B O S C
Board of Scientific Counselors

REPORT OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY BOARD OF SCIENTIFIC COUNSELORS AIR AND ENERGY (A-E) SUBCOMMITTEE

RESPONSES TO CHARGE QUESTIONS

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CONTENTS

LIST OF ACRONYMS

AAPCA	Association of Air Pollution Control Agencies
ACE	Air, Climate, and Energy
A-E	Air and Energy
AMD	Atmospheric Model Development
BenMAP	Benefits Mapping and Analysis Program
BOSC	Board of Scientific Counselors
CAA	Clean Air Act
CARB	California Air Resources Board
CENRAP	Central Regional Air Planning Association
CENSARA	Central States Air Resource Agencies
CMAQ	Community Multiscale Air Quality Modeling System
CSS	Chemical Safety for Sustainability
DOE	Department of Energy
ECOS	Environmental Council of the States
ERIS	Environmental Research Institute of the States
EPA	U.S. Environmental Protection Agency
HAP	hazardous air pollutant
HHRA	Human Health Risk Assessment
HSRP	Homeland Security Research Program
ITRC	Interstate Technology and Regulatory Council
LADCO	Lake Michigan Air Directors Consortium
MARAMA	Mid-Atlantic Regional Air Management Association, Inc.
MJO	multi-jurisdictional organization
MBI	market-based research
NACAA	National Association of Clean Air Agencies
NAAQS	National Ambient Air Quality Standards
NASA	National Air and Space Administration
NC	North Carolina
NERL	National Exposure Research Laboratory
NESCAUM	Northeast States for Coordinated Air Use Management
NGO	non-governmental organization
NTAA	National Tribal Air Association
ORD	Office of Research and Development
PFAS	per- and polyfluoroalkyl substances
PM	particulate matter
RTP	Research Triangle Park
SBIR	Small Business Innovation Research
SHC	Sustainable and Healthy Communities
SIP	State Implementation Plan
SSWR	Safe and Sustainable Water Resources
STAR	Science to Achieve Results
StRAP	Strategic Research Action Plan
WESTAR	Western States Air Resources Council

INTRODUCTION

The mission of the U.S. Environmental Protection Agency (EPA) Office of Research and Development (ORD) is to provide the best available science and technology to inform and support public health and environmental decision-making at the Federal, state, tribal, and local levels, addressing critical environmental challenges and anticipating future needs through leading-edge research. The ORD's Air and Energy (A-E) research program focuses on the science and engineering needed to improve air quality, reduce the number of nonattainment areas in the United States, and protect public health and the environment. It is one of the Agency's six, highly integrated national research programs. The other five are Chemical Safety for Sustainability (CSS), Homeland Security Research Program (HSRP), Human Health Risk Assessment (HHRA), Safe and Sustainable Water Resources (SSWR), and Sustainable and Healthy Communities (SHC).

ORD has developed Strategic Research Action Plans (StRAPs) to guide each research program. The draft A-E Strategic Research Action Plan, 2019–2022 (A-E StRAP)[1] articulates a four-year strategy for delivering air- and energy-related research to address EPA's strategic objectives and mandates, as identified in the FY 2018–2022 EPA Strategic Plan (EPA Strategic Plan)[2]. It is the third such strategic planning exercise in this format (previous StRAPs covered 2012–2016 and 2016–2019). The current StRAP evolved through close collaboration with EPA Program and Regional partners, input from the EPA laboratories and centers working with A-E, and consultation with the states to identify their needs, particularly through the Environmental Council of the States (ECOS), along with engagement with the tribes.

Currently, ORD is seeking input from the Board of Scientific Counselors (BOSC) on the draft 2019–2022 StRAP documents and proposed research strategies. The emphasis is on advancing ORD research that can successfully address the needs identified by EPA programs and regions, and states and tribes. This review by the BOSC A-E Subcommittee is focused on strategic directions and proposed research priorities described in the draft A-E StRAP. Future BOSC reviews will address research activities and outcomes over the course of the StRAP implementation.

BACKGROUND

In November 2018, A-E provided the BOSC A-E Subcommittee with review materials relating to the draft A-E StRAP and five charge questions to consider when reviewing the materials. Subsequently, the A-E Subcommittee:

1. Reviewed the draft StRAP (October 24, 2018 version) and related materials (see Appendix B for list of materials);
2. Met with the A-E Acting National Program Director and program staff on November 13–14, 2018 in Research Triangle Park (RTP), North Carolina (NC). In addition to A-E presentations, the Subcommittee had opportunities to discuss elements of the plan with program staff (see Appendix A for meeting agenda);
3. Deliberated as a group on the charge questions; and

[1] Air and Energy National Research Program, *Strategic Research Action Plan, 2019 – 2022*, External Review Draft, October 24, 2018 version. Updated: March 11, 2019 version.

[2] Working Together, FY 2018-2022 U.S. EPA Strategic Plan, available at https://www.epa.gov/planandbudget/strategicplan

4. Divided into five workgroups to draft initial responses to each charge question.

The five Subcommittee workgroups drafted specific responses to each charge question after the November 2018 meeting. The Chair and Vice Chair of the Subcommittee prepared an initial draft of the Subcommittee report based on charge question responses provided by the five small groups, circulated the initial draft report to all Subcommittee members, asked for review comments, and planned a teleconference on March 22, 2019 to discuss the draft report.

Prior to the teleconference, EPA released a revised draft StRAP (Draft, March 11, 2019 version) that reflected some of the feedback and discussion at the November 2018 meeting. As a result, several recommendations or suggestions made in an earlier draft of the Subcommittee report were no longer necessary and were removed from the report. These included recommendations to more comprehensively identify state and tribal research needs in the StRAP and to provide a more detailed description of the aims and expected products of critical extramural programs. For the same reason, a suggestion to better articulate anticipated research outcomes was also deleted. Some recommendations were moved from the list of recommendations to text discussion or included as suggestions.

The report was further revised based on Subcommittee member comments and discussions during the teleconference on March 22, 2019. The recommendations of the A-E Subcommittee in the draft report are based on material provided to us prior to and after the November 2018 meeting, presentations made during the day and a half meeting, and deliberations during the meeting and after the teleconference.

[Anticipated in future]

The draft report was submitted to the full BOSC Executive Committee, which met in June 2019 in RTP, NC to review and discuss draft reports from each of the ORD BOSC subcommittees. The Chair, Vice Chair, and Dr. Aneja of the A-E Subcommittee are members of the Executive Committee; Dr. Geffen and Dr. Aneja participated in the meeting. The A-E Acting National Program Director, Dr. Alan Vette, was present. They and the members of the BOSC Executive Committee discussed the A-E Subcommittee draft report during the meeting, asked clarifying questions, provided perspective, and offered comments to the A-E Subcommittee Chair and Vice Chair.

Subsequently, the A-E Subcommittee Chair and Vice Chair revised the charge question report in response to questions and comments raised during the BOSC Executive Committee meeting, as well as the additional information provided during the meeting, and submitted this revised report back to the Executive Committee for their final review.

STRAP RESEARCH OBJECTIVES

The draft A-E StRAP outlines research to address EPA's strategic objectives and mandates to improve air quality, reduce the number of areas currently in nonattainment of the National Ambient Air Quality Standards (NAAQS), and protect public health and the environment. As described in the draft StRAP, the A-E research objectives are for FY 2019–2022 are:

> **Assess Impacts** — Improve understanding of the processes regulating human and ecosystem exposures and of the effects associated with air pollutants at individual, community, regional, national, and global scales.

Expand Approaches to Prevent and Reduce Emissions — Develop and evaluate new approaches to prevent and reduce air pollution now and in the future, particularly sustainable, cost-effective, and innovative multi-pollutant and sector-based approaches.

Advance Measurement and Modeling — Improve the human exposure and environmental modeling, monitoring, metrics, and information that are needed to address emerging and future risks and inform air quality decision making at the national, state, tribal, and local levels.

Inform Decisions — Deliver state-of-the-art science and tools to inform implementation of the NAAQS and other air quality regulations and policies at the national, state, tribal, and local levels.

To achieve these objectives and more clearly align with the EPA Strategic Plan, the A-E research program is updating its structure to organize research activities under three interrelated topics: (1) Science for Air Quality Decisions; (2) Extreme Events and Emerging Risks; and (3) Next Generation Methods to Improve Public Health and the Environment. Although many scientific issues cut across all three research topics, one in particular – wildland fires – highlights the importance of an integrated science focus and has been identified separately, as it will draw from activities in all three topic areas. The integration of research on wildland fires across the three main topics provides a guide to integrated research for other scientific issues that cut across more than one topic. The following figure is a conceptual diagram from the draft StRAP that illustrates the updated organizational structure of the A-E program.

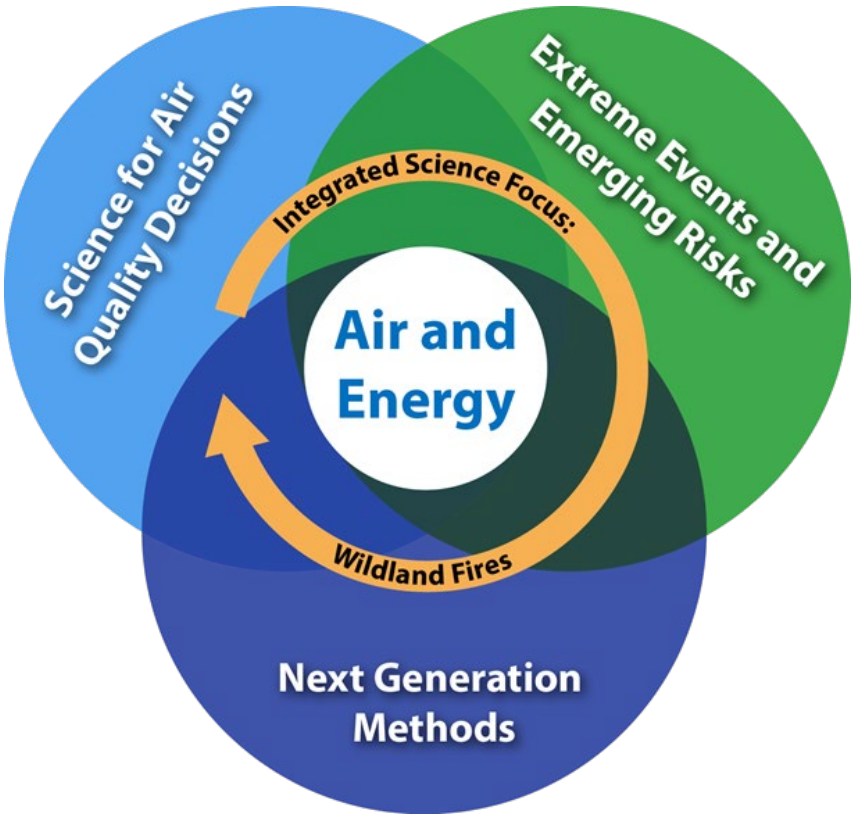

Figure 1. A-E Research Topics

The draft A-E StRAP further subdivides each of the three high-level research topics into eight research areas, plus the integrated research area focused on wildland fires. The following table from the draft StRAP is an overview of the A-E program structure, with three research topics and nine research areas.

Table 1. Overview of the A-E Research Program Structure

Topic	Research Areas	
Science for Air Quality Decisions	#1: Approaches to support air quality management programs for multiple pollutants at multiple scales	#9: Wildland Fires (Integrated Science Focus)
	#2: Approaches for characterizing source emissions, air quality, exposure, and mitigation strategies	
	#3 Public health and environmental responses to air pollution	
Extreme Events and Emerging Risks	#4: Public health and ecosystem exposures and responses to emerging air pollutants and sources	
	#5: Methods to evaluate environmental benefits and consequences of changing energy systems	
	#6: Methods to enable resilience to future environmental stressors	
Next Generation Methods to Improve Public Health and the Environment	#7: Emerging approaches to improve air quality and exposure characterization	
	#8: Novel approaches to assess human health and ecosystem impacts and risks	

Appendix 1 of the draft StRAP lists 29 proposed, high-level research outputs, including proposed delivery timeframes, organized by topic and research area. Outputs are defined as deliverables with the research results synthesized and/or translated into the format needed by the end user(s). The A-E program plans to maintain engagement with partners throughout the research process to optimize the utility of the research products to meet their needs.

CHARGE QUESTIONS AND CONTEXT

The A-E Subcommittee was charged with five questions as follows:

> Q.1a: Does the research outlined for the 2019–2022 timeframe support the relevant Agency priorities as described in the EPA and ORD Strategic Plans?
>
> Q.1b: Each ORD research program undertook a rigorous engagement process to provide additional detail on specific EPA program and region, state, and tribal needs, the results of which are summarized in the StRAP objectives and explanations of research topics and areas. How well does the proposed research program respond to these partner-identified needs?
>
> Q.1c: Does the StRAP, including the topics, research areas, and proposed outputs, clearly describe the strategic vision of the program? Given the environmental problems and research objectives

articulated, please comment on the extent to which the StRAP provides a coherent structure toward making progress on these objectives in the 2019–2022 time frame.

Q.1d: Recognizing ORD's focus on addressing identified partner research needs, in the presence of reduced scientific staff and resources, are there any *other critical emerging* environmental needs or fields of expertise and/or new research methods where this program should consider investing resources?

Q.1e: What are some specific ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems?

These same five charge questions were posed to each of the BOSC subcommittees to guide their review of the ORD draft StRAPs. The responses of the A-E subcommittee to the charge questions are contained in the following section.

SUBCOMMITTEE RESPONSES TO CHARGE QUESTIONS

The Subcommittee appreciates the efforts of the A-E program leadership and staff to develop and deliver a StRAP that builds on the history of important scientific contributions in the program and positions the A-E research enterprise for effective scientific advances in the context of evolving Agency priorities. The research topics identified are based on important science challenges and are well suited to the program's strengths. The plan also allows for opportunities to address complex and/or emerging scientific issues with a systems approach, as demonstrated by the cross-cutting design of the wildland fires research area. Continued attention to development of the workforce of the future is suggested to position the program for future success. The A-E program has made changes to the engagement process for identifying partner and stakeholder needs and is encouraged to update the StRAP to more clearly represent the attention to outreach and dialogue that is continuing to be an important part of the program. The A-E program vision, while well-articulated in this StRAP, should be carefully implemented with review to ensure that research work for immediate and short-term responses do not become the sole focus or goal of A-E research activities. To continue its record of success, A-E work must be a balance of the interests of EPA partners inside and outside the laboratories with those of the wider A-E science research communities. Striking the proper balance of work for immediate Agency responses and a commitment to longer-term research on topics relevant to A-E missions and goals will help ensure that A-E and ORD as a whole can continue leading advancements in environmental science. Clearer articulation of the applied science questions that could drive new A-E research, and how those research areas are aligned with A-E scientific strategy and research priorities, would help ensure a balanced approach in A-E's research plan and agenda.

The StRAP should provide a more detailed description of the aims and expected products of the extramural research programs which are an integral part of the A-E research agenda. This description will help ensure a more comprehensive view of the research program. The Subcommittee also encourages A-E to include potential issues related to energy – currently the "E" in A-E is underrepresented. These issues certainly represent critical emerging needs in environmental science. Examples are provided in the report on where proactive research could inform important scientific questions. The A-E StRAP should also explicitly include environmental justice and citizen science topics that are important to regional, state, local and tribal agencies, and the public at large, and potentially include energy and environmental justice as cross-cutting research issues in Appendix 3 of the StRAP. Given the challenging funding environment,

the use of a variety of approaches to advance solutions is recommended. The Subcommittee suggests focused utilization of the EPA/Small Business Innovation Research (SBIR) program (perhaps around specific challenges to develop Next-Gen answers to emerging environmental problems) as one approach, as well as a focused call using the Science to Achieve Results (STAR) program, which could be utilized for attacking an emerging environmental challenge. Finally, broader use of interagency partnerships and collaborations is recommended to maximize efficiencies and make the best use of intellectual and physical capital.

Specific responses to each of the five charge questions follow below. The responses highlight strengths of the plan as identified by the Subcommittee, as well as suggestions for additions or clarifications to the plan that might reinforce plan priorities and/or enhance understanding of ongoing activities and initiatives. The responses also include one or more specific recommendations for action by the A-E program leadership and staff for each charge question.

Charge Question 1a

> Q.1a: Does the research outlined for the 2019–2022 timeframe support the relevant Agency priorities as described in the EPA and ORD Strategic Plans?

Narrative

The EPA Strategic Plan is largely mission-oriented. As stated directly in the plan, it emphasizes a "back-to-basics" agenda with three overarching goals: *1) refocus the Agency on its core mission (deliver real results to provide Americans with clean air, land, and water, and ensure chemical safety); 2) restore power to the states through cooperative federalism (rebalance the power between Washington and the states to create tangible environmental results for the American people); and 3) lead the Agency through improved processes and adhere to the rule of law (administer the law as Congress intended, to ensure the Agency is focused on its statutory obligations under the law).*

The ORD Strategic Plan[3] focuses on how to operate within ORD to achieve the overall EPA mission. It outlines how ORD plans to ensure that its science is well formulated, focused on priority issues, conducted in a manner consistent with scientific protocols and guidelines, and accessible to the public in a way that is both transparent and understandable.

The Subcommittee has identified the following strengths concerning the alignment of the research outlined in the draft StRAP with relevant Agency priorities as described in the EPA and ORD Strategic Plans and provides additional suggestions and recommendations for A-E program leadership consideration.

Strengths

- There is a clear relationship between the outlined research and the EPA Strategic Plan Goal 1: Core Mission, Objective 1.1, "Improve Air Quality". This approach has historically been a major priority for the A-E program research agenda, with important outcomes, and will continue to be a key element of the program moving forward.
- The draft StRAP does a good job tying research priorities to the appropriate regulatory drivers and policy context, providing links to the relevant regulations and strong justification for the research agenda described in the plan.

……

[3] EPA, Office of Research and Development, Strategic Plan 2018–2022, available at https://www.epa.gov/research/epa-office-research-and-development-strategic-plan-2018-2022

- With respect to alignment with Goal 2: Cooperative Federalism, the StRAP highlights significant efforts that the A-E staff has engaged in to meet this goal. In each research area, external needs are identified as context and drivers for the outlined research program.
- The broad portfolio of the program includes both intramural and extramural research activities. One example of extramural research discussed at the BOSC meeting focused on research centers looking at the issue of exposure to multiple pollutants. This is a good example of extramural research contribution to the A-E portfolio that aligns well with the EPA core mission as well as regulatory compliance work.
- Specific outputs for each research area were provided in the plan, which is aligned with the EPA approach of using more measurements and metrics to highlight the value of its research and the accomplishments of its research programs. Appendix 1 of the draft plan summarizes specific outputs for each research area.
- Overarching wildland fire/biomass burning research intersects with all three research topics and most of the research areas. It is a good example of a systems approach to important and/or emerging questions or issues that don't fit neatly into just one of the research topics. The increasing complexity of environmental issues will continue to demand this integration.

Suggestions

The following suggestions for modification of the StRAP are provided to better highlight alignment of the research outlined in the draft StRAP with relevant Agency priorities.

- Material in the StRAP itself should be expanded to more clearly show the breadth of the engagement with partners and stakeholders. Program leadership and staff have emphasized the need to continue to engage in communications and dialogue throughout the development and implementation of the StRAP. See response to Charge Question 1b for discussion concerning how well the proposed research program responds to partners' needs.
- The Subcommittee believes that the draft StRAP misses an opportunity to highlight alignment with EPA Strategic Plan Goal 3: Rule of Law and Process, Objective 3.5, "Improve Efficiency and Effectiveness". Delivering "on-demand" data to the right people at the right time, the grants processes, and information management are specifically described in the EPA Strategic Plan as central to meeting this objective. The A-E program clearly have processes in place that can contribute to this goal. The Subcommittee suggests the StRAP could better highlight how the program will "acquire, generate, manage, use, and share information" to more clearly demonstrate alignment with this EPA goal.
- The Subcommittee encourages A-E to include more discussion in their StRAP about the workforce requirements and workplace enhancements to implement the action plan. This will provide stronger alignment with ORD Goal 3: Enhancing the Workforce and Workplace. Recognizing that there has been significant attrition in A-E staff, some priority on building and supporting the workforce and work environment would be helpful. The Subcommittee appreciates that this is a challenge given ongoing budget constraints, but also believes this is an important priority for the future. Creative approaches to engaging in partnerships with other ORD programs and/or extramural research institutions might be considered.
- While the Subcommittee believes that there is good alignment between the research outlined in the draft StRAP with relevant Agency priorities as described in the EPA and ORD Strategic Plans, the structure of the draft StRAP does not make the alignment clear. See response to Charge Question 1c for discussion of this issue.

- The Subcommittee recognizes that the contents of Appendix 1 are not intended to be exhaustive or final. As A-E finalizes the outputs, we encourage the program to continue its focus on alignment with ORD's translational science goals.
- We encourage the A-E program to ensure that scope is maintained for exploratory research in their StRAP to enable the Agency to respond to emerging issues. The pace of scientific discovery continues to accelerate, and the problems of tomorrow are likely to be more complex and challenging than those currently known. It is critical that the StRAP has some level of flexibility built in to evaluate, identify, and pursue emerging scientific challenges that are aligned with EPA's primary mission and vision.

Recommendations

The Subcommittee offers two recommendations to capitalize on opportunities to demonstrate how the research outlined for the 2019–2022 timeframe supports the relevant Agency priorities as described in the EPA and ORD Strategic Plans.

Recommendation 1a.1: Identify and describe in the StRAP the process by which A-E will balance immediate needs within EPA and longer-term, exploratory research objectives so that A-E and ORD can be prepared for future science needs. The action plan should include a process for review and evaluation of this balanced approach.

Recommendation 1a.2: Add discussion in the StRAP to reflect activities by A-E (current and planned) concerning EPA Strategic Plan Objective 3.5, "Improve Efficiency and Effectiveness", and ORD Goal 3: Enhancing the Workforce and Workplace.

Charge Question 1b

> Q.1b: Each ORD research program undertook a rigorous engagement process to provide additional detail on specific EPA program and region, state, and tribal needs, the results of which are summarized in the StRAP objectives and explanations of research topics and areas. How well does the proposed research program respond to these partner-identified needs?

Narrative

EPA ORD, and in particular the A-E national program, has made changes to the engagement process used to incorporate the needs of stakeholders and partners into the strategic planning process. ORD has long had relationships with the Agency's program and regional offices but has not engaged as much with other groups (e.g., states and tribes). There is clear intent to interact more broadly with a wide variety of stakeholders in developing and implementing the StRAP over the next few years, rather than focusing only on the partner organizations within EPA. Within ORD, A-E has made a good initial start by looking at ECOS and the National Tribal Air Association (NTAA) air quality priorities. The StRAP reflects the needs identified [to date] by programs, regions, states and/or tribes within each research area. The Subcommittee encourages A-E to continue to engage with these groups and others, and specifically continue conversations with the states, as it refines the StRAP and implements the action plan. This is a long-term project of building relationships, and it is helpful to have a strategy for further developing processes and to have metrics to assess progress in this endeavor.

In response to the charge question, the Subcommittee considered how the engagement process is explained in the draft A-E StRAP, whether A-E is responding to the needs identified, and whether there are partners or stakeholders that require additional outreach.

The Subcommittee has identified the following strengths concerning the engagement process and the alignment of the research outlined in the draft StRAP with partner-identified needs, and provides additional suggestions and recommendations for A-E program leadership consideration.

Strengths

- The presentations and discussion at the BOSC meeting demonstrated that A-E has accomplished significant outreach and engagement with a variety of stakeholders, although not all of these efforts are clearly reflected in the draft StRAP. Reaching out to external partners is an important element of EPA's outreach, and we encourage the A-E program leadership and staff to identify approaches that will enable them to continue dialogue with these groups.
- Appendix 2 in the StRAP provides a high-level summary of the needs of states and tribes. Additional information on needs of states and tribes was also identified in the draft StRAP within each research area. The StRAP report responds to the needs that were identified.
- The plan identifies key issues and outputs that build on the technical expertise and foresight of A-E, and at the same time, provide great benefit to external partners (e.g., states and tribes) who do not have the resources or technical staff to fully articulate and respond to emerging issues (e.g., per- and polyfluoroalkyl substances, or PFAS). When problems come up, these stakeholders need EPA to help mobilize resources and talent to rapidly provide assistance.

Suggestions

- We encourage A-E to continue discussion with tribes and states, using the process outlined in Dr. Alan Vette's presentation to the Subcommittee. It can be helpful to have separate discussion with tribal organizations to ensure that their voices are heard. In addition, A-E should commit to ongoing communication and updates with the states, tribes, and other external partners as the research topics and projects are refined.
- The draft StRAP made a good start at identifying partner and stakeholder needs, but it would be helpful to expand on how those needs will be addressed and how A-E will continue to refine its understanding of the needs. A process for prioritizing needs as well as checking back with partners to see if new needs are identified would be useful to summarize in the StRAP.
- The draft StRAP misses an opportunity to highlight the extensive A-E outreach efforts to date and the connection between outreach and program design. The Subcommittee suggests adding detail on the process of engagement and commitment to continuing dialogue as discussed in the recommendations. Slide 38 in Alan Vette's presentation to the Subcommittee ("Input from outside stakeholders") should be included in the StRAP as a means to summarize how A-E connected with the outside stakeholders.
- Reaching out to ECOS is a good first start, but this group represents a high-level view from state agencies. The Subcommittee suggests that A-E consider reaching out to the National Association of Clean Air Agencies (NACAA), the Association of Air Pollution Control Agencies (AAPCA), and multi-jurisdictional organizations (MJOs) to allow for more granularity of the issues. The MJOs have good relationships among states and provide more regional perspective from states because they don't

require consensus from the larger group (NACAA/AAPCA). Some examples of MJOs are MARAMA, WESTAR, NESCAUM, LADCO, CENSARA, CENRAP, CARB, NTAA.[4]

- The program could leverage the existing relationship with ECOS to include more specific questions (items) about emerging needs from the states on the ERIS States' Research Needs Survey. ORD and A-E can also make use of the regional offices' connections to the states and local organizations to identify emerging needs.
- As A-E formulates its research priorities and plans, engaging more intentionally with MJOs as research partners could be valuable. Formalized procedures for engaging in conversation with MJOs are recommended; for example, make technical presentations to MJOs on A-E research programs and facilities and connect A-E principal investigators with specific organizations/individuals on projects.
- A-E creates the A-E research news quarterly web newsletter and science matters newsletter and these are great resources. These resources should be highlighted in the StRAP as part of the overall A-E strategic outreach and engagement plan, and could also be advertised more to states, MJOs, non-governmental organizations (NGOS), academia, and trade groups.

Recommendations

The Subcommittee offers three recommendations concerning the engagement process and the alignment of the research outlined in the draft StRAP with partner-identified needs.

Recommendation 1b.1: There is a need to have more engagement with states and tribes, in particular, educational outreach on A-E capabilities. It would also be helpful to educate partners on the kinds of questions EPA can answer. For example, EPA staff might attend MJO meetings (in person or via webinar) to present ORD capabilities and then ask questions of states' needs. This can be a good mechanism for identifying emerging issues.

Recommendation 1b.2: Academia, science associations, etc. are mentioned in the draft StRAP, but it would be helpful to discuss in more detail how these outreach efforts occur and are utilized by EPA. NGOs are not discussed and should be included (unless they are considered community action groups).

Recommendation 1b.3: We encourage continued collaboration and communication through sensor workshops/wildfire workshops and including communities involved in these issues to be a part of the workshops.

Charge Question 1c

> Q.1c: Does the StRAP, including the topics, research areas, and proposed outputs, clearly describe the strategic vision of the program? Given the environmental problems and research objectives articulated, please comment on the extent to which the StRAP provides a coherent structure toward making progress on these objectives in the 2019–2022 time frame.

Narrative

The draft A-E StRAP provides a summary of topics, research needs, and outputs related to energy and the atmosphere, including the role of EPA in helping improve air quality, that clearly describe the strategic

[4]The full list of acronyms can be found on page 4.

vision of the program. The A-E strategic vision directly addresses a subset of the vision of the entire EPA program, as indicated by yellow ovals in the figure below:

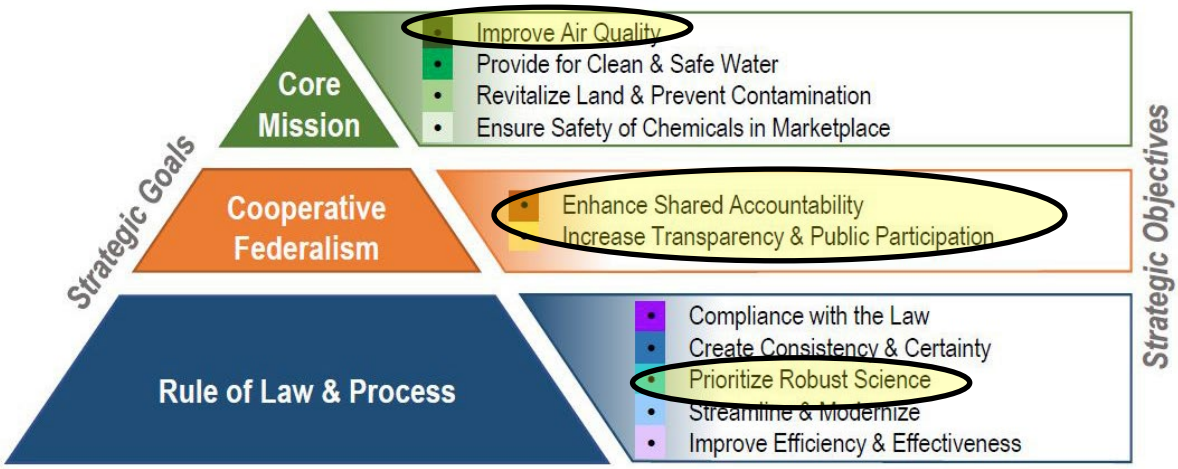

Figure 2. EPA Strategic Plan (FY 2018–2022)

The engagement of A-E partners in the development of the StRAP will facilitate the distribution of information related to air pollution and the other goals and objectives in the EPA 2018–2022 Strategic Plan. This broader participation should also encourage individuals to provide feedback on a variety of topics related to air pollution, including emerging measurement techniques, newly identified pollutants, methodology for pollution reduction, etc.

The Subcommittee understands that this plan is strategic, and not an implementation or action plan. The Subcommittee commends A-E for setting forth ambitious goals in the draft StRAP, some of which (e.g., the role of forest and wildland fires in air pollution) will likely extend beyond 2022. The StRAP provides a good start in addressing science questions under the broad themes of A-E research. The work on forest and wildland fire is especially highly relevant and well-developed. The A-E Program is supporting work at EPA ORD National Exposure Research Laboratory (NERL) Atmospheric Model Development (AMD) Branch, for example, that could help advance air pollution modeling related to the research area of wildland fire, especially if additional resources are available. The plans for forest and wildland fire work described in the draft StRAP should also provide an opening for continued testing of new and improved sampling methods, including satellite remote sensing of forest fire characteristics such as burn area, etc., under a broad range of conditions relevant to many areas of importance to regional and local policies. We applaud the effort of A-E in bringing together this draft StRAP that clearly demonstrates EPA's continued support of scientific research and overall environmental efforts related to atmospheric pollution and energy utilization in the United States.

Communication mechanisms associated with the StRAP must be carefully designed, and implemented to be supportive of the science conducted in the A-E program. The first stages of communication developments are described in the draft StRAP for making desired information available. However, the tasking for information sharing should not distract from the core scientific mission of EPA ORD A-E. The A-E Subcommittee recognizes that EPA is working under conditions of limited resources and that priorities need to be clearly delineated to maximize the effectiveness of chosen communication mechanisms.

The draft StRAP also shows a substantial commitment to both enhanced shared accountability and increases in transparency and participation by a range of partners. Ongoing engagement with various

partners will encourage understanding and support for the scientific approaches used in regulatory and specialized monitoring air quality and the reduction of air pollution to meet EPA and ORD Strategic Plan objectives. Feedback from the partners identified in the StRAP will encourage and strengthen relationships at A-E that will be helpful in meeting EPA objectives for monitoring and decreasing air pollution, and help shape current and future activities.

The Subcommittee has identified the following strengths concerning the strategic vision of the program, and the extent to which the StRAP provides a structure for making progress toward outcomes in the 2019–2022 timeframe, and provides additional suggestions and recommendations for A-E program leadership consideration.

Strengths

- The draft StRAP provides an excellent general summary of topics and research areas for the A-E national program and the A-E program vision. It sketches a coherent general structure for progress against those topics and the larger general ORD and EPA objectives and goals. The document shows the importance of addressing issues related to energy utilization and air quality and sketches the general picture of how these research areas are related and are mutually reinforcing. The A-E research vision is appropriately ambitious and thoughtfully built on well-known historical successes in Air, Climate, and Energy (ACE) and EPA ORD; this is an excellent template for the A-E programs.
- The additional emphasis in this draft StRAP on planning for greater participation of partners from diverse groups (other governmental agencies, industry, scientific groups, NGOs, states, and tribes), and on related translation of A-E science products for informing decisions, are very positive aspects of this plan.
- The draft StRAP shows that effective and efficient environmental policy must be built from well-established science with the flexibility to respond to any future policy-relevant questions. This policy needs to address known environmental and energy components, recognizing the relative importance of these components in the United States will change. The protection of human and ecosystem health depends on the ability of A-E to marshal science to account for effects of those changes, many of which are currently unknown.
- The draft StRAP thoughtfully shows points of possible integration of intra- and extramural research on A-E topics.

Suggestions

- The present draft StRAP document could benefit from the development of a listing (possibly a table) that would show priorities and how they fit into the overall vision of EPA and the StRAP.
- Mechanisms could be developed through internal collaboration with EPA offices which receive science products from A-E to facilitate access of those A-E partners to the data sets, reports, papers, etc., as well as in the translation of those science products to help make decisions informed by the best A-E science outputs. Providing general and flexible time lines for the major components of the plan would be helpful for demonstrating the connections from A-E science to the partners identified in the StRAP. The inclusion of further consideration of the use of a system's approach to help integrate the various components, including the social aspects, would be helpful.
- Particular research lines could be described in slightly more detail as a means to illustrate where, for example, the air pollution and energy resource components of A-E could be brought together to show how this work advances the science of each component relevant to EPA and its partners.
- The plan needs clearer articulation of the applied science questions that will drive new research for A-E to meet its obligation to remain at the forefront of environmental science research relevant to

EPA's missions. An explicit systems integrative approach as suggested above will help illustrate and delineate separate lines of research and where and how those lines cross to enhance the usefulness of work on each applied science question to A-E and ORD.

- More specific descriptions of formalized procedures for producing and iterating science research questions need to be provided along with identification of the impacted scientific communities. These questions should be dedicated to protecting the A-E aspects of human health and the environment. Better articulation of these questions would more strongly tie them to the general EPA Strategic Plan objectives.
- The Subcommittee has some concern that the draft StRAP sourcing of research ideas is too far in the direction of A-E's partners and product end-users, leaving insufficient attention to the environmental science research communities relevant to work under the specific A-E components of ORD. The continued close integration of A-E with the wider atmospheric and energy research communities outside EPA is vital to ensuring that EPA ORD can maintain its position of advancing environmental science. An element of a more inclusive approach could be articulation of a process for identifying and prioritizing work preparing for future 'unknown unknowns'.
- A clearer description of specific motivating science questions and why the A-E program is best suited to answer those questions would strengthen the connection of A-E work to the ORD goal of remaining at the forefront of environmental science research. The science challenges outlined early in the plan may be a part of this motivation, but they are organizationally removed from the specific research topics and areas in the StRAP. This added description would improve the utility of the StRAP as a framework for planning implementation by suggesting where A-E can best allocate resources within its program and where partnering with other EPA ORD components and other partners outside EPA ORD can support the work at A-E. Finer articulation of those science questions would also help facilitate the re-orientation and selection of science partners for A-E and help shape the various science products needed to meet ORD and A-E objectives and further deliver science to support EPA's missions.
- A-E could improve the StRAP with better developed approaches for distinguishing forest and wildland fire effects from industrial air pollutants and pollutants from other sources. These approaches should support determinations under current EPA regulatory policy related to allowable exceedances under wildfire smoke conditions. Such information would also provide an opening for advancement of source apportionment modeling and the enhanced representation of chemical plume modeling inside large-domain air quality models.

Recommendations

The Subcommittee offers three recommendations regarding the strategic vision of the program, and the extent to which the StRAP provides a structure for making progress toward outcomes in the 2019–2022 timeframe.

Recommendation 1c.1: The StRAP should include a description of the process or mechanisms and general timelines that will be used to facilitate access of the A-E partners to data sets, reports, papers, etc., as well as how A-E or ORD will work to translate those science products for broader use in informing decision-making.

Recommendation 1c.2: The A-E program vision must balance the interests of partners with those of the environmental science research communities to ensure they remain in a leadership role in advancing environmental science. Clearer articulation of the applied science questions that will drive new research for A-E would help refine the research plan and agenda. The present draft StRAP document should include a listing (possibly a table) of research priorities and how they fit into the overall vision of EPA and the StRAP.

Recommendation 1c.3: A clearer description of specific motivating science questions and why the A-E program is best suited to answer those questions would strengthen the connection of A-E work to the ORD goal of remaining at the forefront of environmental science research. The science challenges outlined early in the plan may be a part of this motivation, but they are organizationally removed from the specific research topics and areas in the StRAP.

Charge Question 1d

> Q.1d: Recognizing ORD's focus on addressing identified partner research needs, in the presence of reduced scientific staff and resources, are there any other critical emerging environmental needs or fields of expertise and/or new research methods where this program should consider investing resources?

Narrative

The Subcommittee recognizes A-E for its proposed work on emerging environmental needs and investments in new research methods as described in the draft StRAP. Air and energy issues range across wide scales in space (e.g., indoor to regional to global air pollution) and time (e.g., acute to chronic health effects), which demand innovative tools and multidisciplinary approaches. The A-E program has proposed a relatively modest (in comparison to past years) but balanced research portfolio with investments in new tools (e.g., low-cost sensors and satellite products) and scientific investigations on criteria pollutants, hazardous air pollutants (HAPs), and emerging issues (e.g., wildland fire impacts).

The Subcommittee identified the following strengths of ORD's A-E program to address critical emerging environmental needs, and its investments in staff expertise and research methods, and provides additional suggestions and recommendations for A-E program leadership consideration.

Strengths

- The draft A-E StRAP recognizes resource constraints on both intramural and extramural resources from prior years due to staff cuts, loss of critical expertise, and extramural funding reductions, and focuses on what is expected to be doable with anticipated resources.
- The A-E research program successfully balances EPA's responsibilities regarding some legacy areas of scientific investigation (e.g., particulate matter, or PM, health effects, air quality models, cookstove emissions) and critical emerging areas, such as the proposed research on ecosystem and human vulnerability to wildland fires, and wildland fire risk mitigation and communication.
- The bibliography of 878 peer-reviewed publications and other documents published from 2015 to 2018 demonstrates ORD's current success in identifying research priorities and providing important and scientifically relevant outcomes.
- The research program on PFAS demonstrates ORD's multi-disciplinary thinking on emerging environmental topics.
- The draft A-E StRAP material describing the Proposed Outputs (FY2019–2022) for research on both legacy and emerging areas of investigation was well described and aligned with the identified program, regional, state, and/or tribal needs.

Suggestions

- The extramural research program (existing STAR and ACE Center grants, Health Effects Institute support) addresses important environmental topics (e.g., health effects from low concentration exposures, cumulative impacts of multiple-pollutants, and organic carbon). While a high-level description is provided in the StRAP, an explicit description of how the extramural efforts are complementary with A-E intramural efforts in selected research topics and areas would give a more complete picture of the full research program.
- The A-E StRAP should outline potential issues related to energy in more detail – currently the "E" in A-E is underrepresented. Examples of where proactive research could inform important scientific questions include air quality impacts of distributed generation, impacts of fires and emergency situations at energy storage facilities, potential emissions of chemicals used in carbon capture systems, and end of life issues (e.g., solar panel disposal and potential impacts).
- The A-E StRAP should explicitly include environmental justice topics that are important to regional, state, local, and tribal agencies, and the public at large. These can fit into existing efforts on use of low-cost sensors, satellite data, wildland fire impacts, etc.
- There could be more attention to HAPs, especially toxics emitted from brake and tire wear (where ORD can link with European and California efforts), and small stationary facilities (e.g., hexavalent chromium) that have become relatively more important as $PM_{2.5}$- and ozone-related health effects are reduced.
- ORD's indoor air quality program has a long history of advancing knowledge on time-activity patterns and microenvironmental exposures to all age groups, indoor pollutant sources and emissions, radon exposure, exposure reduction strategies, etc. The A-E StRAP has a proper focus on wrapping up ongoing work on cook stoves and new work on indoor penetration of wildland fire smoke, but there could be a stronger effort to rebuild broad staff expertise, seek partnerships with international and other agencies, and link with work on energy systems and environmental justice. For example, building energy efficiency measures have implications for indoor pollutant exposures.
- There could be more attention to simplified tools to assist Programs, regional, state, local, and tribal agencies with limited resources in addressing their statutory responsibilities. Examples include reduced-form air quality models for State Implementation Plans, simpler tools for source control

prioritization (e.g., intake fraction approach, ozone and PM formation scales), identification of long-range transport and global climate impacts on air quality, and identification of super-emitting sources for enforcement purposes.

- The readability of A-E StRAP could be improved with a better mapping of the report's objectives, topics, etc. with a matrix or other type of table or chart. As currently written, the plan identifies four research program objectives, each of which is supported by a number of science challenges. The link between those and the research topics and areas, which appear to be the core of the A-E strategic research plan, needs to be clarified.

Recommendations

The A-E Subcommittee recognizes that ORD is in the midst of what could be a large downsizing in staff and extramural funding, and that its research portfolio over the next three fiscal years should reflect this reduced baseline but still be comprehensive and nimble enough to address the priority research needs of the Nation. Until there is more clarity on the resources available through the budget process and implementation of the Administrator's priorities, the Subcommittee offers the following recommendations on ORD's A-E program to address critical emerging environmental needs, and its investments in staff expertise and research methods

Recommendation 1d.1: Add energy and environmental justice as Cross-cutting Research Issues in Appendix 3.

Recommendation 1d.2: Consider adding work on HAPs (brake and tire wear, small stationary sources) and simplified tools for State Implementation Plan (SIP) modeling, source control prioritization, and enforcement, as resources allow.

Recommendation 1d.3: Consider rebuilding staff expertise on building ventilation and other indoor air quality topics.

Charge Question 1e

> Q.1e: What are some specific ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems?

Narrative

As stated in the draft StRAP, "the [Clean Air Act] CAA states that EPA shall conduct research "related to the causes, effects (including health and welfare effects), extent, prevention, and control of air pollution." The CAA further requires that this includes "research, testing, and development of methods for sampling, measurement, monitoring, analysis, and modeling of air pollutants" and research on "the short-term and long-term effects of air pollutants … on human health." Further research listed under the CAA includes efforts to "improve understanding of the short-term and long-term causes, effects, and trends of ecosystems damage from air pollutants on ecosystems."

The Subcommittee applauds the Agency's long history of promoting innovative approaches to solving environmental problems. Historically the Agency used STAR grants to develop mission-oriented scientific projects and issued SBIR awards to encourage scientists, engineers, and entrepreneurs to develop new and potentially marketable environmentally relevant devices and techniques. These programs have been

a successful element of EPA's portfolio. While the Subcommittee recognizes that A-E does not control the SBIR and the STAR programs, we recommend that A-E grasp any opportunity to use these programs to the extent allowed by available budget. These programs have historically enabled EPA, through its extramural research operation, to work broadly with academia, trade associations and industry to augment its intramural research program. For example, A-E played an integral role in developing the highly successful market-based Acid Rain program.

In addition to capitalizing to the greatest possible extent on the STAR and SBIR programs, we encourage A-E to continue to promote innovations to deal with next generation environmental problems, despite the reduction in staff and financial resources imposed by the "lean" agency profile. EPA can incentivize innovation with efficiency and fiscal responsibility through recognition of exceptionally high-quality research that advances the A-E mission. Criteria for recognition can include individual or team initiative, relevance to the Agency's core mission, responsiveness to state, local, and tribal partner needs, impact on the state-of-the-science/technology, and innovation that leads to cost savings. Awards could involve national recognition for excellence, potentially coupled with monetary awards for exceptional efforts.

The Subcommittee suggests that A-E focus available EPA/SBIR resources on specific challenges to develop Next-Gen answers to emerging environmental problems. The Agency should encourage cost sharing. Potential topics might include:

- Air quality impacts on downwind communities and effects on health, which requires research on particle chemistry, exposure scenarios, uptake and distribution in respiratory tracts, and translocation to other organs.
- Economic impacts of the effects of pollutants at a range of temporal and spatial scales.
- Fallout of toxic products on soil with subsequent contamination of groundwater; impact on aquatic species (e.g., GenX in Eastern NC).
- Contamination of agricultural products by toxic fire-related compounds such as polycyclic aromatic hydrocarbons and toxic metals.
- Planning for the future using appropriate climate models to predict number and intensity of wildfires.
- Pesticide use where the product is sprayed as an important exposure route for residents in nearby communities. The crossover is damage to forests by pests leading to increased risk of fires and the risk of bystander exposure. Other air contamination aspects of pesticide usage could be a collaborative effort across EPA divisions and A-E can provide significant expertise related to exposure modeling, exposure assessment, risk assessment, and risk management.

The Subcommittee also suggests that A-E Environmental Excellence Awards could be established and presented to industry partners and state agencies that demonstrate innovative solutions that reduce emissions, health effects, or environmental impacts. Firms could benefit by advertising that they received an EPA award for environmental excellence. This type of incentive worked well with the "ENERGY STAR" designation program. EPA could also provide testing, certification, or validation for innovative measurement instruments or approaches and control technologies. Such an award program could be linked with an SBIR program, which would allow new techniques that solve environmental challenges to be more fully developed and eventually come to market.

A-E could sponsor environmental challenges at relevant national meetings of scientific and trade associations that involve local high school and college teams to compete to solve a local problem selected by the conference organizers with the collaboration of the EPA regional staff. The American Chemical Society and the Air and Waste Management Association both host such annual challenges, which might

provide good opportunities for collaboration. The environmental challenges could be cross-cutting across ORD research programs.

The Subcommittee suggests that A-E consider developing an EPA Mission Oriented Collaborative Research Program to invite scientists, engineers, stakeholders, tribal, and other partners to propose an approach to solve a current or emerging environmental problem. Groups with winning proposals might then work with an A-E team, bringing to bear EPA resources or expertise if specific equipment or methodology were found to be helpful. EPA could also reach out to foundations and form public/private partnerships that could leverage ongoing and new innovative efforts.

EPA could also sponsor partner activities at EPA facilities by expanding a guest researcher and/or intern program, as well as potentially broadening its engagement with other agencies. Ideas include:

- Inviting candidates who propose an innovative solution to a current or emerging environmental problem to work with A-E scientists to test a new approach or device where access to EPA resources and facilities could accelerate progress.
- Facilitating the testing of developed instruments, procedures, and technologies at EPA or in the field at partner's facilities.
- Augmenting resources by reaching out to foundations and making use of expertise at other agencies (e.g. National Air and Space Administration [NASA] and the U.S Department of Energy [DOE]) that have environmental mandates to expand specific programs.
- Partnering with other agencies on key research agendas and topics, maximizing efficiencies, and making the best use of intellectual and physical capital. As just one example, the U.S. National Climate Assessment, a multi-agency report released late in 2018, recommends five foundational cross-cutting research areas, the first two of which (integrated natural and social science, engineering, and other approaches; and observations, monitoring, and infrastructure for critical data collection and analysis) are well suited for A-E to address in partnership with others.

The Subcommittee would like to emphasize the importance of improving and applying EPA's AERMOD, Community Multiscale Air Quality (CMAQ), and Environmental Benefits Mapping and Analysis Program (BenMAP) software for the purpose of accurately monetizing the cost of airborne pollutant emissions, as a first step in developing market-based incentives for mitigating current or emerging environmental issues. Reasons include:

- Market-based incentives (MBIs) could be useful and cost-effective alternatives to imposing new regulations for pollution control.
- Environmental taxes, deposit refund systems, and tradeable pollution permits could be suitable instruments for inducing pollution abatement behavior.
- A key barrier to employing MBIs to promote pollution abatement is developing a realistic dollar value to be applied to the value of a tax or credit, which could be addressed and verified by the application of appropriate EPA computational models.
- Updates and modifications of EPA's computational arsenal could support the development by EPA, state and tribal partners of pollutant trading or subsidy strategies or approaches as alternatives to new regulatory actions.

Recommendations

The Subcommittee offers three recommendations regarding ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems.

Recommendation 1e.1: While the Subcommittee recognizes that A-E does not control the EPA/SBIR program, A-E should grasp any opportunity to use the SBIR program to develop Next-Gen answers to emerging environmental problems. Potential topics are listed in the text.

Recommendation 1e.2: While the Subcommittee recognizes that A-E does not control the STAR program, A-E should take advantage of any access to the STAR program to provide specific challenges to scientists and engineers to identify an emerging environmental problem and submit a concept proposal for addressing that concern. The A-E program could encourage cost sharing and provide funding and/or other resources to one or more concepts that would advance the strategic priorities of the program.

Recommendation 1e.3: Establish an Interagency Task Force to focus on future needs and to make available or share resources. In the lean agency framework, the utilization of existing equipment and facilities that are underused could be maximized through intra-agency, interagency, and collaborative research initiatives. An active program of collaboration and cooperation should be fostered to maximize efficiency and make the best use of intellectual and physical capital.

Summary List of Recommendations

This section provides a listing in a single location of the recommendations provided earlier in the report in response to each charge question.

Charge Question 1a. Does the research outlined for the 2019–2022 timeframe support the relevant Agency priorities as described in the EPA and ORD Strategic Plans?

Recommendation 1a.1: Identify and describe in the StRAP the process by which A-E will balance immediate needs within EPA and longer-term, exploratory research objectives so that A-E and ORD can be prepared for future science needs. The action plan should include a process for review and evaluation of this balanced approach.

Recommendation 1a.2: Add discussion in the StRAP to reflect activities by A-E (current and planned) concerning EPA Strategic Plan Objective 3.5, "Improve Efficiency and Effectiveness", and ORD Goal 3: Enhancing the Workforce and Workplace.

Charge Question 1b. Each ORD research program undertook a rigorous engagement process to provide additional detail on specific EPA program and region, state, and tribal needs, the results of which are summarized in the StRAP objectives and explanations of research topics and areas. How well does the proposed research program respond to these partner-identified needs?

Recommendation 1b.1: There is a need to have more engagement with states and tribes, in particular, educational outreach on A-Ecapabilities A-E. It would also be helpful to educate partners on the kinds of questions EPA can answer. For example, EPA staff might attend MJO meetings (in person or via webinar) to present ORD capabilities and then ask questions of states' needs. This can be a good mechanism for identifying emerging issues.

Recommendation 1b.2: Academia, science associations, etc. are mentioned in the draft StRAP, but it would be helpful to discuss in more detail how these outreach efforts occur and are utilized by EPA. NGOs are not discussed and should be included (unless they are considered community action groups).

Recommendation 1b.3: We encourage continued collaboration and communication through sensor workshops/wildfire workshops and including communities involved in these issues to be a part of the workshops.

Charge Question 1c. Does the StRAP, including the topics, research areas, and proposed outputs, clearly describe the strategic vision of the program? Given the environmental problems and research objectives articulated, please comment on the extent to which the StRAP provides a coherent structure toward making progress on these objectives in the 2019–2022 time frame.

Recommendation 1c.1: The StRAP should include a description of the process or mechanisms and general timelines that will be used to facilitate access of the A-E partners to data sets, reports, papers, etc., as well as how A-E or ORD will work to translate those science products for broader use in informing decision-making.

Recommendation 1c.2: The A-E program vision must balance the interests of partners with those of the environmental science research communities to ensure they remain in a leadership role in advancing environmental science. Clearer articulation of the applied science questions that will drive new research for A-E would help refine the research plan and agenda. The present draft StRAP document should include a listing (possibly a table) of research priorities and how they fit into the overall vision of EPA and the StRAP.

Recommendation 1c.3: A clearer description of specific motivating science questions and why the A-E program is best suited to answer those questions would strengthen the connection of A-E work to the ORD goal of remaining at the forefront of environmental science research. The science challenges outlined early in the plan may be a part of this motivation, but they are organizationally removed from the specific research topics and areas in the StRAP.

Charge Question 1d. Recognizing ORD's focus on addressing identified partner research needs, in the presence of reduced scientific staff and resources, are there any other critical emerging environmental needs or fields of expertise and/or new research methods where this program should consider investing resources?

Recommendation 1d.1: Add energy and environmental justice as Cross-cutting Research Issues in Appendix 3.

Recommendation 1d.2: Consider adding work on HAPs (brake and tire wear, small stationary sources) and simplified tools for State Implementation Plan (SIP) modeling, source control prioritization, and enforcement, as resources allow.

Recommendation 1d.3: Consider rebuilding staff expertise on building ventilation and other indoor air quality topics.

Charge Question 1e. What are some specific ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems?

Recommendation 1e.1: While the Subcommittee recognizes that A-E does not control the EPA/SBIR program, A-E should grasp any opportunity to use the SBIR program to develop Next-Gen answers to emerging environmental problems. Potential topics are listed in the text.

Recommendation 1e.2: While the Subcommittee recognizes that A-E does not control the STAR program, A-E should take advantage of any access to the STAR program to provide specific challenges to scientists and engineers to identify an emerging environmental problem and submit a concept proposal for addressing that concern. The A-E program could encourage cost sharing and provide funding and/or other resources to one or more concepts that would advance the strategic priorities of the program.

Recommendation 1e.3: Establish an Interagency Task Force to focus on future needs and to make available or share resources. In the lean agency framework, the utilization of existing equipment and facilities that are underused could be maximized through intra-agency, interagency, and collaborative research initiatives. An active program of collaboration and cooperation should be fostered to maximize efficiency and make the best use of intellectual and physical capital.

CONCLUSIONS

Overall, the A-E Subcommittee found that the draft A-E StRAP clearly describes a strategic vision and action plan that supports the Agency priorities and strategic plans. The A-E research program focuses on the science and engineering approaches needed to improve air quality, reduce the number of nonattainment areas in the United States, and protect public health and the environment. The draft StRAP effectively links A-E research priorities with the appropriate regulatory drivers and policy context for the Agency, and lays out a research agenda that balances the needs of stakeholders and partners with important and emerging topics in environmental science. The plan could do more to highlight the overall integrated research portfolio with some description of extramural research efforts, particularly as complementary with A-E intramural efforts around key strategic topics; this would give a more comprehensive view of the full research program. The Subcommittee also encourages A-E to place a priority on ensuring the portfolio effectively balances near-term needs within the Agency with longer-term, exploratory research objectives. Striking the proper balance of work for immediate Agency responses and a commitment to longer-term research on topics relevant to A-E missions and goals will help ensure that A-E and ORD as a whole can continue leading advancements in environmental science.

The new structure for the A-E research program, around three science topics and one integrated topic, provides a useful construct for the future directions of the program. Each of the three topics and related research areas are well suited to the program's strengths, while also supporting opportunities to address complex and/or emerging scientific issues with a systems approach. The plan successfully balances EPA's responsibilities regarding historical areas of scientific investigation (i.e., air quality models) with critical emerging areas. The selection of wildfires research as a cross-cutting topic, as an example, addresses an important science gap, leveraging the strengths of the A-E team. Providing opportunities in the plan for emerging, cross-cutting areas is important, as the increasing complexity of environmental issues will continue to require integration across more traditional research topics. The plan would benefit from a clearer articulation of the applied science questions that will drive the research agenda, aligning these

questions more clearly with the specific research topics and areas in the StRAP. The links between the program objectives, science challenges, research topics, and research areas are not as clear as they could be. The Subcommittee also suggests that the plan should outline potential issues related to energy in more detail – the "E" in A-E is currently underrepresented. The StRAP could also be improved with a greater articulation of expected outcomes related to the research in support of EPA/ORD strategic priorities and objectives.

The presentations and discussion at the review meeting demonstrated the extent of the outreach and engagement by the A-E team with partners and stakeholders, though not all of these efforts are reflected in the draft StRAP. The document could do more to clearly convey the breadth of engagement as well as the commitment to continued dialogue and interaction. There are a number of specific recommendations in the report that discuss areas where additional clarity would be useful. The Subcommittee also notes that it is important for the program to retain a balance between partner-driven research priorities and those required to ensure that the A-E team maintains its leadership role in the science community and continues to fulfill its mission. To that end, we encourage the A-E program to ensure that scope is maintained for exploratory research that allows the Agency to respond to emerging issues.

The Subcommittee encourages A-E to continue to pursue innovative approaches to conducting their research and to rewarding/encouraging their scientists. This is particularly important given the recent reductions in staff and financial resources. A number of ideas are provided for consideration by the A-E program, including awards and recognition of excellence both for program scientists who have achieved exceptionally noteworthy research or technology outcomes and for industry partners and/or state agencies that demonstrate innovation solutions. The Subcommittee reinforced the value of the EPA SBIR and STAR programs, and encourages the Agency to reinvigorate those programs, perhaps with a specific focus on emerging environmental challenges or focused topical areas of research.

In conclusion, the Subcommittee believes that the A-E StRAP articulates and organizes an ambitious and achievable research program that is well-aligned with EPA's objectives and mandates to improve air quality, reduce the number of nonattainment areas in the United States, and protect public health and the environment. The A-E StRAP will promote high priority research needed by EPA's partners with the resources available. The Subcommittee looks forward to reviewing the implementation of the research outlined in this StRAP in future meetings, and continuing to serve as a resource to the A-E program on scientific and strategic topics related to its research programs.

APPENDIX A: MEETING AGENDA

United States Environmental Protection Agency
Board of Scientific Counselors (BOSC)
Air and Energy (A-E) Subcommittee

Meeting Agenda
November 13-14, 2018
U.S. EPA Room C-112
109 T.W. Alexander Drive, Durham, NC 27709

TIME	TOPIC	PRESENTER
Tuesday, November 13, 2018		
8:00-8:30	Registration	
8:30-8:40	Welcome, and Opening Remarks Introduction	Charlette Geffen, Chair
8:40-9:00	Subcommittee Introductions	Subcommittee
9:00-9:10	DFO Welcome	Tim Benner
9:10-9:30	ORD Welcome	Jennifer Orme-Zavaleta
9:30-11:30	StRAP Development Presentation • General approach • Expanded engagement with stakeholders • Proposed A-E program structure moving forward • Time allowed for SC questions	Alan Vette
11:30-11:45	Review of Charge Questions	Charlette Geffen, Chair
11:45-1:00	Lunch	
1:00-1:30	Public comments (if any)	
1:30-3:30	Discussion of Charge Questions • EPA Overview • SC Discussion	Alan Vette Subcommittee
3:30-4:30	Subcommittee Discussion and EPA response to questions	Subcommittee Alan Vette
4:30-4:45	Wrap-up and Adjourn	
Wednesday November 14, 2018		
8:30-9:30	Subcommittee discussion EPA response to Subcommittee questions	Subcommittee Alan Vette
9:30-12:00	Subcommittee discussion and writing	Subcommittee
12:00-12:45	Lunch	
12:45–2:15	Subcommittee discussion and writing	Subcommittee
2:15-2:30	Wrap-up and Adjourn	

Note: The agenda does not include specific breaks. Breaks were held at the discretion of the Subcommittee Chair.

APPENDIX B: MATERIALS

Material Provided in Advance of the Meeting

Materials to Support the Charge Questions

- Agenda
- Charge questions
- Draft A-E StRAP (External Review Draft, October 24, 2018 version)
- EPA Strategic plan https://www.epa.gov/planandbudget/strategicplan
- ORD Strategic Plan
- A-E Program Summary
- Partner Engagement Summary

Informational Materials

- Product and output summaries (7 examples provided)
- Bibliography (2015–2018)
- A-E Resources sheet with links to:
    - ACE/A-E External Newsletter
    - FACT Sheets
    - Science matters
    - Grants information
    - Tools and toolboxes

Additional Material Provided During the Meeting

- BOSC A-E Subcommittee roster
- National Tribal Association's Status of Tribal Air Report, May 2018, presented at the National Tribal Forum on Air Quality Hosted by the Fond Du Lac Band of Lake Superior Chippewa.
- Interstate Technology and Regulatory Council (ITRC), 2018 Priorities with Focused Constraints – States Point to Shifting Product Needs (summary of state priorities from 2018 survey of states to understand the environmental issues and the technical constraints preventing solution).
- Environmental Research Institute of the States (ERIS), 2016 ERIS States' Research Needs Survey, A Summary of State Environmental Priorities.
- U.S. Environmental Protection Agency (EPA), Office of Research and Development (ORD), PowerPoint presentation by Alan Vette, Acting Program Director of the Air and Energy Research Program: Air and Energy National Research Program, Discussion with A-E BOSC Subcommittee on the Draft A-E Strategic Research Action Plan (StRAP).