  - **Rebecca Dodder:** That is the theme here. We enjoy studying those scenarios and the demands in technology. Regarding the specific example of server use, we do have a very detailed industrial sector that captures data on lighting, heating, and freezing food. We can model changes in those end-use demands to see how it affects the entire systems.
  - **Darrell Winner:** Apple is strongly pushing to reduce these emissions.
- **Viney Aneja:** Rebecca, you pointed out that President Biden noted a goal of achieving net-zero carbon by 2050. However, only 42% of the energy portfolio includes renewable energy. Is there a disconnect between net-zero and renewable energy's value?
  - **Rebecca Dodder:** That is a baseline, so the presentation graphic probably did not capture modeled policies or recent net-zero announcements. We would need to model these types of scenarios.
  - **Viney Aneja:** So, there was a disconnect between Sherri's presentation and your comments.
  - **Rebecca Dodder:** Sherri presented on current work, whereas I was challenging people to think about how this will transform as we think about net-zero pathways.
  - **Charlette Geffen:** Does that imply you are examining carbon sequestration technologies that might take carbon out of the system?
  - **Rebecca Dodder:** We do not do analyze storage from a modeling and measurement standpoint. Rather, our modeling work examines technologies, such as the biomass-based integrated gasification combined cycle (IGCC) with carbon capturing.

- **Bart Croes:** I had a question about climate pollutants. It is unfortunate that we use CO2 and methane. There is an intersection of energy systems. Are you focused on that at all? I have a second question on indoor air quality.
    - **Rebecca Dodder:** We do have active measurement work examining methodologies of residential wood combustion. We have very deep analytical experience in PM and black carbon. However, COVID-19 has impeded the work.
    - **Darrell Winner:** We have some work on that, and it is an area of active discussion in our research planning mode for our next set of work. Given limited resources over the past few years, we could not do as much work as we had hoped.
    - **Bryan Hubbell:** The Office of Indoor Air has interest in terms of opportunity and indoor air exposure in relation to changes in the built environment. We are aware of it but want to make sure we have a good systems approach.
    - **Marcus Sarofim:** We are very interested in better understanding the impacts on climate and black carbon methane's contribution to global background ozone, which is a complicated subject.
- **Annette Rohr:** I wanted to discuss the concept of equitable decarbonization. What are ORD's thoughts about evaluating the costs and benefits of such issues as energy affordability, site redevelopment, fossil plant redevelopments. How can ensure equitable distribution of costs and benefits?
    - **Bryan Hubbell:** We hope to address this in the research planning cycle. We intend to disseminate information on the impacts of energy transitions in vulnerable communities and the benefits of energy transitions, while making sure we are not introducing new burdens to those communities. We are working to develop a Request for Application (RFA).
- **Connie Senior:** Are you planning to incorporate air capture and CO2 sequestration into the models, because we recognize that both can reduce CO2?
    - **Rebecca Dodder:** We have captured more of the carbon captured storage. When we incorporate such technologies, we capture information on both energy and carbon, but I do not think models capture it right now.
- **Michael Kleinman:** We hear about calculating the benefits and offsetting costs. The benefits seem to focus on mortality, but morbidity affects larger numbers of people. Would that change the cost benefit analysis.
    - **Bryan Hubbell:** The wide range of morbidity points do not move things much. If you are conducting a full assessment, the numbers are substantial, and morbidity is noted.

Meet the Scientists, Session #3:

Room A

Energy Systems Modeling and Databases, Session-Lead

Tom Pierce, CEMM

GLIMPSE

Dan Loughlin, CEMM

EPAUS9r-TIMES

Carol Lenox, CEMM

CoMET

Ozge Kaplan, CEMM

Room B

Biofuels, Session-Lead

Britta Bierwagen, CPHEA

Biofuels Report to Congress

Chris Clark, CPHEA

Terrestrial Effects of Land Use Change

Steve LeDuc, CPHEA

Revitalizing Research to Address the Challenge of Climate Change

Bryan Hubbell, ACE NPD
Andy Miller, ACE NPD for Climate

Dr. Bryan Hubbell noted ORD is deep in their planning stage and is still uncertain about their budget and available resources.

Dr. Andy Miller presented slides providing background information on ORD research program planning for ACE. Climate change broadly impacts the ACE program, where the key challenges include addressing EJ, criteria and toxic air pollution, wildfires, indoor air quality, and energy and transportation transformations. The planning structure focuses on two major topics, including understanding air pollution, climate change, and their impacts on human health and ecosystems, and responding to risks and impacts and preparing for the future. Topic 1 covers Research Areas 1-5 and Topic 2 covers Research Areas 6-9. ACE's climate research focuses on providing scientific support for actions addressing climate change impacts on public health and welfare, especially in frontline communities. The themes of this research focus include (1) protecting public health in the face of immediate threats created by fires, floods, droughts, permafrost melt, and other extreme events, (2) informing preparedness adaptation, and long-term resilience for public health and well-being, and (3) identifying and quantifying the public health and environmental benefits of reducing greenhouse gas emissions and sustainably reshaping our energy system. Dr. Miller noted the main directions of the research plan with the key goal of providing actionable, locally relevant information and data to non-expert decision makers.

He described an EPA, Tribal, and State engagement, which included two tribal listening sessions, eight program and regional partner research area dialogues, and a 3-day climate research workshop. The state and tribal listening sessions discussed the key themes of air quality

impacts, such as ozone and wildfires, ecosystem impacts, including water temperatures, energy impacts on communities, exposure and health costs, extreme events, such as drought, and changing precipitation patterns. The second listening session discussed other key themes, including government and policy collaboration needs, land management concerns about contaminated sites, modeling and monitoring data consolidation tools, water quality with a focus on HABs, unique tribal concerns, and working with communities to share effective approach information. The key themes from the climate workshop included the need to conduct research on response, resilience, and adaptation to climate impacts and mitigation and intervention to reduce impacts. In addition, Dr. Miller noted that ORD and program and regional office partners recognized the need to adjust how research is done to provide data and information for decision makers. There was strong support for expanding cross-EPA and cross-ORD engagement and collaboration.

- **Connie Senior:** I am pleased to see are researching long term issues. Would you explain what the "transitions to a sustainable future" research areas is intended to cover?
    - **Andy Miller:** Energy system research and modeling, including ways of conducting research and engaging at the regional level. We make sure we are transforming regional level engagements and disseminating our research. It is primarily focused on the technological side of energy transportation systems.
    - **Bryan Hubbell:** We are also including nature-based solutions and long-term thinking, such as blue carbon, to study how we can remove carbon from the atmosphere and address community resilience.
- **Michael Kleinman:** When reviewing the Strategic Plan, you considered wildfires an overarching area of research. I wanted to encourage people to think about the impact of climate change impacts on wildfires, because it is extremely important. It has huge impacts on smoke and welfare.
    - **Bryan Hubbell:** We embedded that throughout the program. We are even more strongly noticing the linkages between wildfires and climate change. We also recognize wildfires emit climate chemicals. We made sure to address it in Topic area 1 and the extreme events research area in Topic 2.
    - **Andy Miller:** This is one of the challenges of changing structure. It might appear we are not emphasizing wildfires, but it is included in multiple places.
- **Viney Aneja:** Does nuclear energy play a role in addressing net zero carbon emissions?
    - **Andy Miller:** We at EPA do not have a big role there. Nuclear does play a role, but it is not up to us to decide whether we should or should not. We do include it in our modeling.
    - **Viney Aneja:** There is an air component, so should you not be prepared to address it?
    - **Bryan Hubbell:** Other parts of the organization study these radiological events.
- **Art Werner:** We know that climate change is a global event. How are you thinking about dealing with the national and worldwide aspects of the climate change problem?

  - **Andy Miller:** We account for those in some ways, but other agencies are better equipped to understand consequences and impacts. We are involved in efforts that would aid where appropriate. We do not have a clear role in evaluating emissions from other countries.
  - **Bryan Hubbell:** We have science roles in this, such as the cost of carbon. Some of our scientists are participating in a climate focus through embassies. We are not avoiding global engagement, but we are a receiver of such information, not a generator of it.
- **Sandy Smith:** It was helpful to hear about your planning and partner engagement process. Did anything you hear alter your thinking about the relative allocation of resources?
  - **Bryan Hubbell:** Yes. We heard to focus not only on urban but also rural populations. We also want to hear from the tribes how to better characterize the impacts. We heard several specific issues, such as an emphasis on methane and addressing it going forward. As we go forward, we are going to continue to hear about these things. Another example was permafrost. If we had not been talking to the regions and states, we would not have heard about these issues. We provided an opportunity for each region to voice their climate needs so we could hear them and they could hear us.
- **Jennifer Hains:** Do you have plans for evaluating ways to quantify effects on overburdened communities?
  - **Bryan Hubbell:** The administration has two key priorities, which are addressing the climate change crisis and addressing EJ concerns. We have emphasized the links between the two. We must address these concerns in both urban and rural communities, which face similar yet different issues. We must take a holistic view of these overburdened communities. One thing we heard was that these communities feel they are constantly barraged with insults, causing them both physical and mental harm. Because of the uncertainties going forward, they know the situation will worsen. This is something we want to investigate and quantify when possible. We are going to continue to try to find ways to quantify and combine that with qualitative measures.
  - **Jennifer Hains:** How do you sustain this as a priority?
  - **Andy Miller:** It has been fascinating to observe how far the agencies have moved toward incorporating social science into their research programs. This is an issue of routine discussion, and there is strong recognition we must include this social component in research. This is an issue with longevity. Aside from the EJ emphasis, there is a much stronger foundational aspect across the agencies.
- **Myron Mitchell:** Would be helpful to summarize the models, their purpose, and some of their inputs and outputs?
  - **Bryan Hubbell:** That is a good point. For models, as we are working to link them to various scales, and it is important to understand the results. Dan Loughlin is working on this, and we have an interest in linking global scale models with local

and regional scale models. We should consider this as we move forward with our planning.

- **Charlette Geffen:** It might be helpful to clarify the gaps and data needs in the models and how they drive the need for obtaining certain measurements.
- **Bryan Hubbell:** We are planning additional work to verify chemical measurements. CEMM has this need to relate measurements to modeling and to explain and understand sensors and air quality measurements to improve use for various applications.
- **Sherri Hunt:** The model development and evaluation teams work together and have good communication with one another. This is possible because they work together in the same laboratory.

BOSC Subcommittee Questions and Answers

Charlette Geffen, Chair
Sandy Smith, Vice Chair

- **Connie Senior:** How are you integrating direct air captured into energy system models? Are you considering use of hydrogen in the energy system in the research?
  - **Ozge Kaplan:** We are participating in energy modeling. As a part of electromagnetic field (EMF) decarbonization, we are studying hydrogen. I think a facility team produced carbon neutral steel from hydrogen. We are trying to incorporate cost, efficiency, and air assumptions. As far as blending and building, some cities are considering these, and we are exploring it.
  - **Dan Loughlin:** Our energy modeling forum is important because it allows for interactions with sufficiently funded groups, which provides a starting point and data for the modeling groups.
  - **Carol Lenox:** The reason it is transportation-focused is because there was a direct request. In conversations with the Office of Air Transportation and Air Quality (OTAQ), we have focused on moving into other sectors. We plan to include this in the future, and buildings and the electric sector are on the horizon. For direct air capture, due to our limited resources we are relying on committee members to contribute data.
  - **Connie Senior:** It is important to make sure those are on your radar because they could be happening in 10-15 years.
  - **Carol Lenox:** The current schedule includes integrating data into the model within the next year.
  - **Andy Miller:** With regards to direct air capture and carbon sinks, several agencies, including DOE, do not have the green light to proceed. Data integration is not progressing as much as we had hoped. There are basic gaps beyond our current capabilities, so progress will take some time.
- **Sandy Smith:** We talked about feedback loops in the past. What is the formal feedback loop process for models and tools?

  - **Dan Loughlin:** We are trying to engage people and encourage them to try different things and work on different projects. One of the most valuable things we have done recently was to bring GLIMPSE into a classroom setting, which led to many different unanticipated uses of the model.
  - **Bryan Hubbell:** Many of our folks are adopting Agile approaches, where we work with users early in the process and focus on user need and feedback.
  - **Ozge Kaplan:** We obtained stakeholder input to determine what issues EPA is facing at the state level. We presented the conceptual aspect of the tool. It is important that we use this Agile approach. We need to develop hubs within universities so they can take ownership of tools, educate students, and work with local governments.
- **Art Weaver:** We talked about emissions from cookstoves in previous meetings. I have not heard mention of them today.
  - **Bryan Hubbell:** We outlined this work a year ago. We are still considering what is the next phase if that research is to be continued. There is an interest in addressing black carbon, and we do have an interest in residential wood combustion. The Agency is very interested in how we can encourage countries to adopt cleaner cookstoves. The folks from OAR would agree on the need for emphasis on this.
- **Louie Rivers:** What are the mechanisms that can replicate what is happening in Region 1? How can they make use of these tools in their climate resilience plans?
  - **Bryan Hubbell:** We are working on how to translate information generated in one region to other regions.
  - **Andy Miller:** Providing climate-related information is a huge challenge. The focus has been on research organizations, but this is operational information, so there is a need to move that information into science topics. There are many questions, but agencies are studying ways to standardly disseminate information.
- **Annette Rohr:** To what extent is ORD studying residential natural gas?
  - **Ozge Kaplan:** We recently began studying building electrification. States are grappling with the cost effectiveness of this issue. We can represent this kind of information in our models and quantify the benefits.
  - **Annette Rhor:** How do models incorporate the health effects of emissions?
  - **Dan Loughlin:** We examine broader scenarios involving policy implementation related to the larger implications of emissions changes. We have applied certain trackers to help identify health impacts. The model might suggest the outcomes for consideration in policies, which would be a starting point for highlighting dynamics and future investigation.
  - **Bryan Hubbell:** We have not thought about the emissions yet.

BOSC Subcommittee Workgroup Breakouts

Charge Question 1 Workgroup

Art Werner, Cara Keslar, Jennifer Hains, and Michael Kleinman

The Charge Question 1 Workgroup discussed work in the regions on mobile sensor data collection, measurement of pollutants, including PFAS and PFOS, and analysis before identifying strengths and recommendations.

- Strengths
    - Good work on measuring and evaluating PFAS.
    - Use of mobile sensors to collect data on various sources, such as smoke from wildfires.
    - Use of non-targeted analysis, which is helpful in source identification. If you identify the source, you can begin to identify the emissions and mitigate the source.
    - Evaluation of the implications of VCPs on criteria pollutants.
    - Advances in cleaning products during the COVID-19 pandemic.
- Suggestions
    - Expand the reach of NADP where possible.
    - Use fence line monitoring to evaluate specific sources.
    - Develop better methods for addressing fugitive emissions.
    - Study easy-to-measure target pollutants to better understand measurement problems.
- Recommendations
    - Clearly delineate how to regulate VCPs as a subset of the total VOC.

Charge Question 2 Workgroup

Viney Aneja, Jeffrey R. Arnold, Myron Mitchell, and Louie Rivers

Members of the Charge Question 2 workgroup considered recording discussion topics in a Google Docs document. They selected Dr. Louie Rivers as the champion responsible for editing their working Google document. They discussed strengths and suggestions pertinent to the charge question.

- Strengths
    - Use of measurement and modeling to address climate change issues.
    - Work with specialists to help with design of user-friendly tools.
    - Continued development of new and enhanced use of combined models to characterize connections of energy production and use and plausible climate change effects.
    - An increased number of ACE scientists working on specific problems and Strategic Plan elements.
    - Adherance to past suggestions about incorporating energy as a research topic.
    - An active response to the new administration’s focus on climate change.
    - Integration of a focus on EJ into work.
    - Aligning work with the Strategic Plan.

    - Consideration of previous work on air pollution, especially in terms of interactions, in EPA climate change work.
- Suggestions
    - Include more discussion on greenhouse gas emissions from the agricultural sector.
    - Initiate an on-going dialogue with USDA to ensure greenhouse gases are addressed in a meaningful way.
    - Characterize the effects of climate change and greenhouse gases on non-human species.
    - Provide a synopsis of models used by EPA related to climate change research, including required tables of inputs and outputs, information on temporal and spatial scales, demonstrated applications, and known limitations for use.
    - Describe key elements of models in relation to individual Strategic Plan products.
    - Extend attention to the probabilistic character of using projected future climate conditions so results of stand-alone and integrated modeling studies can be presented less deterministically. This is especially important for results designed for use by non-chemical practitioners unfamiliar with techniques for modeling future climate.

Charge Question 3 Workgroup

Bart Croes, Annette Rohr, and Connie Senior

- Strengths
    - Offices' valuing of modeling work at different scales, and inclusion of multiple scales, including fine scale versus city scale, in new modeling tools.
    - Beta testing of models with various groups prior to public dissemination.
    - A good record on publishing and disseminating models and information into the hands of end users and stakeholders.
    - Science advancement through training, information dissemination, and published modeling work.
    - Active partnerships with other agencies.
- Suggestions
    - Provide systematic access to resources needed for training and model use.
    - Increase coordinated outreach.
    - Include emerging technologies or policies in scenario development.
- Recommendations
    - Reward and provide greater recognition for scientific leaders conducting successful tasks beyond writing papers.
    - Emphasize dissemination of information about models and trainings to end users.

BOSC Subcommittee Workgroup Reports

Dr. Jennifer Hains reported out for the Charge Question 1 workgroup and noted the group discussed the research areas and focused on Charge Question 1. The group focused discussion on measuring PFAS, using mobile sensors to collect data, and regulating VCPs. They recommend delineation of how to regulate VCPs as a subset of the total VOC.

Dr. Jeff Arnold reported out for the Charge Question 2 workgroup and noted the subcommittee was pleased with the ACE climate change work associated with urban and regional air pollutants. The group identified specific strengths including use of modeling and tools to evaluate energy production and use and climate change. They recommend increased integration of energy and climate change evaluation into modeling work and enhancing use of tools by individuals without technical training.

Dr. Connie Senior reported out for the Charge Question 3 workgroup. The group was pleased to learn modeling work includes different scales, especially down to the city level, and program offices and regions value modeling tools and databases. Activities on dissemination of research to stakeholders are encouraging. Partnerships and collaborations between modelers and other offices, agencies, and external stakeholders is also a strength. The group recommends ACE adopt more intentional outreach training and address a perceived lack of sufficient strategic direction for scenario development by accounting for emerging technologies and policies. The group also recommends a better reward structure for scientists and scientific leaders.

Wrap up and Next Steps

Charlette Geffen, Chair
Sandy Smith, Vice Chair

Dr. Charlette Geffen recognized the importance of leveraging partnerships, incorporating social science in research, and recognizing the challenges of overburdened communities with EJ concerns. She noted a need to revisit the Strategic Plan before finalizing a draft document for review and comment. She instructed members to email her or Sandy Smith with any additional thoughts.

She reminded everyone there is a meeting scheduled for October 27. She asked workgroups to post updates on SharePoint by October 25 and discussed logistics of working in the site. She noted a second follow-up meeting is scheduled for November 12, by when she hopes the document is almost final. At that meeting they plan to discuss and close out the recommendations. She asked workgroups to post on SharePoint by November 8 any updates for discussion at the November 12 meeting. The goal is to have by November 22 an email chain for final comments on the report.

Adjourn

The meeting adjourned at 6:00 p.m., Eastern Time.

Wednesday, October 27, 2021

The meeting generally followed the issues and timing as presented in the agenda provided in Appendix A of this meeting summary.

Convene Meeting

The meeting convened at approximately 2:00 p.m., Eastern Time.

Welcome, Opening Remarks and Member Introductions

Tom Tracy, Designated Federal Officer, Office of Science Advisor, Policy, and Engagement

On behalf of Tom Tracy, Charlette Geffen welcomed attendees and provided an overview of the meeting agenda.

Report out for Charge Question #1

Cara Keslar reported out for the Charge Question 1 workgroup: For the narrative, they highlight technical work, such as PFAS, and discuss different tools and issues. There is an unfinished fourth paragraph about the use of community tools. They list some strengths and talk about research in VCPs, commending EPA for time-sensitive work on VCPs and sanitizing projects since the onset of COVID-19. They discuss next generation modeling approaches, mobile sensor packages in cars, fence line monitoring, and use of drones. They are encouraging EPA to continue that research. They discuss PFOS and PFAS research as a great framework and commend EPA on use of the speciate database to develop source emission estimation. They also discuss brake and tire wear as pollutants.

- **Charlette Geffen**: Is this a place where we can reference the broader on-going PFAS activity? Is it worth commenting about the broader activity?
    - **Sandra Smith**: I think mentioning these specific areas reinforces them. We will discuss them in greater detail elsewhere in the document.
- **Connie Senior:** After the meeting with EPA, I investigated some of the models they use. The OTAQ model has a section on estimating tire wear, and EPA made the point that they rely heavily on this model. If they are going to make improvements, they would need to coordinate with OTAQ. Keep this in mind when asking them about brake and tire wear. There are already collaborations and use of this model. EPA is reviewing non-targeted analyses, which will help with source identification and emissions mitigation. We appreciated and wanted them to focus on using the NADP network, specifically for PFAS. It is cost effective and uses resources already in place. We want to encourage development of better guidance on how communities can use sensors to understand possible pollutants.
- **Jeff Arnold:** I do not remember details about PFAS and NADP. Are they currently processing samples co-located with NADP sites for PFAS?
    - **Cara Keslar**: My recollection is that they are using the NADP samples in Wisconsin to identify certain markers of PFAS. We think it would be great to expand this nationwide.
    - **Art Werner**: The work I know of in North Carolina does not use NADP.
    - **Cara Keslar**: One of the presentations showed a map of Wisconsin and showed the specific work.
    - **Jeff Arnold**: There is a lot of opportunity there if there are science questions requiring answers.
- **Viney Aneja:** I think this network will only measure a handful of PFAS. We should articulate this in the report so there is no unrealistic expectation hundreds of chemicals

will be measured. I think this has been clearly stated by EPA. Has analysis of PFAS chemicals already begun?
    - **Bryan Hubbell:** We are performing targeted analyses and examining total methods. The targeted methods will review the mass. Right now, we are still developing methodologies for use in future field studies.
    - **Art Werner:** There are other people developing methods on PFAS and PFOS. What are we doing to encourage collaboration?
    - **Michael Kleinman:** There has been collaboration with the North Carolina DEQ in PFAS modeling, which has contributed to methods development.
- **Jeff Arnold:** What projects is CEMM working on, and are they listed as products?
    - **Bryan Hubbell:** There is a set of products.
- **Cara Keslar**: We talked about odor and increased coordination with states and local groups. Following up with states, allowing citizen participation, and encouraging more onsite monitoring, if possible, would be helpful. We encourage more development of guideline documents for using ETO modeling systems consistently. It is important to coordinate with the Toxic Substances Control Act (TSCA). We suggest focusing attention on health outcomes from anthropogenic secondary organic aerosols (SOAs). The subcommittee encourages continued collaboration with CPHEA on tire wear and with the USDA.
- **Michael Kleinman**: I think it is important to recognize that PFAS is a compound that bioaccumulates in people. ACE could increase focus on the transfer of PFAS compounds out of wastewater and solid materials into the air, which would allow it to distribute much more broadly and represent a long-term exposure potential.
- **Sandra Smith**: Regarding the PFAS suggestions, I would clump them together and note there is an on-going EPA-wide effort. Point toward the various suggestions we have made in the report in a briefer fashion.
    - **Jeff Arnold**: I think it is reasonable for us to talk about PFAS and to state our suggestions and recommendations continue to fall under EPA's research lines.
- **Charlette Geffen**: Do people have thoughts on how to elevate this? Where do we think there could be recommendations?
- **Art Werner**: We need to make actionable recommendations.
- **Cara Keslar**: What does the larger group think should be considered a recommendation?
- **Connie Senior**: Maybe the suggestions on odor and increasing coordination with state and local groups, tying that into sensors, would be something we could recommend?
    - **Michael Kleinman**: I think this would be useful to frame as a recommendation.
    - **Jennifer Hains**: Mentioning it in the summary could be useful.
- **Jeff Arnold**: Is it possible to build a recommendation that would encourage novel work, such as development of next generation emissions models and reviewing non-VOC emissions? Would it be useful to consider a recommendation that says something about source emissions and the characterization of emissions?

- **Michael Kleinman**: EPA has requested applications for such work. I think this is something already being done.
    - **Jeff Arnold:** So maybe we would not need to make this a recommendation.
- **Charlette Geffen**: Part of the charge question discussed how the research affects our understanding of pollution, namely for disproportionately affected communities.
    - **Jennifer Hains**: Maybe developing the strategy for toxicity linked to health outcomes to understand substantial health effects might be relevant?
- **Michael Kleinman**: An example is when California had an oil spill that created ecological trauma and VOC exposures. The efforts of EPA and its development of methods to improve detection and analysis of large incidents serve to improve our understanding of how these exposures will affect communities.
- **Michael Kleinman**: Vulnerable consumer products represent organic compounds emitting into the air. I think it is important to think about how EPA should prioritize those as a potential source.

Report out for Charge Question #2

Dr. Jeff Arnold, Senior Scientist, US Army Corps of Engineers

Dr. Jeff Arnold explained the committee's plan to answer Charge Question 2. They commend ACE for restoring carbon and for translating products to make them informative for action. They express concern over certain products not accounting for a changing climate. The committee believes partial ACE funding of the atmospheric modeling group might redirect work to provide advancements for topics relevant to ACE. The committee notes the importance of prioritizing decisions with the most impact. Their suggestions include continuing work on the emissions database and exploring opportunities from the agriculture sector to better characterize emissions. Dr. Viney Aneja added the suggestion to evaluate greenhouse gas emission from the use of fertilizers. Dr. Arnold agreed and noted the work from John Walker and the team from the Cincinnati laboratory as helpful for tying in fertilizers. He concluded with the group's suggestion to characterize the impacts of climate change on non-human species.

- **Charlette Geffen:** Is it appropriate to think about the charge question as prioritizing to set the foundation for future work to provide sustainable strength going forward?
    - **Jeff Arnold**: Yes, we are not suggesting stopping work on packaging and processing outputs to inform decisions. We recommend determining a focus and priority with a more constant view of what ACE can best inform.
    - **Charlette Geffen:** That is helpful. As we go through these reports, it would be great to have more examples.
    - **Jeff Arnold:** We will draw up more examples.
- **Charlette Geffen:** I think it would be helpful to review case studies, because when we review the charge question, we want to make sure we are thinking about the context of extreme events and the impacts.
    - **Sandy Smith:** I encourage you to add more detail to make clear what we are suggesting to EPA.

  - **Jeff Arnold**: Myron, could you help us out on how we could be more specific on what we mean by characterizing the impacts on non-human species?
  - **Myron Mitchell:** I could work on specific examples to those sections. The biota, plants, and animal extinction rates are high levels unseen before. It is a large topic of major impact.
  - **Jeff Arnold**: We will try to be specific about these points.
- **Charlette Geffen**: I was impressed heard about a research portfolio, instead of products from a different part of the country we had not seen before. I found it useful to hear about the experiences of people from Corvallis and obtain a broader perspective.
  - **Jeff Arnold:** That is a great point. I also thought it was helpful to hear from folks outside of Research Triangle Park (RTP) in North Carolina. The Corvallis case is great at showing ACE's strength of being an integrated program that can collaborate with other laboratories. We will include that.
  - **Charlette Geffen**: That would be great.
- **Art Werner:** When we talk about non-human effects, we can use the secondary air quality standards that have been ignored.
  - **Jeff Arnold**: From a climate perspective, the NOx secondary pollutants are short-lived actors and might not be relevant for investigating greenhouse gases. Art, are you suggesting we say something about that as a model?
  - **Art Werner:** Yes, I think that is something the model could include.
  - **Charlette Geffen**: Art, if you have ideas on the specifics of the secondary portfolio, it would be helpful for you to send your ideas to the charge question team.
- **Michael Kleinman**: We might want to suggest as an interim measure development of strategies for mitigation methods to reduce criteria pollutants, greenhouse gases, and climate forcing compounds. It might be a part of an underlying strategy.
  - **Jeff Arnold**: I think there was discussion of how to characterize climate-related benefits from NOx control, but I do not remember any specifics.
  - **Bryan Hubbell:** It is something of interest as we move forward. We are trying to understand the relationship between controls and reactions for the next round of research planning.
  - **Jeff Arnold**: We did not miss anything, but it would be helpful to identify it as a ripe avenue.
  - **Bryan Hubbell:** As we lay out our vision going forward, we understand climate and air quality are integrated. I think that would be very appropriate.
- **Jeff Arnold**: The last two suggestions were for the ACE to produce a synopsis of agency models currently in use related to climate change and demonstrate applications and any limitations for use where those models are key elements of individual Strategic Plan products. We will investigate if this was already covered.
- **Charlette Geffen**: There is a hierarchy for some of the models where some are used for internal research purposes and others for work with partners. I do not know whether your synopsis differentiates between model types.

    - **Jeff Arnold**: It would be great to have a spreadsheet enumerating these models. Sometimes people do not need internal research models.
    - **Charlette Geffen**: Right, you need different levels of skill to implement different models.
- **Myron Mitchell**: I think we should emphasize to EPA that we appreciate their systematic approach. I also think it would be helpful to have a compendium synopsis of models in use with a description of their purposes. There is a real opportunity to use the models as synthesis tools for developing new understandings of how to collaborate and conduct outreach.
    - **Charlette Geffen**: Myron, will you ensure your verbiage is included in the charge question?
    - **Myron Mitchell**: Will do.
- **Michael Kleinman**: Some models have land use scenarios. To what extent can we use those models to improve adaptation and resilience in communities with EJ concerns?
    - **Jeff Arnold**: Michael, are you suggesting that models be more available specifically for applications where communities have been underserved in the past?
    - **Michael Kleinman**: Yes, that would be one way to do that.
    - **Connie Senior:** I am providing in the chat a link to a compendium of EPA models.
- **Connie Senior**: It is important we ask EPA to consider novel work. I think the suggestion of defining when to make models more accessible and when to use certain models is useful.
    - **Charlette Geffen**: We can also list items as strengths and commend EPA for doing these things.
- **Jeff Arnold:** One idea would be to generalize the idea of using models as an integrating element and to make products specifically related to climate, so the products are more actionable. We can ask them to broaden the use of available tools.
    - **Louie Rivers:** I agree this might not be the responsibility of the scientist to make tools useful and disseminate them to the right communities. I am not sure who would be responsible, but ORD should be involved.
    - **Jeff Arnold**: I think we can frame this as not putting the burden on the scientist, but the scientist might be involved.
- **Jennifer Hains:** I think it would be helpful to have guidance on communication.
    - **Charlette Geffen:** Is there a role for partner input about what is useful?
- **Louie Rivers:** I think it would be helpful for EPA to increase focus on the emission from agricultural sectors.
    - **Sandy Smith:** I believe we should target the question and specify the climate change work.
    - **Cara Keslar**: We did not specifically address agricultural emissions in the first charge question, so I agree that would rise to the level of climate change.

- **Myron Mitchell**: It might be helpful for EPA to clarify particularly important areas for which they are most suited. We could develop a hierarchy of priorities since we do not have a lot of time.
    - **Charlette Geffen**: With the new administration, every agency is looking at these kinds of problems. We want to make sure we are honoring the role of EPA.

Report out for Charge Question #3

Connie Senior, Executive Editor-in-Chief, Clean Energy.

Connie Senior explained EPA provided follow up to some of their questions before the call so her summary might not be as evolved. They identified strengths in models, including a good track regard of publication, good efforts to disseminate models to a wide variety of users, and proactively obtaining feedback about the models. Program officers and regions value the modeling efforts, and several productive partnerships with other agencies have been testing and improving models. They suggest ensuring modeling tools can answer critical EJ questions and adding capabilities for quantifying the health impacts of building decarbonization, which will be an important issue. They suggest more intentional and strategic thinking around including emerging technologies related to shifting to cleaner transportation in different modeling scenarios. They also suggest a need for more resources for outreach training and support for modeling and databases. They recommend a reward structure for scientists and engineers with metrics recognizing translation activities. Bart Croes noted they should add to the list of strengths mention of the great work in the third triangle biofuels reports.

- **Jennifer Hains**: I think your first and last comments are important and great.
- **Louie River**: Your first suggestion makes sense as a recommendation, considering the focus of the Agency.
- **Michael Kleinman**: Recent findings from California indicate fugitive emissions from various processes contribute to a large fraction of greenhouse gases. Incorporating techniques to better quantify such data in models would improve mitigation.
- **Connie Senior**: Can you add that to the charge question so we can capture what you are thinking?
    - **Bart Croes**: We asked that question at our meeting with EPA and the response was program staff create these reports. I am not sure what might be ORD's role.
    - **Sherri Hunt:** A different team captures the emissions measurements, so there is some work in emissions. The ORD researchers help develop methods.
- **Connie Senior**: Are fugitive emissions safe from area sources or industrial sources in the models? I want to make sure that it is covered.
    - **Sherri Hunt**: I believe the model covers that.
- **Connie Senior**: I want to ask whether the Charge Question 2 group believes anything has fallen between the cracks between the two responses?
    - **Sandy Smith**: I am glad you asked that question, Connie. We have applauded EPA for integrating across their research areas, and it would be good if we could do the same in the report.

- **Sherri Hunt:** The energy modeling team stated they capture fugitive releases of methane and VOCs from oil and gas operations and pipelines, but the model focus is generally on combustion processes. This is an area into which models could expand.
- **Jennifer Hains:** I approve of acknowledging translational science.
    - **Connie Senior:** I do not want EPA to think we are suggesting they are not already doing this. We are impressed with their work, and we want to encourage them to continue such work.
    - **Charlette Geffen:** Resources and support will probably be an overriding comment.
- **Art Werner:** It seems we were talking about important fugitive admissions.
    - **Bart Croes:** There is good research on that in California. We examined 272,000 potential methane leaks sources in the state. You know more about 60% of our sources and identified about 100 super meters. There has been similar national work. The Environmental Defense Fund organized a project described in a *Science* article.
- **Charlette Geffen**: Do you all agree with Jennifer's preliminary recommendations for the charge question?
    - **Louie Rivers***:* Yes.

Next Steps

- **Bart Croes:** It would be helpful to include a general recommendation on EJ as a priority. I believe it intersects with the three areas.
    - **Charlette Geffen:** Thanks, Bart.
- **Myron:** It would be helpful to emphasize in the document the importance of climate change. The future of climate change is now. We must begin thinking about future impacts of climate change.
    - **Jeff Arnold:** We could refer to a big assessment report outside of EPA and then command their work in ACE investigate how these products fit in the long chain of research products.
- **Louie Rivers:** That cuts across all charge questions. I was impressed scientists across the 3 charge questions talked about the serious idea of user design, which is the first step in translation of modeling tools
- **Sandy Smith**: EJ and translational science. One thing evident to me across the three days of presentations is how ACE has embedded the viewpoint of EJ issues in their research planning and implementation. They have made huge progress on EJ issues and translational science. Including specific suggestions to help EPA enhance their translational science work and improve user-friendly issues would be helpful.
- **Jeff Arnold**: People in the geosciences do not typically use the term "translational science." Maybe we should describe it differently?
    - **Bryan Hubbell**: We have had conversations about language within ORD. We are trying to move research from the laboratory to a practical setting decision makers can use. It has similarities to translational medicine. If you are going to use the

term translational science, it is good to confirm the definition. It is important to use it in the correct context.
    - **Charlette Geffen**: We have also used the term decision-relevant science.
- **Sandy Smith**: Another overarching theme I would offer for consideration is more formalized use of partner engagement.
- **Connie Senior**: I would appreciate it if we could achieve consensus on terminology definitions and descriptions across charge questions. It is important to include language EPA uses. Input from EPA or others would be helpful.
- **Michael Kleinman**: We have heard about development of cell phone applications for odor, environmental PM exposures, and other uses. These provide people with information about exposures and triggering reactions. Dissemination of those tools would be useful. This could be an example of ways to apply the technologies of other applications as well.
- **Jeff Arnold**: I think we should use the language the Agency uses to demonstrate we are reviewing presentations and are directly engaged. We can talk about translations, but translational science has different meanings.
    - **Bryan Hubbell**: I am going to cut and paste language from the Strategic Plan.
    - **Charlette Geffen**: We have also talked about being careful because we do not want an additional requirement on bench scientists.
    - **Bryan Hubbell**: I encourage avoiding the dichotomy between bench science and translational science. One can be part of a translational or solution-driven process even if you are not directly involved in stakeholder engagement. We want to align and develop a research program that supports it.
    - **Jeff Arnold:** Solution-driven is key because it focuses on the end and not the process.
    - **Charlette Geffen**: The mission is solution-driven.
    - **Connie Senior**: We want to ensure there is a balance in sufficient resources so important activities can move forward and integrated teams with diverse skillsets can be rewarded.
- **Charlette Geffen**: As we finalize the draft report, the group can comment on overarching themes.

Adjourn

The meeting adjourned at 5:00 p.m., Eastern Time.

Friday, November 12, 2021

The meeting generally followed the issues and timing as presented in the agenda provided in Appendix A of this meeting summary.

Convene Meeting

The meeting convened at approximately 2:00 p.m., Eastern Time.

Welcome, Opening Remarks and Member Introductions

Dr. Charlette Geffen welcomed the attendees and provided an overview of the meeting agenda. The group discussed meeting logistics for working on the draft recommendations.

- **Myron Mitchell:** I would suggest the document could benefit from an indication we are not looking at the future, but the present situation because we are involved with the effects of climate change now. Therefore, we should encourage the importance of prioritizing this as much as possible.
    - **Sandy Smith:** Are you suggesting more emphasis on the current urgency surrounding climate change?
    - **Louie Rivers:** I agree. Maybe we should include it in the front matter.
    - **Jeff Arnold:** I agree. It can appear at the top, and we could rewrite it to say our responses relate to past, current, and projected future climate change.
    - **Viney Aneja:** I concur.
    - **Charlette Geffen:** Sandy and I will work on integrating a stronger comment in the front matter and maybe reference the Intergovernmental Panel on Climate Change (IPCC) and other reports, to highlight the urgency, both in projections and current impacts. Groups should enhance text where needed if they think this is relevant to their charge question.
- **Jeff Arnold:** Would it be useful for us to include mention of the endangerment finding at the beginning?
    - **Bryan Hubbell:** I think it would be good to refer to previous actions. It compliments what we said earlier about what is happening right now.
    - **Charlette Geffen:** Jeff, because you are the most familiar with that, it would be great if you could draft a few sentences.
- **Art Werner:** We might want to emphasize these areas are linked. In a sense, if you prioritize climate change you will also make a lot of progress on the other air pollution issues.
    - **Charlette Geffen:** Can you provide some specifics, Art?
- **Jeff Arnold:** There has been a change from what we used to call co-benefits. Is there a better term?
    - **Bryan Hubbell:** I agree with you. You can still use the word co-benefits. Emphasizing all benefits matter is important. It is very helpful to call for understanding these are interrelated and inter-linked challenges.
- **Louie Rivers:** By focusing on climate change, it pairs well with the Agency's focus on vulnerable communities and EJ.
    - **Charlette Geffen:** The overview material does not sufficiently cover that?
    - **Louie Rivers:** The message could be tighter. I would like to hear others' opinions.
    - **Jennifer Hains:** It is not simply a co-benefit, it is also a benefit. I like the idea of highlighting the EJ impacts and benefits as much as possible.

  - **Charlette Geffen:** Louie and Jennifer, unless I receive push back from the committee, are there specific examples we can include? Perhaps you can provide comments on SharePoint if you do not have an answer now.
  - **Louie Rivers:** I will try to post specific instances from the deliberations we had in the first meeting.
- **Sandy Smith:** I wanted to clarify with Louie the point about EJ. The overarching text that we put into the front piece focuses on how well ACE is doing on integrating EJ into their overall approach and research implementation. Do you want to strengthen that text, or is this a separate point?
  - **Louie Rivers:** It is a slightly different point. By focusing on climate change, we are also focusing on EJ because they are linked. If we conduct research on climate change, it likely will take place in vulnerable communities.
  - **Charlette Geffen:** I disagree, to an extent. When I think of climate change, I also think about people in the mountains or wildfires, and they do not always pertain to a group I would historically perceive as vulnerable.
  - **Louie River:** I agree with that, but when you have a large population impacted by climate change, certain groups would not be able to mitigate as well as others.
  - **Charlette Geffen:** I understand your point now. Thank you, Louie.
- **Michael Kleinman:** One issue we could emphasize is the link between reducing the emissions of other pollutants, such as particulate matter and hazardous air pollutants. These have a major effect on communities with EJ concerns, and they mitigate climate change. There is a co-benefit. Determining to what extent increased mitigation in such communities provides benefits for reducing climate effects is helpful.
  - **Bart Croes:** There is a persistent disparity in PM 2.5 exposures, and the health implications are serious. I want to ensure we focus on the disparities of PM 2.5. I could add in a few sentences about this
  - **Sandy Smith:** Is that point in the charge question text? I think it is a great point to make if it is responsive to the charge question.
  - **Bart Croes:** It is not explicit in Charge Question 1, but as we investigate the charge question and emerging chemicals of concern, we do not divert too much from PM 2.5.
  - **Charlette Geffen:** I think it would be helpful, Bart, if your group could add more emphasis on the specifics of the charge question.

Discussion and Feedback – Draft Recommendations

- **Cara Keslar:** For the first recommendation, we wanted to make sure there were specific procedures for EtO monitoring and analysis for consistency. For Recommendation 2, we spoke on expanding work on VCPs and understanding anthropogenic impacts. The last recommendation is moving away from using a mass base PM measurement and using NADP, PM 2.5 Chemical Speciation Network (CSN), and National Toxics Trends Network (NATTS) instead.

  - **Viney Aneja:** Does the committee not wish to indicate the composition of PM 2.5 is an important entity to health but rather state it contains sulfur and transitional metals?
  - **Cara Keslar:** I understood it as moving away from sulfur and traditional metals.
  - **Viney Aneja:** I am confused because the subcommittee has highlighted sulfur and transitional metals. Why not indicate composition itself, which would include everything?
  - **Art Werner:** I think that is the point. We know very little about the composition of these chemicals.
  - **Michael Kleinman:** We could change the wording to include the particle composition.
  - **Viney Aneja:** Correct.
  - **Bryan Hubbell:** This set of charge questions was not set to focus on PM 2.5. I understand we would want to move in this direction, but there is a huge literature on other toxins. I am concerned this is outside the focus of this charge question.
  - **Annette Rohr:** I do not know if it is accurate to say that there is not a lot known.
  - **Charlette Geffen:** Is this something about which we feel strongly enough to make a recommendation?
  - **Michael Kleinman:** We are recommending an enhanced focus on the air toxic components of PM 2.5 and other chemicals that contribute to health effects.
  - **Charlette Geffen:** Maybe the focus is not specifically PM but rather as we explore other toxins, we ensure the constitutes of PM are included in the mix?
  - **Connie Senior**: It is important to review what we said in the previous report to ensure we are consistent from one report to another.
  - **Charlette Geffen:** Maybe we can continue to maintain the focus on the emerging toxins but include PM. For Recommendation 3, the action would be to review the prior report for consistency and to avoid repetition.
- **Charlette Geffen**: Does level 1 rise to a level of recommendation, and if so, is there a clear recommendation for EPA?
  - **Bart Croes:** Compared to number 2, number 1 seems somewhat mundane, and I would prefer to see it as a suggestion rather than a recommendation.
  - **Cara Keslar:** I believe it rose to the level of a recommendation because state groups struggle to reach a level of consistency and have asked for this. The larger group should decide whether it is a recommendation or suggestion.
  - **Connie Senior:** Considering Cara's point, I think it is significant enough for a recommendation.
  - **Bart Croes:** We should switch the order of Recommendations 1 and 2.
- **Charlette Geffen:** Do you all believe the additions in Recommendation 1.1 belong in the paragraph, and if so, are they worded appropriately?
  - **Connie Senior:** I think we could move the second part of 1.1 to suggestions because it is not actionable.
- **Charlette Geffen**: Does the group think we should move the second recommendation to suggestions?

  - **Cara Keslar**: I think we could move some of the sentences.
  - **Charlette Geffen**: The last three sentences could constitute the bulk of the actual recommendation.
- **Jeff Arnold**: For Charge Question 2, we were impressed with how serious the ACE team is about their work. All our recommendations focused on better communication and support for the amazing projects we have seen. The first recommendation is to establish guidelines for models, model products, and information that drives science discovery and adaptation and mitigation strategies.
  - **Charlette Geffen**: I am trying better to understand the core actionable element for EPA.
  - **Art Werner**: We use the word "model" several times in the recommendation, but I am not sure what we are modeling.
  - **Jeff Arnold**: The idea is not to model in the expansive statistical sense. We would like to see a discussion of how best to put together general processed-based models characterizing the threats and effects of climate change relevant to ACE's work for EPA.
  - **Art Werner**: I would like to see this in writing.
  - **Jeff Arnold**: This is a draft, and we will work on it.
  - **Charlette Geffen**: It would be useful to pick one or two examples.
- **Myron Mitchell**: I think it would help to start with actional items instead of the description of the situation and include actual examples of how this is occurring currently in EPA.
  - **Jeff Arnold**: Can I ask people from the Charge Question 2 group to supply ideas?
- **Charlette Geffen**: When you think about the guidelines, to which category of models are you referring? Those in development?
  - **Jeff Arnold**: We are aware EPA uses many models that are not EPA products themselves. We would not ask EPA to describe how to use models but rather how to apply them.
  - **Charlette Geffen**: As someone who has previously received this type of feedback, I will state guidelines can range in effectiveness. It would be helpful for the receiver to have more clarity.
- **Viney Aneja**: What size should a recommendation be? Also, our other point was talking about earth system modeling. We were trying to highlight there should be some connection between what EPA is doing and what others are doing, and there should be clarity on the processes taking place.
  - **Charlette Geffen:** It could be useful to clarify we are talking about the earth system models. I retain my concern about guideline effectiveness.
  - **Jeff Arnold:** We would not ask you to write guidelines on the development of applications of earth system models, but the use of outputs and modeling chains EPA uses. We will clarify.
- **Sandy Smith**: Myron's statement about starting with the actionable items is appropriate. We could move the rest of the language to the text discussion. This relates to Viney's question about what a recommendation should look like.

  - **Bryan Hubbell**: I appreciate that nowhere does the word guidance appear. I think you are telling us to assist those outside of EPA in linking models together. I agree, but using the word guidelines is a quasi-regulatory thing we should avoid.
  - **Jeff Arnold**: We are trying to avoid that, but we are also avoiding a catalog of the models. What we want is technology and knowledge transfer from ACE applications to others.
  - **Bryan Hubbell**: I think that is a great recommendation, Jeff, but we should change the wording. I think the phrase "providing clear assistance to inform and or change use" would be more comfortable.
- **Charlette Geffen**: For Recommendation 2.2 it seems you are asking to add the agricultural sector to the mix of emissions and greenhouse gases.
  - **Jeff Arnold**: We are asking for enhancing the inclusions and characterization. We think enhanced collaboration between USDA and EPA could better characterize a large fraction of emissions.
- **Charlette Geffen**: Is this a suggestion? If it is a recommendation, what are we asking the ACE group to do?
  - **Viney Aneja**: In my judgement, becasue the two greenhouse gases NOx and methane are implied, both play a major role. We are encouraging continual collaboration and dialogue between EPA and USDA in the hope of trying to achieve mitigation.
  - **Louie Rivers**: When we first had a session, someone from EPA suggested making this a recommendation. Often the agriculture section was missing from emission models.
  - **Charlette Geffen**: Can we change the wording so it is actively engaged with the focus of the recommendation?
  - **Louie Rivers**: I like the suggestion you made about the last sentence.
- **Michael Kleinman**: Can we broaden the recommendation to include other sources of biogenic emissions?
  - **Charlette Geffen**: How would you feel about including the biogenics?
  - **Louie Rivers**: I like that idea, but we need more discussion. I do not believe the USDA is doing such work.
  - **Charlette Geffen**: Michael, how would you feel about including the biogenics topic in the body of the text?
  - **Michael Kleinman**: I think that would be a good change. We could also include transfer of waste processing in that section.
  - **Viney Aneja**: I do like the notion of including biogenics in the text, but for Recommendation 2.2 most of the components are about the agriculture sector, so we should include the biogenics part in the body.
- **Connie Senior**: In our previous meeting we wanted to have recommendations around EJ issues and resources. Recommendation 3.1 states we would like to know whether EPA is providing sufficient spatial resolutions and scales to ensure such issues are being captured. I do not feel the recommendations were written clearly. We might need to rewrite them. I would like support in identifying action items.

  - **Charlette Geffen**: For Recommendation 3.1, we saw evidence of some models at the city scale that might not have included all chemical species. Do you think that would be a good model for others going forward? What are you thinking?
  - **Connie Senior**: The sense was to ensure models will be able to address critical EJ issues.
  - **Charlette Geffen**: I am assuming earlier dialogue laid the groundwork.
  - **Art Werner**: The recommendation suggests EPA is not doing anything related to this, so we should recognize that work. Recommending ORD "take specific action" might be problematic.
  - **Jeff Arnold**: We should encourage the Agency to continue model development and evaluation work that brings down the scale in providing answers. Instead of providing a specific scale, a scale should be helpful for actions.
  - **Louie Rivers**: I remember New Jersey Region 1 presentation about municipalities. We should applaud their work but ask how the models help vulnerable communities.
  - **Bart Croes**: It would be good for EPA to evaluate EJ in energy modeling.
- **Charlette Geffen**: Recommendation 3.1 seems to discuss scale and the chemical species included in models. Is that correct?
  - **Jeff Arnold**: Yes, and they are interlinked. It is not just models but also observations. We could invert the recommendation and start with the idea of studying community impacts not represented and then speak about the need for continuing to enhance development models at scales helpful for addressing those problems.
  - **Charlette Geffen:** Can the local scale models include a link back to their measurement activities and recommendations about chemical species?
- **Charlette Geffen**: I do not know what "critically assessing all aspects of the changing energy system through the lens of equity" means.
- **Michael Kleinman**: The charge questions asked about the transportation system. Are there any recommendations we can include related to transportation?
  - **Connie Senior**: We did not specifically mention transportation, but it is implicit in the discussion.
  - **Michael Kleinman**: There is a suggestion about transportation. Perhaps we should change it to a recommendation?
- **Art Werner**: Is there a reason we are not talking about data collection?
  - **Connie Senior**: We could encourage EPA to ensure they are thinking about measurements and modeling focused on EJ communities.
  - **Art Werner**: At some point one must validate models, which is what you are saying.
- **Charlette Geffen:** Michael mentioned an important point about the structure of the charge question. The charge question is not about EJ, but rather the evolution of the complexity of energy and transportation systems. I think it is important to think about how our recommendations address EJ challenges, but I want to make sure our recommendations relate to the charge question.
  - **Annette Rohr**: I think the points about transportation and measurements are important and we could rework Recommendation 3.1 to include this.

  - **Jennifer Hains**: I think it is important we include EJ in the recommendation. The charge question might not ask about EJ, but it EJ issues are part of the answer.
    - **Charlette Geffen**: Are you suggesting the two are closely connected? Modeling will help with understanding the complexities of different transportation and energy technologies and their effects. When ACE is evaluating the energy system, are we also encouraging them to look through the lens of equity to study the differentiating impacts of effects on different communities?
    - **Connie Senior**: I am having trouble defining what is actionable.
    - **Charlette Geffen:** Perhaps we can talk about continuing to encourage the refinement of model resolution and robustness by ensuring incorporation of output measures. As they conduct evaluations, they think about EJ and other implications. If we want to continue through the lens of equity, it is not clear to me everyone would have the same interpretation of the terms.
- **Connie Senior**: Recommendation 3.2 states ORD should consider the application of additional resources in two specific areas, including more intentional coordination with the user community on outreach, training, and support for tools and databases, and science translation to optimize dissemination of information.
  - **Charlette Geffen**: Sometimes ORD resources are limited, so we could frame it as a priority.
  - **Sandy Smith**: We have used the wording of priority in the past. It can be problematic to ask for more resources.
  - **Jeff Arnold:** In the past, we have tried to frame it as encouraging continued support. Is that safer?
  - **Charlette Geffen:** Yes, we could frame it as continued support or providing additional assistance in these areas.
  - **Connie Senior:** I want to ensure we communicate clearly this is important work worthy of support.
  - **Sandy Smith:** EPA is planning their next Strategic Plan, so it is important to make known our opinion about what they should prioritize.
- **Charlette Geffen:** I know at one point we questioned using the term "science translation," but the term seems to convey the right message.
  - **Myron Mitchell:** I would suggest reviewing Recommendation 3.2 to be sure we clearly state our expectations about the user communities to which EPA should translate science.
  - **Michael Kleinman:** I am wondering if we should add something about integrating jurisdictions. Trying to develop better ways to guide a program in response to needs.
  - **Charlette Geffen:** That is a good point. Some dissemination happens through the partners, but not necessarily through ACE. There is an intermediate space, where it is important for those users to have a good understanding of the tools.

    - **Art Werner:** There are different impacts on people in rural and urban communities. We cannot focus solely on one narrow area. We must acknowledge people in different areas have different needs.
- **Connie Senior**: We need to recraft Recommendation 3.1. We need to review the many great suggestions we have received and edit. For Recommendation 3.2, I assume Charlette and Sandy will discuss with Bryan Hubbell and try to find an appropriate recommendation. I agree it needs to be a recommendation useful to ORD.
    - **Charlette Geffen:** We do have Sherri Hunt here from EPA.
    - **Sherri Hunt:** It is difficult. I appreciate the comments about wanting to make sure there is a small team and being able to disseminate information. There could be encouragement for working with different regions, where some of the communication occures. I think working through existing structures is a way to leverage on-going activities. This is challenging. I will discuss with Bryan.
    - **Andy Miller:** As you are making these recommendations, putting them in the context of ORD can be helpful. Pointing out good work appropriate support could extended is a valid response and recommendation. It is always a balancing act. Indicating where additional support might have a broader impact is good. You do not have to recommend additional resources.

Next Steps

Charlette Geffen discussed next steps and SharePoint logistics.

Adjourn

The meeting adjourned at 4:30 p.m., Eastern Time.

Appendix A: Agenda

United States Environmental Protection Agency
Board of Scientific Counselors (BOSC)
Air, Climate, and Energy Subcommittee
Meeting Agenda
October 12 - 14, October 27, and November 12, 2021
Virtual

Day 1: Tuesday, October 12, 2021, Eastern Daylight Time

Time (EDT)	Agenda Activity	Presenter
10:30 – 11:00	Sign on & Technology Check	
11:00 – 11:15	Welcome and Opening Remarks	Tom Tracy, Designated Federal Officer (DFO) Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
11:15 -11:30	ORD Welcome	Wayne Cascio, ORD Acting Principal Deputy Assistant Administrator for Science
11:30 – 11:45	Overview of ACE BOSC SC Meeting Format and Charge Questions	Bryan Hubbell ACE National Program Director (NPD)
11:45 – 11:55	Update on BOSC EC PFAS Research Discussion	Susan Burden, Office of Science Advisor, Policy, and Engagement (OSAPE)
Charge Question 1		
11:55 – 12:10	**CQ1:** Science Needs Related to Air Toxic Sources and Emerging Contaminants (Research Areas 2 and 4)	Bryan Hubbell, ACE NPD
12:10 – 12:25	Approaches for Addressing Scientific Challenges and Key Uncertainties in Characterizing Air Toxics and Contaminants of Emerging Concern	Alice Gilliland, Acting Center Director, Center for Environmental Measurement and Modeling (CEMM)
12:25 – 1:55	Research to Understand Source Emissions and Ambient Concentrations of Air Toxics and Contaminants of Emerging Concern	Tiffany Yelverton, CEMM Richard Shores, CEMM Alan Vette, CEMM Chet Wayland, Office of Air and Radiation (OAR)
1:55 – 2:10	**BREAK**	
2:10 – 4:10	**Meet the Scientists, Session #1**	

Time (EDT)	Agenda Activity	Presenter
	Room A	
	Air Toxics – Source Measurement and Methods, Session Lead	Wyat Appel, CEMM
	PFAS Methods Development	Jeff Ryan, CEMM
	Fenceline Measurements and Methods Development	Eben Thoma, CEMM
	PFAS Incineration	Jonathan Krug, CEMM
	Room B	
	Air Toxics – Ambient Measurement and Methods, Session Lead	Mike Hays, CEMM
	VOCs/Odor Explore App	Rachelle Duvall, CEMM
	EtO Ambient Measurement and Methods Development	Ingrid George, CEMM
	Air Toxics Ambient Measurement and Methods Development	Tamira Cousett, CEMM
	Room C	
	Air Toxics Modeling and Databases, Session Lead	Donna Schwede, CEMM
	Incorporating PFAS into the CMAQ Model	Emma D'Ambro, CEMM
	Updates to the SPECIATE database	George Pouliot, CEMM
	Adding VCP Chemistry to CMAQ	Havala Pye, CEMM
4:10 – 4:25	**BREAK**	
4:25 – 4:40	Public Comments	Tom Tracy, DFO
4:40 – 5:15	Clarification Questions from BOSC SC	Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
5:15 – 6:15	Working Session for BOSC SC Discussion	

Day 2: Wednesday, October 13, 2021, Eastern Daylight Time

Time (EDT)	Agenda Activity	Presenter
10:30 – 11:00	Sign on & Technology Check	
11:00 – 11:15	Welcome Back	Tom Tracy, DFO Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
Charge Question 2		
11:15 -11:30	**CQ2:** Science Needs to Understand Climate Change Impacts (Research Area 6)	Andy Miller, ACE Associate NPD for Climate

Time (EDT)	Agenda Activity	Presenter
11:30 – 11:45	Approaches to Understand and Prepare for Climate-Driven Impacts	Tim Watkins or TBD, Acting Center Director, Center for Public Health and Environmental Assessment (CPHEA)
11:45 – 1:15	Research to Understand Climate Impacts and to Enable Resilience	Peter Beedlow, CPHEA Britta Bierwagen, CPHEA Chris Weaver, CPHEA Stephanie Santell, Office of Water (OW) Dan Brown, Region 10 Jeremy Martinich, Office of Administration and Policy (OAP)
1:15 – 1:30	**BREAK**	
1:30 – 3:30	**Meet the Scientists, Session #2**	
	Room A	
	Water Quality and Aquatic Resources, Session Lead	Darrell Winner, CPHEA
	Stormwater Best Management Practices	Tom Johnson, CPHEA
	Adaptation Planning Frameworks	Jordan West, CPHEA
	Regional Watershed Resilience	Naomi Detenbeck, CEMM
	Room B	
	Ecosystem Effects, Session Lead	Peter Beedlow, CPHEA
	Coldwater Fish Refugia	Joe Ebersole, CPHEA
	Nutrient Transport	Jana Compton, CPHEA
	Room C	
	Scenarios and Impacts, Session Lead	Tanya Spero, CEMM
	Global Change Explorer	Phil Morefield, CPHEA
	Storm IDF curves	Anna Jalowska, CPHEA
3:30 – 3:45	**BREAK**	
3:45 – 4:15	Public Comments	Tom Tracy, DFO, OSAPE
4:15 – 4:45	Clarification Questions from BOSC SC	Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
4:45 – 5:30	Working Session for BOSC SC Discussion	

Day 3: Thursday, October 14, 2021, Eastern Daylight Time

Time (EDT)	Agenda Activity	Presenter
10:30 – 11:00	Sign on & Technology Check	
11:00 – 11:15	Welcome Back	Tom Tracy, DFO, OSAPE Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
Charge Question 3		
11:15 – 11:25	**CQ3:** Science Needs for Impacts of Changing Energy Systems (Research Area 5)	Sherri Hunt, ACE Principal Associate NPD
11:25 – 12:15	Approaches and Research to Understand Impacts of Changing Energy Systems	Darrell Winner, CPHEA Rebecca Dodder, CEMM Marcus Sarofim, OAP Shutsu Wong (R1)
12:15 – 12:30	**BREAK**	
12:30 – 2:00	**Meet the Scientists Session #3**	
	Room A	
	Energy Systems Modeling and Databases, Session Lead	Tom Pierce, CEMM
	GLIMPSE	Dan Loughlin, CEMM
	EPAUS9r-TIMES	Carol Lenox, CEMM
	CoMET	Ozge Kaplan, CEMM
	Room B	
	Biofuels, Session Lead	Britta Bierwagen, CPHEA
	Biofuels Report to Congress	Chris Clark, CPHEA
	Terrestrial Effects of Land Use Change	Steve LeDuc, CPHEA
2:00 – 2:15	**BREAK**	
2:15 – 3:15	Revitalizing Research to Address the Challenge of Climate Change	Bryan Hubbell, ACE NPD Andy Miller, ACE ANPD for Climate
3:15 – 4:00	Clarification Questions from BOSC SC	Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
4:00 – 5:00	BOSC SC Workgroup Breakouts	
5:00 – 5:45	BOSC SC Workgroup Reports	
5:45 – 6:00	Wrap up and Next Steps	Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
6:00	Adjourn	Tom Tracy, DFO

Appendix B: Participants

BOSC Air, Climate and Energy Subcommittee Members:

Charlette Geffen, *Chair*
Sandra Smith, *Vice Chair*
Viney Aneja
Jeffrey Arnold
Bart Croes
Jennifer Hains
Cara Keslar
Michael Kleinman
Myron Mitchell
Louie Rivers, III
Annette Rohr
Constance Senior
Art Werner

EPA Designated Federal Officer (DFO): *Tom Tracy, Office of Science Advisor, Policy, and Engagement*

EPA Presenters:

Wyat Appel, *Physical Scientist, Center for Environmental Measurement and Modeling*
Peter Beedlow*, Scientist, Center for Public Health and Environmental Assessment*
Britta Bierwagen, *Group Chief, Center for Public Health and Environmental Assessment*
Dan Brown, *Environmental Engineer, Region 10*
Susan Burden, *Scientific Support Advisor, Office of Science Advisor, Policy and Engagement*
Wayne Cascio, *Acting Principal Deputy Assistant Administrator for Science, Office of Research and Development*
Chris Clark, *Research Scientist, Center for Public Health and Environmental Assessment*
Jana Compton, *Ecologist, Center for Public Health and Environmental Assessment*
Tamira Cousett, *Junior Chemist, Center for Environmental Measurement and Modeling*
Emma D'Ambro, *Chemist, Center for Environmental Measurement and Modeling*
Naomi Detenbeck*, Ecologist, Center for Public Health and Environmental Assessment*
Rebecca Dodder, *Physical Scientist, Center for Environmental Measurement and Modeling*
Rachelle Duvall, *Environmental Engineer, Center for Environmental Measurement and Modeling*
Joe Ebersole, *Research Fish Biologist, Center for Public Health and Environmental Assessment*
Ingrid George, *Physical Scientist, Center for Environmental Measurement and Modeling*
Alice Gilliland, *Acting Center Director, Center for Environmental Measurement and Modeling*
Michael Hays, *Physical Scientist, Center for Environmental Measurement and Modeling*
Bryan Hubbell*, National Program Director, Air, Climate, and Energy Research Program*

Anna Jalowska, *Physical Scientist, Center for Public Health and Environmental Assessment*
Thomas Johnson, *Physical Scientist, Center for Public Health and Environmental Assessment*
Ozge Kaplan, *Senior Environmental Engineer, Center for Environmental Measurement and Modeling*
Jonathan Krug, *Mechanical Engineer, Center for Environmental Measurement and Modeling*
Stephne LeDuc, *Biologist, Center for Public Health and Environmental Assessment*
Carol Lenox, *Physical Scientist, Center for Environmental Measurement and Modeling*
Daniel Loughlin, *Physical Scientist, Center for Environmental Measurement and Modeling*
Jeremy Martinich, *Climate Scientist, Office of Atmospheric Programs*
Andy Miller, *Associate National Program Director for Climate, Air, Climate, and Energy Research Program*
Philip Morefield, *Researcher, Center for Public Health and Environmental Assessment*
Tom Pierce, *Associate Director for Science, Center for Environmental Measurement and Modeling*
George Pouliot, *Physical Scientist, Center for Environmental Measurement and Modeling*
Havala Pye, *Physical Scientist, Center for Environmental Measurement and Modeling*
Jeff Ryan, *Senior Scientist, Center for Environmental Measurement and Modeling*
Stephanie Santell, *Environmental Scientist, Office of Water*
Marcus Sarofim, *Environmental Scientist, Office of Atmospheric Programs*
Donna Schwede, *Physical Scientist, Center for Environmental Measurement and Modeling*
Richard Shores, *Environmental Scientist, Center for Environmental Measurement and Modeling*
Tanya Spero, *Research Physical Scientist, Center for Environmental Measurement and Modeling*
Eben Thoma, *Physical Scientist, Center for Environmental Measurement and Modeling*
Alan Vette, *Division Director, Atmospheric and Environmental Systems Modeling Division*
Tim Watkins, *Center Director, Center for Environmental Measurement and Modeling*
Chet Wayland*, Director, Air Quality Assessment Division, Office of Air and Radiation*
Chris Weaver, *Chief, Integrated Science Assessment Branch, Center for Public Health and Environmental Assessment*
Jordan West, *Aquatic Ecologist, Center for Public Health and Environmental Assessment*
Darrell Winner, *Associate Director for Integrated Science, Center for Public Health and Environmental Assessment*
Shutsu Wong, *Environmental Engineer, EPA Region 1*
Tiffany Yelverton*, Principal Investigator and Assistant Center Director, Center for Environmental Measurement and Modeling*

Other EPA Attendees

Tim Benner
Ann Brown
Alexis Bryant
Serena Chung
Gayle Hagler
Matt Harwell
Beth Hassett-Sipple
Sherri Hunt
Taylor Lass
Elisa Lazzarino
Tom Long
Libby Nessley
Karen Oliver
Lara Phelps
Amina Pollard
Gail Robarge
Bruce Rodan
Mary Ross
Elizabeth Sams
Kathryn Saterson
Angie Shatas
Bailey Stearns
Lynn Tran
Emily Trentacoste
Chau Vu

Other Attendees:

Gabriel Bellott-McGrath
Carrie Brown
Seung-Hyun Cho
David Dayton
Prakash Doraiswamy
Tiffany Finck-Haynes
Nicholas Georges
Paul Gilman
Geneva Gray
Francisco Javier
Lucinda Johnson
Ed Monachino
Stuart Parker
Sean Reilly
Glenda Renee
Erik Wright

Contractor Support:

Canden Byrd
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Denyse Marquez Sanchez
Leah West
Sam Whately

Appendix C: Charge Questions

Q1: The ACE research program is implementing research to develop new methods to quantify source and near-source emissions, as well as ambient levels, of toxic air pollutants and contaminants of emerging concern. These methods are needed to identify pollutant sources and levels of exposure for communities and individuals.

What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of its air toxics and contaminants of emerging concern measurements methods research, and how this research will improve our understanding of these pollution sources and exposures, particularly for disproportionately impacted communities? [RA1, RA2, RA4]

Q2: Climate change is expected to continue to increase the negative environmental and human health impacts of wildfires, flooding, drought, and other extreme events. Developing the knowledge and approaches to build resilience and adapt to these events is critical to preparing communities and protecting vulnerable populations and ecosystems.

What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of research to understand effects of climate-driven changes on natural and human systems, adverse impacts on human health and the environment from climate stressors, and approaches to prevent or reduce these impacts? [RA6]

Q3: The Nation's energy and transportation systems are experiencing major transformations in response to economic drivers and to meet the Biden Administration's goal of net-zero carbon emissions by 2050. Understanding the dynamic changes in these complex, interconnected systems is important for understanding impacts of policies and technology changes on emissions of greenhouse gases, air pollutants, and other health and environmental impacts.

What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of its research portfolio to gain a better understanding of how energy and transportation systems may evolve and the consequences for emissions and other impacts. [RA5]