

**Science Advisory Board (SAB) /Board of Scientific Councilors (BOSC) Draft Report (11/20/14) to Assist Future Meeting Deliberations -- Do Not Cite or Quote --**

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7 INSERT DATE  
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9 EPA-SAB-1X-XXX

10  
11 The Honorable Gina McCarthy  
12 Administrator  
13 U.S. Environmental Protection Agency  
14 1200 Pennsylvania Avenue, N.W.  
15 Washington, D.C. 20460  
16

17 Subject: Strategic Research Planning for 2016-2019: A Joint Report of the Science Advisory  
18 Board and ORD Board of Scientific Counselors  
19

20 Dear Administrator McCarthy:

21  
22 The Science Advisory Board (SAB) and the Executive Committee of the Board of Scientific Counselors  
23 (BOSC) provide this letter to you at a time of great promise and important choices for the EPA's Office  
24 of Research and Development (ORD). ORD requested our two committees to provide early advice to  
25 inform the agency's strategic planning for ORD's six major program areas and four priority cross-  
26 cutting topics to cover the period 2016-2019. This is a time of opportunity for ORD because the  
27 integrated research programs it inaugurated in 2012 have matured to the point where strategic plans can  
28 help communicate ORD's ambitious mission and serve as a guide to how it will generate or leverage the  
29 most significant research the EPA needs. ORD faces, however, important decisions regarding these  
30 plans, because EPA research resources are likely to be stable or, in real terms, declining, while the  
31 research needs envisioned increase in complexity and scope. For the strategic plans to be truly useful,  
32 they must provide a transparent way for the agency and the public to understand what ORD views as the  
33 key research needed to support the EPA's mission and how ORD sees its role both in generating that  
34 research and partnering with others.  
35

36 The SAB and the BOSC held a public meeting on July 24-25, 2014, to develop the preliminary input for  
37 the enclosed report. The SAB and the BOSC also held a public teleconference on (INSERT DATE) to  
38 reach agreement on the report. In those deliberations, the SAB and the BOSC reviewed draft Strategic  
39 Research Action Plans (StRAPs) for the following six programs: Air, Climate and Energy; Safe and  
40 Sustainable Water Resources; Chemical Safety for Sustainability; Sustainable and Healthy  
41 Communities; Human Health Risk Assessment; and Homeland Security. The committees also reviewed  
42 draft roadmaps for four cross-cutting research topics identified by ORD (Children's Environmental  
43 Health, Nitrogen and Co-pollutants, Climate Change, and Environmental Justice). ORD asked our  
44 committees to respond to several over-arching questions regarding the relationship of ORD's programs  
45 to the agency's Strategic Plan, how ORD's proposed research addresses environmental issues of 2020  
46 and beyond, and how well ORD's programs overall will position the agency to address complex

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1 environmental problems. There were also specific questions for ORD's six program areas and four  
2 cross-cutting topics. The SAB and BOSC addressed all these questions and provide in this report  
3 recommendations to strengthen ORD strategic planning in each of the ORD question areas.  
4

5 The full report responds to the broad scope of ORD's request; key observations and recommendations  
6 include the following:  
7

- 8 • ORD's draft StRAPs and roadmaps are closely aligned with the goals in the EPA strategic plan  
9 and represent an impressive transformation in ORD's research planning process.
- 10 • The plans are appropriately broad and ambitious, but they do not effectively communicate the  
11 scope of achievable research relative to ORD's anticipated resources. The StRAPs should  
12 communicate ORD's highest priority research related to the EPA's mission and decision-makers'  
13 needs and ORD's role in generating that research and partnering with others.
- 14 • Sustainability is stated as a goal in all the StRAPs, yet a common operational definition of  
15 sustainability across programs is not evident. The EPA's specific role of protecting human health  
16 and ecosystems within a sustainability framework needs to be highlighted.
- 17 • The draft StRAPs and roadmaps are in different stages of development. The various  
18 recommendations in the enclosed report are offered to improve them as communication and  
19 planning tools.
- 20 • It is critical for ORD to develop a human resource strategy to attract and develop a scientific  
21 staff capable of accomplishing the planned research, which depends on integration across ORD  
22 programs and disciplinary integration, particularly involving the social, behavioral and decision  
23 sciences.
- 24 • ORD's cross-cutting roadmaps represent a significant step forward for the EPA. They provide a  
25 framework for research integration on large-scale, complex environmental challenges.
- 26 • The SAB and BOSC stress that implementation is as important as planning. ORD should explain  
27 how each StRAP and roadmap will be used and develop methods for evaluating their  
28 effectiveness.  
29

30 The SAB and BOSC commend ORD for seeking advice at this early stage in strategic planning. Both  
31 committees are ready to assist the agency with additional advice to advance EPA's priority research. We  
32 look forward to your response regarding the advice in the enclosed letter.  
33

34 Sincerely,

35  
36  
37 Chair  
38 Science Advisory Board  
39

Chair  
Board of Scientific Counselors

40  
41 Enclosure

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This report has been written as part of the activities of the EPA Science Advisory Board (SAB) and the EPA Board of Scientific Counselors (BOSC). The SAB is a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The SAB is structured to provide balanced, expert assessment of scientific matters related to problems facing the agency. The BOSC is also a balanced, expert public advisory group. It provides extramural scientific information and advice to the ORD Assistant Administrator. This report has not been reviewed for approval by the agency, and, hence, the contents of this report do not represent the views and policies of the Environmental Protection Agency or other agencies in the Executive Branch of the Federal government. Mention of trade names of commercial products does not constitute a recommendation for use. Reports of the SAB are posted on the EPA website at <http://www.epa.gov/sab>, and reports of the BOSC are posted on the EPA website at <http://www.epa.gov/osp/bosc>.

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**U.S. Environmental Protection Agency  
Science Advisory Board  
December 2014**

(Insert Roster When Available)

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## **Acronyms and Abbreviations**

|        |   |
|--------|---|
| ACE    | Air, Climate and Energy   |
| ATSDR  | Agency for Toxic Substances and Disease Registry                        |
| BOSC   | Board of Scientific Counselors  |
| CEH    | Children’s Environmental Health   |
| CBPR   | Community-based participatory research                                  |
| CRTS   | Community Risk and Technical Support                                    |
| CSS    | Chemical Safety for Sustainability                                      |
| DOE    | U.S. Department of Energy   |
| EDSP   | Endocrine Disruptors Screening Program                                  |
| FTTA   | Federal Technology Transfer Act   |
| HHRA   | Human Health Risk Assessment  |
| HSRP   | Homeland Security Research Program                                      |
| IPCC   | Intergovernmental Panel on Climate Change                               |
| IRIS   | Integrated Risk Information System                                      |
| ISA    | Integrated Science Assessment   |
| ORD    | EPA Office of Research and Development                                  |
| NOAA   | National Oceanic and Atmospheric Administration                         |
| NHANES | National Health and Nutrition Examination Survey                        |
| NRC    | National Research Council   |
| OECD   | Organisation for Economic Co-operation and Development                  |
| REACH  | Registration, Evaluation, Authorisation and Restriction of<br>Chemicals |
| SAB    | Science Advisory Board  |
| STAR   | Science to Achieve Results  |
| SHC    | Sustainable and Healthy Communities                                     |
| SSWR   | Safe and Sustainable Water Resources                                    |
| USDA   | U.S. Department of Agriculture  |
| VOIA   | Value of information assessment   |

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**1. EXECUTIVE SUMMARY**

In 2011 and 2012, the Science Advisory Board (SAB) and the Board of Scientific Counselors (BOSC) Executive Committee provided advice to the EPA’s Office of Research and Development (ORD) on strategic directions as ORD realigned its research into six integrated programs. The initial research plans guided ORD for 2012-2016. ORD is now beginning the development of Strategic Research Action Plans (StRAPs) to address research needs from 2016 -2019 for the six programs:

- Air, Climate and Energy
- Safe and Sustainable Water Resources
- Chemical Safety for Sustainability
- Sustainable and Healthy Communities
- Human Health Risk Assessment
- Homeland Security

The update of these plans is in the formative stages, providing an opportunity to solicit early input and insights from the Chartered SAB and the BOSC Executive Committee. A joint meeting was held July 24-25, 2014, to discuss these StRAPs in the context of specific charge questions (provided in Appendix A). The results of that meeting are presented in this report. The first charge question focuses on the relationship of the StRAPs to overall priorities of the agency as described in the new EPA Strategic Plan (2014-2018). The second charge question relates to ORD’s ability to anticipate the science that will be needed for environmental protection for 2020 and beyond. The next set of charge questions is specific to each research program. The remaining charge questions address specific examples of crosscutting, coordinated and transdisciplinary research across programs as demonstrated through draft roadmaps for four cross-cutting research topics identified by ORD (Children’s Environmental Health, Nitrogen and Co-pollutants, Climate Change, and Environmental Justice) and for ORD research overall. Summarized below are the major topics addressed by the SAB and the BOSC and their major recommendations.

**Relationship to the EPA Strategic Plan**

ORD’s draft StRAPs and roadmaps demonstrate high-level strategic thinking in linking ORD’s efforts to the EPA strategic plan and in framing, in a coordinated way, how ORD programs support sustainability. This represents a major change in the EPA’s research planning. The draft documents can be used as powerful tools for communicating how the EPA’s complex and inter-related research relates to the agency’s mission. Although the ORD plans are impressive, it is challenging to evaluate the StRAPs and roadmaps as internal strategic planning documents without a better understanding of ORD resources, personnel, and personnel backgrounds and capabilities.

Recommendations:

- Communicate more consistently in the StRAPs and roadmaps the EPA’s specific research niche and how ORD plans to partner with other entities, including international organizations and other federal agencies.
- Use the StRAPs and roadmaps to communicate the most important priorities for ORD to address.
- Communicate more clearly how research is being planned to inform specific agency decisions.

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- Describe how decision makers will access information about the uncertainties associated with ORD-generated tools and data.
- Clarify how sustainability relates to the specific research planned in each program and how sustainability is operationally defined in each program.
- Explain how ORD will develop or access the social, economic and behavioral sciences needed to achieve the goals of the EPA’s Strategic Plan.

**Overall perspectives on proposed research to address environmental issues of 2020 and beyond**

ORD has made significant progress through the StRAPs and roadmaps in placing its research in a framework of the major environmental challenges confronting the United States. However, given that the ORD draft planning documents did not explicitly address longer-term vs. near-term needs, it is difficult for the SAB and BOSC to evaluate whether the proposed research areas will address the key environmental issues facing the agency in 2020 and beyond.

Recommendations:

- Provide a more explicit description of the approach used to identify research necessary to anticipate emerging environmental issues.
- Add a section to each StRAP and roadmap whose purpose is to describe anticipated research needs for the next decade.

**Air, Climate and Energy**

The EPA’s Air, Climate, and Energy research program (ACE) has a strong strategic plan, linking well to the EPA Strategic Plan and agency priorities, and addressing some of the most important current and emerging issues facing environmental quality, human health, and society in the coming decades. The program is exceptionally broad, with its scope encompassing criteria air pollutants, greenhouse gases, climate change, and energy. Energy, in particular is an extensive component, as the life cycle of energy influences all elements of the environment, and overlaps with the other five program areas.

Recommendations:

- Document progress in agency programs addressing greenhouse gases and plan the research needed to inform future decisions.
- Include a conceptual framework linking elements of the ACE program in the ACE StRAP
- Clarify relative priorities, with respect to budget distribution and interactions with other agencies.
- Elaborate and/or expand the research to be conducted on mitigation of climate change impacts.
- Focus the distributed monitoring of air quality on quality data collection and distribution to citizens.
- Consider explicit focus on and analysis of agricultural sources and other land use contributions to air pollution.
- Provide more specific targets for the short-term research aims.
- Consider specifying projects that will integrate ACE with other programs.
- Consider incorporating energy efficiency/conservation research.

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- 1       • Plan to incorporate renewable energy scenarios and pathways developed by other organizations  
2       in ORD’s analysis of environmental impacts.

3 **Safe and Sustainable Water Resources**

4 The Safe and Sustainable Water Resources (SSWR) StRAP outlines research activities in support of the  
5 EPA’s Strategic Plan’s goal of *Protecting America’s Waters*. The major research topics were developed  
6 from an overarching theme of maintaining environmental, social and economic sustainability in the face  
7 of significant stressors, including climate change, extreme events, land use, aging infrastructure and  
8 population growth.

9  
10 Recommendations:

- 11       • Prioritize research in order to allocate resources across research areas, balance immediate and  
12       long-term needs, and leverage areas of strength completed by partnerships.  
13       • Plan for the human resource needs required by increased collaboration, integration and  
14       partnerships.  
15       • Anticipate regional needs and changing demographics.  
16       • Develop models with appropriate capability to communicate uncertainties.  
17       • Communicate the concept that wastewater is a resource.  
18       • Increase integration with ORD’s Human Health Risk Assessment and ACE programs and with  
19       other federal agencies.  
20       • Build on the EPA’s dual role of research and regulation to identify a unique research role in  
21       moving toward a sustainable water-energy future.

22 **Chemical Safety for Sustainability and Human Health Risk Assessment Research**

23  
24 Overall, the draft StRAPs for the EPA’s Chemical Safety for Sustainability (CSS) and Human Health  
25 Risk Assessment (HHRA) research programs are scientifically robust and well aligned to the  
26 overarching EPA Strategic Plan. In fact, the programs were considered to be on a path to revolutionize  
27 chemical safety assessment and viewed as cutting edge and leading the field.

28  
29 Recommendations:

- 30       • Communicate more effectively the priorities within the programs and the approach to priority  
31       setting.  
32       • Clarify the intended uses of new tools.  
33       • Build confidence in new approaches for assessing safety.  
34       • Continue integrating in a targeted and purposeful manner.  
35       • Advance exposure-based approaches.  
36       • Take a methodical, step-wise approach to incorporation of novel data streams.  
37       • Develop novel approaches to address cumulative risk in a holistic manner.  
38       • Continue to emphasize communication, education and outreach.  
39

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1 **Sustainable and Healthy Communities**  
2

3 ORD's Sustainable and Healthy Communities (SHC) StRAP provides a thoughtful, applied roadmap for  
4 advancing high priority agency research. SHC focuses on conducting basic research on community-  
5 oriented environmental and health issues, and providing information to communities and the agency's  
6 regional offices concerning the development and application of sustainable practices relating to  
7 environment, society and economy.  
8

9 Recommendations:

- 10 • Address the challenges of developing good decision support tools and maintaining and sustaining  
11 partnerships.
- 12 • Communicate that environmental health is a critical driver of overall human well-being and that  
13 sustainability at the community level requires recognition and understanding of the coupled  
14 human-natural system.
- 15 • Plan for robust and flexible decision tools.
- 16 • Assess emerging environmental issues with special attention to changing demographics,  
17 cumulative impacts, and energy-related environmental impacts.
- 18 • Make integration of research planning a priority for management and capacity building.
- 19 • Address ecological and human health as an integrated, coupled human-natural system.
- 20 • Continue and expand research focused on defining and measuring well-being, building on  
21 existing resources on this topic.
- 22 • Conduct a thorough review of ongoing research in the science of sustainability.
- 23 • Look outside the agency for ideas about research methods.
- 24 • Build transdisciplinary and applied social science research capacity within ORD.
- 25 • Clarify the "three pillars" approach to sustainability.  
26

27 **Homeland Security**  
28

29 The Homeland Security research program (HSRP) has a primary mandate of performing research related  
30 to the EPA goals of protecting water supplies and on post-disaster clean-up in both indoor and outdoor  
31 environments. The original focus was on chemical, biological, and radiological threats from terrorists  
32 but the mission has recently been broadened in the draft StRAP to include "all threats" to water supplies  
33 and post-disaster cleanup regardless of the source (e.g., terrorist, natural disasters).  
34

35 Recommendations:

- 36 • Explore a systems approach and partnerships to stretch limited resources to help meet the HSRP  
37 historical focus and new "all threats" mission.
- 38 • Plan for tools relevant to multiple related hazards and invest in innovative approaches.
- 39 • Maintain the current high level of integration with ORD research programs and terrorism-related  
40 research of other agencies and build partnerships with non-terrorism, disaster-related agencies as  
41 well as EPA regional offices.
- 42 • Plan to integrate terrorism-related and non-terrorism disaster response and prevention research.
- 43 • Clarify in the StRAP what is meant by the HSRP systems approach and how it will be used in  
44 research planning.

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1  
2 **Children's Environmental Health**  
3

4 The Children's Environmental Health (CEH) cross-cutting roadmap preliminary draft is superbly  
5 developed and represents a great start to integrating research on CEH across the six programs. The  
6 EPA's ORD has a unique niche and important leadership role in selecting CEH as a cross cutting area.  
7

8 Recommendations:

- 9
- 10 • Develop a more comprehensive translation research strategy to enhance the links from basic and  
11 observational science to intervention/implementation science to community action/policy toward  
12 the goal of improving children's health.
  - 13 • Clarify and support research on communities' roles and involvement
  - 14 • More clearly describe how research themes in the StRAPs will be integrated to support the issues  
15 described in the CEH roadmap. Identify mechanisms for motivating ORD research programs to  
16 be responsive to the roadmap and to evaluate their responsiveness.
  - 17 • Recognize and optimize the role of leveraging partnerships and prior investments.
  - 18 • Research gaps are noted but more specificity and synthesis is needed.
  - 19 • Describe how research priorities will be set.
  - 20 • Identify mechanisms for motivating and evaluating the responsiveness of ORD's research  
programs to the CEH roadmap.

21 **Nitrogen and Co-pollutants**  
22

23 Research on the biogeochemical cycling of nitrogen and co-pollutants spans multiple environmental  
24 media and requires integration of basic science, models and mechanisms across multiple EPA program  
25 areas. Consequently it is an excellent choice for cross-cutting research and integration across ORD  
26 program areas. The Nitrogen and co-pollutants roadmap is well written and well organized. It is highly  
27 responsive to previous SAB input and recommendations (U.S. EPA SAB 2011b).  
28

29 Recommendations:

- 30
- 31 • Strengthen discussion of nutrient resource recovery and related technologies.
  - 32 • Expand discussion of linkages with the SHC and ACE programs.
  - 33 • Expand discussion of agriculture and agriculture-related research.
  - 34 • Include an extended discussion of uncertainties associated with modeling and assessment of  
impacts of proposed management actions.
  - 35 • Clarify how research priorities are set based on gap analyses and consider a "value of  
36 information assessment" approach.

37 **Climate Change**  
38

39 Creating the EPA climate change cross-cutting roadmap is a challenge and the current draft roadmap on  
40 climate change is somewhat disappointing. The EPA's resources devoted to climate change, a critical  
41 environmental issue, are a small percentage of the overall federal climate change budget. ORD can best

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1 approach this budget challenge by focusing resources on “actionable science” that informs ways the  
2 EPA can help address how climate influences air and water quality.

3  
4 Recommendations:

- 5 • Describe how planned research will inform future EPA decision making.
- 6 • Describe more clearly the ORD climate change research niche (“actionable science” and its plan  
7 to work with other international and federal partners to ensure EPA’s science needs are met).
- 8 • Improve the presentation and flow of the climate change roadmap.
- 9 • Identify research priorities associated with the problem statement.
- 10 • Expand the roadmap discussion of “Research gaps and priority research needs” (social sciences,  
11 uncertainties, decision-relevant scale, and synthesis).
- 12 • Provide a discussion of how the roadmap will be used to guide research.

13 **Environmental Justice**

14  
15 The Environmental Justice roadmap provides a good framework for a research path in environmental  
16 justice. Although the problem statement is well described, specific goals and objectives are not. Without  
17 anticipated achievements, it is difficult to know which steps should be taken in a research roadmap to  
18 lead to effective results.

19  
20 Recommendations:

- 21 • Incorporate input from communities to identify problems associated with environmental,  
22 biological, behavioral, social, economic and spatial stressors, and how they interrelate.
- 23 • Integrate community participation throughout each science challenge and have community  
24 individuals inform the research process.
- 25 • Consider including examples to illustrate relationships to ORD’s six research areas and  
26 employing Community-Based Participatory Research (CBPR) to promote research relevance.

27 **Integration across ORD programs**

28  
29 Integration is critical given the EPA’s resource-limited environment and the interdisciplinary and cross-  
30 program nature and application of the science data, tools, knowledge and products ORD plans to  
31 produce. Integration must occur internally within the EPA, external to the EPA within the United States  
32 with the agency’s partners, and internationally. The ORD’s cross-cutting roadmaps represent a very  
33 important step forward. The SAB and BOSC commend ORD’s progress in undertaking this integrated  
34 planning, and offer recommendations for strengthening the roadmaps and making them more consistent,  
35 moving from research planning to research execution, and defining a successful process for providing  
36 research to decision makers that incorporates institutional learning about that process.

37  
38 Recommendations:

- 39 • Strengthen the roadmaps and make them more consistent with each other and with the StRAPs.
- 40 • Identify and communicate ORD research priorities in the roadmaps and commit ORD resources  
41 to them.
- 42 • Acknowledge and plan for actual integration, which requires active collaboration from the onset.

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- 1 • Plan for the human resource and information needs required to carry out integrated research
- 2 programs.
- 3 • Identify the criteria or a process for evaluating research “results that advance EPA's ability to
- 4 address complex problems.”
- 5 • Implement a process for identifying ORD cross-cutting research topics and managing their life
- 6 cycle.

7

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**2. BACKGROUND AND CHARGE**

The EPA’s research programs in the Office of Research and Development (ORD) are structured to understand environmental problems and inform sustainable solutions to meet the agency’s strategic goals. The research programs are organized into six national program areas: Air, Climate, and Energy; Safe and Sustainable Water Resources; Sustainable and Healthy Communities; Chemical Safety for Sustainability; Human Health Risk Assessment; and Homeland Security.

After receiving advice from the Science Advisory Board and Board of Scientific Counselors in 2011 (U.S. EPA SAB 2011a) on new strategic directions for its research programs and in 2012 on implementation of these programs (U.S. EPA SAB 2012), ORD requested the SAB and BOSC to provide early advice to inform research planning for the period 2016-2019. This planning included development of Strategic Research Action Plans (StRAPs) for the six program areas and “roadmaps” for four cross-cutting areas (Children’s Environmental Health, Nitrogen and Co-pollutants, Climate Change, and Environmental Justice)

The SAB and the BOSC held a public meeting on July 24-25, 2014, to discuss the preliminary draft StRAPs and roadmaps. The SAB and the BOSC also held a public teleconference on (INSERT DATE) to discuss a draft of this report.

ORD requested the SAB and the BOSC to address a series of charge questions provided in Appendix A. The charge included general questions related to ORD strategic directions; program-specific topics; roadmaps for cross-cutting topics; and program integration.

Section 3 provides responses to overarching, ORD-wide questions. Section 4 provides responses to ORD’s program-specific charge questions. Section 5 addresses questions concerning the draft roadmaps for ORD’s four cross-cutting topics and for ORD programs more generally. Additional technical comments for each cross-cutting topic are included in Appendix B. Discussions of ORD programs and cross-cutting topics appear in this report in the order they were discussed during the face-to-face meeting on July 24-25, 2014. All sections include recommendations, organized by the charge questions.

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### 3. GENERAL FINDINGS AND OVERARCHING RECOMMENDATIONS

#### 3.1. Relationship to the EPA Strategic Plan

*Charge Question 1(a). Considering the proposed research directions and focus, how well is ORD as  
a whole poised to support EPA in meeting the goals of the EPA Strategic Plan?*

In its strategic plan (U.S. EPA 2014), the EPA has committed itself to five environmental goals (Addressing Climate Change and Improving Air Quality; Protecting America’s Waters; Cleaning Up Communities and Advancing Sustainable Development; Ensuring the Safety of Chemicals and Preventing Pollution; Protecting Human Health and the Environment by Enforcing Laws and Assuring Compliance) and to five cross-cutting strategies (sustainability; communities; partnerships; and a high performing organization). ORD’s draft StRAPs and roadmaps show high-level strategic thinking in linking ORD’s research efforts to the EPA strategic plan and in framing, in a coordinated way, how ORD programs support progress toward the goal of sustainability. This represents a sea change in EPA’s research planning. The draft documents are effective tools for communicating how the EPA’s complex and inter-related research relates to the agency’s mission, with one important caveat. The reorganization and redirection of ORD over the past decade and the specific research plans presented in the draft 2016-2019 StRAPs are directed toward providing the scientific foundation for a new integrated systems approach that attends to broad goals of enhanced and sustained health of the environment and the health and well-being of human communities. In contrast to the more traditional focus on informing regulation and compliance, this new broader mission may not be well understood and accepted by other parts of EPA, by the regulated community, and by the public. To the extent that client/public understanding and support is lacking, the ORD should consider making a more concerted effort to “prepare the ground” for the new directions they intend to pursue in the coming decades.

Although the ORD plans are impressive, evaluating the StRAPs and roadmaps as internal strategic planning documents proves challenging without knowing more information about ORD resources, personnel, and personnel backgrounds and capabilities. Given stable or declining funding (in real terms) overall across program areas, there is some concern that the ambitious language in the StRAPs and roadmaps is not likely to match concrete research deliverables. The SAB and BOSC offer the recommendations immediately below to help ORD develop more effective research plans to support the EPA in meeting the goals of the agency Strategic Plan. Recommendations relating to strengthening the relationship of specific national programs to the EPA Strategic Plan may be found in the discussion of each program in section 4.

***Recommendation: Communicate more consistently the EPA’s specific research niche and how ORD plans to partner with other entities, including international organizations and other federal agencies.***

Given the complexity of environmental problems and stable or declining resources, the StRAPs and roadmaps should communicate ORD’s specific research focus within larger environmental issues and describe how ORD or the agency more broadly is meeting the science and research needs associated with those issues. The need for international cooperation is appropriately emphasized generally, but the StRAPs and roadmaps do not describe how the EPA plans to take advantage of knowledge created outside the United States and, in some cases, the StRAPs appear to be “reinventing the wheel.” For example, the Chemical Safety for Sustainability StRAP does not mention two major international programs of direct relevance to that StRAP, namely the European Union Registration, Evaluation,

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1 Authorisation and Restriction of Chemicals (REACH) Program, and the Canadian Priority Substances  
2 List. Similarly, the ORD can only focus on a small component of climate change research important to  
3 the EPA. How will other agency climate change research needs be met and how can ORD best leverage  
4 the many national and international efforts in this area?  
5

6 **Recommendation: Use the StRAPs and roadmaps to communicate the most important priorities for**  
7 **ORD to address.** As noted above, the plans and research directions for the six ORD research programs  
8 are generally well aligned to support EPA in meeting the goals of the EPA Strategic Plan. The challenge  
9 is that many of the planned activities are under-funded, often leading to narrow project scopes with  
10 modest projected impact. Considering the broad mission and range of expectations for ORD research  
11 programs and the reality of steadily declining ORD budgets, there is no easy way to address this  
12 shortcoming. ORD should seek advice from the SAB and BOSC to help it prioritize, rather than just  
13 expanding the list of general research that EPA should be doing by virtue of its broad mission.  
14

15 **Recommendation: Communicate more clearly how planned research will inform specific agency**  
16 **decisions.** ORD can best support the EPA's strategic goals if it develops research that is clearly linked to  
17 the information needs of agency decision makers and adheres to the EPA Strategic Plan core value of  
18 "transparency." ORD should consider expanding the use of the "dashboard for decision makers," which  
19 provides access to ORD-generated tools and research, as articulated by the Chemical Safety for  
20 Sustainability program, into other ORD programs.  
21

22 **Recommendation: Describe how decision makers will access information about the uncertainties**  
23 **associated with ORD-generated tools and data.** In general, users of ORD research need more  
24 information on the reliability of models and forecasts, how to interpret the results of uncertainty  
25 analyses, and how uncertainty analysis will be incorporated into systems-based modeling approaches.  
26 Environmental complexity and biological variability make it critical to conduct and present results of  
27 uncertainty analysis, including statistical reliability of models, contexts where models are tested and  
28 found to be reliable, as well as contexts where models are not as reliable or where reliability has not  
29 been established, and how linking models impacts overall uncertainty. Essential elements include model  
30 verification, calibration and sensitivity analyses, particularly in the context of complex, linked models  
31 and systems-based models in which feedback loops may lead to unexpected outcomes.  
32

33 **Recommendation: Clarify how sustainability relates to the specific research planned in each program**  
34 **and how sustainability is operationally defined in each program.**

35 Although sustainability is presented as a central cross-cutting focus of the StRAPs, the formal role of  
36 sustainability is presented only in abstract terms, and sustainability tradeoffs are not discussed. The  
37 StRAPs do not convey a research agenda driven by the type of detailed, transparent consideration of  
38 sustainability recommended by the National Research Council (NRC 2011). The overall agency  
39 strategic plan appears to adopt the original National Environmental Policy Act definition of  
40 sustainability: "conditions under which humans and nature can exist in productive harmony and fulfill  
41 the social, economic, and other requirements of present and future generations," yet the specific  
42 manifestation of the sustainability concept and relevance for each program's research remains largely  
43 abstract and unstated. In at least one of the StRAPs (HHRA), the word sustainability could be entirely  
44 stricken from the document without any obvious impact. All of the StRAPs would benefit from a more  
45 explicit treatment of sustainability, including how the concept is defined and how it influences the

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1 specific research that is proposed. What *specific* changes in ORD's proposed research strategies have  
2 resulted and will result from the incorporation of sustainability as a guiding theme?  
3

4 ***Recommendation: Explain how ORD will develop or access the social, economic and behavioral***  
5 ***science needed to achieve the goals of the EPA's Strategic Plan.***

6 In terms of strategic emphasis, clarity, and motivations, the StRAPs are best developed in ORD's  
7 traditional areas of strength such as the natural sciences, risk assessment and human health. The draft  
8 StRAPs provide good roadmaps for continuing progress in these areas. Supporting the EPA Strategic  
9 Plan's six major goals and focus on sustainability, however, requires the agency to develop or access  
10 social, economic, and behavioral sciences. Past reviews of ORD research planning (U.S. EPA SAB  
11 2011a, 2012) have noted the lack of a clear research agenda and expertise required to address important  
12 social, economic and behavioral dimensions of the EPA's goals. This shortcoming remains evident in  
13 the current ORD planning documents. The draft StRAPs are not well-developed in the social, economic  
14 and behavioral sciences and in cross-cutting areas that involve these sciences. Although social,  
15 economic and behavioral aspects are mentioned in the StRAPs, the discussion is less sophisticated and  
16 developed compared to parallel topics in natural science, risk and health. Although the relative  
17 importance of social sciences varies across ORD program areas, social and human dimensions are  
18 relevant to all areas.

19 **3.2. Overall perspectives on proposed research to address environmental issues of 2020 and**  
20 **beyond**

21 *Charge Question 1(b). What are the SAB/BOSC perspectives overall on the proposed research*  
22 *directions providing research to address environmental issues of 2020 and beyond?*  
23

24 ORD has made significant progress through the StRAPs and roadmaps in placing its research in a  
25 framework of the anticipated major environmental challenges confronting the United States. However,  
26 this charge question is difficult for the SAB and BOSC to address because the ORD draft planning  
27 documents did not distinguish between longer-term vs. near term needs. The SAB and BOSC offer  
28 recommendations to position ORD research so it explicitly addresses environmental issues of 2020 and  
29 beyond and also offers recommendations for particular areas of focus. Recommendations relating to the  
30 capacity of proposed research described in specific StRAPs to address environmental issues of 2020 and  
31 beyond may be found in the discussion of each program in section 4.  
32

33 ***Recommendation: Invest in research focused on early detection of future environmental problems.***

34 Although the draft StRAPs and roadmaps clearly acknowledge the complexity of emerging issues  
35 indicated in the EPA Strategic Plan, more detail could be provided on how these longer-term focal  
36 points and emergent issues might be better anticipated. ORD should better articulate early risk  
37 detection efforts at multiple geographic and temporal scales. A considerable amount of work outlined  
38 in the strategic plans involves assessment efforts, yet these may not be tuned to pick up on outliers  
39 that might be emerging and trend analysis to monitor trajectories of issues not yet in the cross-hairs of  
40 EPA programs and research. Early detection requires ongoing consultation with advisors and a wide  
41 spectrum of partners, stakeholders and experts to identify emerging problems and research needs.  
42

43 Although the SAB and BOSC review does not permit an extended discussion of future environmental  
44 issues, this report suggests that many anticipated issues will arise as a direct result of the tension

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1 between growth (e.g., population, consumption, economic) and finite resources (e.g., natural  
2 resources, biodiversity) and the ways in which a constrained ecological system can best be managed  
3 to meet human needs. SAB and BOSC members suggest that ORD consider the following focal points  
4 (a combination of stressors, drivers, and impacts) in revising ORD's StRAPs and roadmaps to include  
5 discussion of future environmental challenges: (1) climate change; (2) habitat loss; (3)  
6 introduced/invasive species; (4) eutrophication; (5) chemical contamination; (6) evolving  
7 demographics and social systems; (7) technologies affecting the extraction and use of energy; and (8)  
8 continued transformations of land use and land cover.

9  
10 ***Recommendation: Add a section to each StRAP and roadmap whose purpose is to describe research***  
11 ***needs for the next decade.***

12 ORD's proposed research directions are focused on the near future (e.g., 2016-2019) rather than on 2020  
13 and beyond. Adding to each StRAP and roadmap a section whose purpose is to describe research needs  
14 of the next decade (2020s) and how current research relates to anticipated future issues would force the  
15 discussion. The section should discuss how those anticipated future needs will be identified and the  
16 process for managing the evolution of the research program. The exercise would also help direct ORD's  
17 current research projects and objectives into the future.

18  
19

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## 4. PROGRAM-SPECIFIC RECOMMENDATIONS FOR RESEARCH

### 4.1. Air, Climate and Energy

The EPA’s Air, Climate, and Energy (ACE) research program has a strong strategic plan, linking well to the EPA Strategic Plan and agency priorities, and addressing some of the most important current and emerging issues facing environmental quality, human health, and society in the coming decades. The program is exceptionally broad, with its scope encompassing criteria air pollutants, greenhouse gases, climate change, and energy. Energy, in particular, is an extensive component, as the life cycle of energy influences all elements of the environment, and overlaps with the other five program areas.

#### 4.1.1. Support for the *EPA Strategic Plan* and Overall perspectives on proposed research to address environmental issues of 2020 and beyond

*Charge Questions 2a and 2b. How well will the research directions in each Early Draft StRAP (2016-2019) support EPA in achieving the relevant Agency objectives and cross-cutting strategies, as described in the EPA Strategic Plan (2014 -2018)? What are the SAB/BOSC perspectives on the proposed research directions in the StRAP providing research to address environmental issues of 2020 and beyond?*

***Recommendation: Document the progress addressing greenhouse gases resulting from agency programs and plan the research needed to inform future decisions.***

While the SAB and BOSC found the overall structure and substance of the ACE strategic plan to be sound, this report suggests a few changes that will strengthen the presentation and sharpen the focus. The plan is ambitious, and as such, may seem to be difficult to achievable. The StRAP should be revised to include a bold statement of what the EPA can do to forge a better future. A compelling introduction might begin by reporting on the potential success of the new greenhouse gas regulations in reducing emissions. While the Climate Action Plan is mentioned, the transformational nature of the EPA’s new role in greenhouse gas emissions should be declared as an example of how the new vision and strategic plan can compel major advances for air, climate, and energy both nationally and internationally.

***Recommendation: Include a conceptual framework linking program elements in the ACE StRAP.***

A graphical representation of a conceptual framework at the outset will allow the reader to understand the scope, focus, and anticipated impact of the program (such as that provided in the presentation given by Dr. Daniel Costa, side #4 at the July 24-25, 2014 meeting). Such a figure should show linkages among the elements of the complicated program hierarchy: (a) 3 elements of the program (air, climate, and energy); (b) the 3 research objectives (assess impacts, prevent and reduce emissions, and adapt/mitigate); (c) the 5 research topics; and (d) their short- and long-term aims. Such a diagram and description at the outset might further crystallize motivations and necessary interactions. The objectives are not presented until quite late in the document, but represent the driving force for the strategic plan. A crisp vision for each of the research objectives should be succinctly presented at the very outset in format that links clearly to the conceptual framework.

***Recommendation: Clarify relative priorities, with respect to budget distribution and interactions with other agencies***

The scope of the program is very large, but investments in the individual components (air, climate, and energy) are skewed, with a very large proportion of the effort focused on the “air”, relative to the

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1 “climate” and “energy” elements. This occurs both as a result of the traditional focus on criteria  
2 pollutants within the EPA, and because other federal agencies deploy enormous resources toward  
3 climate and energy research issues [e.g. National Oceanic and Atmospheric Administration (NOAA),  
4 the Department of Energy (DOE), the U.S. Global Change Research Program]. Explicit recognition of  
5 the priorities, how they are reflected in the budget, and in turn how ACE anticipates resource allocations  
6 shifting as a result of the strategic plan should occur early and clearly in the document. Targets for inter-  
7 agency actions that will assist ORD in meeting its climate and energy goals should be elaborated.  
8 Research on mitigation represents a special opportunity for collaborative work that could be led by the  
9 EPA.

10  
11 ***Recommendation: Elaborate and/or expand the research to be conducted on mitigation of climate***  
12 ***change impacts.***

13 The current document (in the research topic on Climate Change Impacts, Mitigation, and Adaptation) is  
14 unclear with respect to what work is planned related to mitigation. For instance, there are no short-term  
15 goals at all related to mitigation. The SAB and BOSC recommend proposing tractable work in this  
16 arena. Connecting the work to the Intergovernmental Panel on Climate Change (IPCC) report on  
17 mitigation would be helpful.

18  
19 ***Recommendation: Focus the distributed monitoring of air quality on quality data collection and***  
20 ***distribution to citizens.***

21 The current document (in the research topic on emissions and monitoring) mixes two endpoints of a  
22 spectrum of environmental data from, on one end, accurate and precise regulatory-quality data from a  
23 limited number of sites, to the other end, ubiquitous citizen-science generated data of uneven overall  
24 accuracy and precision. The SAB and BOSC recommend that ACE work with and motivate  
25 entrepreneurs for the development of extensive high quality data that are available to civil society in real  
26 time and potentially available for use for regulatory purposes. The rapid advances in sensing technology,  
27 the concomitant increases in accuracy and precision, and decreases in cost have highlighted the potential  
28 to deploy environmental sensors at orders of magnitude greater density than is currently the case. When  
29 combined with effective visualization, it is possible to provide civil society with a much greater  
30 understanding of variations in environmental quality at a scale that matters to individuals. ORD is well  
31 positioned to help ensure that the quality of the data that flows from this sensor revolution is both  
32 accurate and inter-compatible. Given the large private investment already being made in the  
33 development of sensors, a convening and coordinating role is where ORD’s investment would have the  
34 largest leverage.

35  
36 ***Recommendation: Consider explicit focus and analysis of agricultural sources and other land use***  
37 ***contributions to air pollution.***

38 Agricultural sources of air pollutants are significant. These sources include hazardous air pollutants,  
39 ammonia, methane and nitrogen dioxide fluxes stemming from fertilization and livestock, particulate  
40 matter from cultivation practices, and both direct and indirect impacts of energy use in agricultural  
41 production. The draft StRAP (essentially all research topics: Climate Impacts, Mitigation and  
42 Adaptation; Emissions and Measurements; Modeling and Decision Support; National Ambient Air  
43 Quality Standards and Multipollutant; Sustainable Energy Evaluation) is silent on agricultural sources,  
44 and their inclusion in the strategic plan and subsequent research is important.

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1 ***Recommendation: Provide more specific targets for the short-term research aims.***

2 The current table in the strategic plan provides both short- and long-term research aims for each of the  
3 research topics. The short-term goals are likely still too diffuse and it will be difficult to identify metrics  
4 that will allow evaluation of success. The SAB and BOSC recommend more specific targets focused on  
5 key knowledge gaps that can be used to define those metrics and actionable work plans.

6 **4.1.2. Design for integration**

7 *Charge Question 2c. Did the presentations and plans indicate that ORD is designing for integration,*  
8 *where appropriate, on topics that are relevant to other research programs?*

9  
10 ***Recommendation: Consider specifying projects that integrate ACE with other programs.***

11 The current ACE strategic plan presents opportunities for integration with other programs but does not  
12 identify goals for integrated research. Such goals for integrated projects would assure that the work  
13 occurs. The Sustainable and Healthy Communities program provides especially good synergy, with  
14 respect to the Emissions and Monitoring research aim, and the Sustainable Energy Evaluation research  
15 aim. Neither of these relationships is currently identified.

16 **4.1.3. Integrating ACE research elements as a coherent whole**

17 *Charge Question 3: Does the SAB/BOSC have suggestions regarding how ACE should target its*  
18 *efforts to understand, model, and convey the potential environmental impacts of possible energy*  
19 *choices?*

20  
21 ***Recommendation: Consider incorporating energy efficiency/conservation research.***

22 The StRAP (Research Topic 5: Sustainable Energy Evaluation) avoids the topic of energy efficiency and  
23 energy conservation, even though energy use represents the single largest source of pollutants and  
24 increased efficiency is one of the most achievable means for reducing energy-related impacts. The  
25 EPA's Office of Atmospheric Programs manages the Energy Star program, which emphasizes the  
26 implementation of incentives for energy efficiency on a small-scale. Will ACE conduct research related  
27 to the behavioral and economic forces related to energy efficiency or on the opportunities for innovation  
28 in the arena of energy conservation and efficiency?

29  
30 ***Recommendation: Plan to incorporate renewable energy scenarios and pathways developed by other***  
31 ***organizations in ORD's analysis of environmental impacts.***

32 ORD should plan to use the renewable energy scenarios and pathways developed by other organizations  
33 as bases to analyze environmental impacts of importance to the EPA. For example, because of EPA's  
34 significant expertise in applied life sciences, it would be useful to engage DOE and other relevant  
35 agencies in the development of synthetic biology methods, which are already in research and  
36 development in the private sector as an alternative means of chemical synthesis and renewable biobased  
37 energy. The StRAP should include more discussion of ORD's coordinating efforts with DOE, the U.S  
38 Department of Transportation, U.S. Department of Agriculture and NOAA around likely scenarios for  
39 alternative fuels, vehicle standards, conservation, renewables and the reasons for their selection.

40 **4.2. Safe and Sustainable Water Resources**

41 The Safe and Sustainable Water Resources (SSWR) StRAP outlines research activities in support of the  
42 EPA's Strategic Plan's goal of *Protecting America's Waters*. The major research topics were developed

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1 from an overarching theme of maintaining environmental, social and economic sustainability in the face  
2 of significant stressors, including climate change, extreme events, land use, aging infrastructure and  
3 population growth. The purpose of the StRAP is to guide resources and activities over the next four  
4 years. The current plan is in its early stages and will be further developed and refined over the next year  
5 in consultation with numerous EPA partners and stakeholders.

6 **4.2.1. Support for the EPA Strategic Plan**

7 *Charge Question 2a. How well will the research directions in each Early Draft StRAP (2016-2019)*  
8 *support EPA in achieving the relevant Agency objectives and cross-cutting strategies, as described*  
9 *in the EPA Strategic Plan (2014 -2018)?*

10  
11 ***Recommendation: Prioritize research in order to allocate resources across research areas, balance***  
12 ***immediate and long-term needs, and leverage areas of strength completed by partnerships.***

13 The four priority areas in the StRAP - watershed sustainability, nutrients, green infrastructure, and  
14 water systems – align well with the Strategic Plan at a high level and represent a balanced plan for the  
15 next four years. ORD is commended for the efforts taken to parse all of the potential research activities  
16 into four focused target areas, but it is essential to prioritize even among these objectives given  
17 declining budgets. SSWR must determine how to allocate resources across research areas and strike a  
18 balance between meeting immediate needs of the Office of Water while continuing to work toward  
19 longer-term strategic objectives.

20  
21 There are several agencies actively involved in maintaining the health of the nation’s waters. SSWR  
22 should identify areas of strength for the EPA and strive to make significant advances in those areas  
23 while developing complementary partnerships with other agencies and stakeholders.

24 **4.2.2. Overall perspectives on proposed research to address environmental issues of 2020 and**  
25 **beyond**

26 *Charge Question 2b. What are the SAB/BOSC perspectives on the proposed research directions in*  
27 *the StRAP providing research to address environmental issues of 2020 and beyond?*

28  
29 ***Recommendation: Plan for the human resource needs required by increased collaboration,***  
30 ***integration and partnerships.***

31 As SSWR works to meet its research goals, partnerships will be essential. While the EPA should  
32 focus on identified research areas, the agency cannot move forward without strong collaborations  
33 across other agencies, both within the United States and internationally. Within the EPA,  
34 collaboration should occur at the ORD level, not just at the level of individual researchers. As the  
35 need for collaboration increases, additional staff dedicated specifically to developing and maintaining  
36 integration within and outside of the agency will be needed.

37  
38 As SSWR plans for future research areas and begins to recruit researchers with the necessary  
39 expertise, it should develop a strategic plan to adequately meet human capital needs. Some examples  
40 include: strategic use of postdoctoral fellows, development of methods to foster mobility for current  
41 EPA scientists, and hiring of social scientists.

42 ***Recommendation: Anticipate regional needs and changing demographics.***

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1 SSWR should continue to anticipate regional issues as well as understand the implications of  
2 changing population demographics. Research on regional and watershed scales (e.g., wildfires,  
3 drought) should be included in overall research activities. Changing populations will affect the size  
4 and characteristics of populations being exposed to certain contaminants, as well as the types of  
5 contaminants present in water and other environmental media. De-population of urban areas (e.g.,  
6 Detroit) should also be considered as this phenomenon may affect resiliency to extreme events, for  
7 example.

8  
9 A stronger focus on invasive species related to regional and national needs should be included,  
10 including implications of climate change and modeling/prediction of secondary transport.

11 ***Recommendation: Develop models with appropriate capability to communicate uncertainties.***

12 In general, model results should clearly communicate uncertainties and limitations to decision makers  
13 and the public. Wherever possible, uncertainty should be quantified. This can be done by  
14 complementing the use of complex process models that do not allow estimation of uncertainties with  
15 simpler, probabilistic models that lend themselves to uncertainty analysis.

16  
17 ***Recommendation: Communicate the concept that wastewater is a resource.***

18 SSWR should actively promote the transition of the term “wastewater” to “resource” to reflect that  
19 wastewater is a secondary resource that has potential for multiple beneficial reuses, both as a source of  
20 water but also as a source of trace metals.

21 **4.2.3. Design for integration**

22 *Charge Question 2c. Did the presentations and plans indicate that ORD is designing for integration,*  
23 *where appropriate, on topics that are relevant to other research programs?*

24  
25 ***Recommendation: Increase integration with ORD’s Human Health Risk Assessment and ACE***  
26 ***programs and with other federal agencies.***

27 The SSWR research plan is generally well integrated with other programs. The plans indicate linkages  
28 between the four priority research areas in SSWR and other programs. Strong linkages exist with  
29 Sustainable and Healthy Communities, but integration with Human Health Risk Assessment should be  
30 increased. Additional focus on the water-energy nexus would strengthen the existing integration with  
31 the ACE StRAP. Beyond integration among the ORD programs, the SSWR StRAP should reflect  
32 improved engagement and collaboration with other agencies, particularly USDA and DOE.

33 **4.2.4. Research for a sustainable water-energy future**

34 *Charge Question 5a. Where can EPA make a significant research contribution in moving toward a*  
35 *sustainable water-energy future, with consideration of energy, water, nutrients, and other*  
36 *resources?*

37  
38 ***Recommendation: Build on the EPA’s dual role of research and regulation to identify a unique***  
39 ***research role in moving toward a sustainable water-energy future.***

40 The StRAP positions the EPA well in the water-food-energy-climate space, and builds on the EPA’s  
41 dual role of research and regulation. Since there are many agencies with interest, expertise and resources  
42 dedicated to the water-energy nexus, it is important that the EPA carve out a unique role by partnering  
43 with other players and actors in this area and avoid duplication of efforts.

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1  
2 The EPA’s work in providing technical assistance to municipalities is useful, particularly for small  
3 systems that lack a research budget. Expertise in areas such as water reuse and systems analysis will  
4 help to reduce energy needs in water treatment and distribution, as well as to develop a life-cycle  
5 approach for water. Strengths in fate and transport modeling, uptake and human and environmental risk  
6 analysis are additional assets for the EPA. Additional focus could be added to climate uncertainties,  
7 understanding extreme conditions and events, and developing mechanisms for adapting to and managing  
8 these situations.

9  
10 The EPA could make a significant contribution in deployment of policies and technologies to address  
11 the water-energy nexus (e.g., social and technological aspects of green infrastructure adoption,  
12 development of monitoring technologies and approaches).

13 **4.3. Chemical Safety for Sustainability and Human Health Risk Assessment Research**

14 Overall, the draft StRAPs for the EPA’s Chemical Safety for Sustainability (CSS) and Human Health  
15 Risk Assessment (HHRA) research programs are scientifically robust and well aligned to the  
16 overarching EPA Strategic Plan. In fact, the programs were considered to be on a path to revolutionize  
17 chemical safety assessment and viewed as cutting edge and leading the field. While the current iterations  
18 of the StRAPs were intentionally high-level strategic documents which did not include many details on  
19 implementation, the availability of the National Program Directors for CSS and HHR during preliminary  
20 webinars and the CSS/HHRA breakout group meeting was extremely helpful in providing additional  
21 clarification. The comments and recommendations below reflect common themes based on both written  
22 and verbal input from SAB and BOSC members. Unless noted otherwise, the comments apply to both  
23 the CSS and HHRA programs.

24 **4.3.1. Support for the EPA Strategic Plan**

25 *Charge Question 2a. How well will the research directions in each Early Draft StRAP (2016-2019)*  
26 *support EPA in achieving the relevant Agency objectives and cross-cutting strategies, as described*  
27 *in the EPA Strategic Plan (2014 -2018)?*

28  
29 ***Recommendation: Communicate more effectively the priorities within the programs and the approach***  
30 ***to priority setting.***

31 At a high level, the research directions appear to align with the highest priority issues for the EPA, are  
32 cross-cutting, and should help the agency achieve its objectives. However, the proposed research  
33 programs are extremely ambitious in their scope. In fact, it seems that there is enough research in the  
34 plans to last well beyond 2020, yet not enough resources to accomplish everything within the 2016-2019  
35 time frame. Therefore, it is recommended that subsequent versions of the StRAPs clearly indicate those  
36 projects which are considered highest priority and can be realistically accomplished with available  
37 resources. In setting priorities, the SAB and BOSC recommend that the landscape of relevant global  
38 research activities be considered in order to avoid duplicative efforts, and to ensure that the EPA is  
39 working in areas which best play to its strengths. Also, it will be important to resist the temptation to de-  
40 prioritize long-term programs in order to overcome budgetary constraints on more urgent deliverables.

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1 ***Recommendation: Clarify the intended uses of new tools.***

2 Both the CSS and HHRA StRAPs speak in high-level terms about generating new tools which should  
3 enable the agency to make “better informed, more timely decisions about chemicals.” While the phrase  
4 “fit for purpose” was frequently used throughout both documents, limited information was provided on  
5 what those purposes were. Therefore, it is recommended that more information on intended applications  
6 of new methods be provided to ensure that the research products which are delivered by the program  
7 actually are fit for purpose in the eyes of end users. Since National Program Directors for both programs  
8 were able to provide verbal examples of “fit for purpose” projects that they had prioritized, the SAB and  
9 BOSC recommend that these examples details be added to the plans. Some suggested applications of the  
10 new tools might include:

- 11
- 12 • Setting priorities among the research programs and plans in the StRAP.
- 13 • Using ToxCast + ExpoCast data to increase the throughput of Provisional Peer-Reviewed  
14 Toxicity Values (PPRTVs) and to increase the certainty of the ones already generated.
- 15 • Creating new Integrated Approaches to Testing and Assessment (IATA’s) and/or new  
16 Organisation for Economic Co-operation and Development (OECD) testing guidelines.

17 **4.3.2. Overall perspectives on proposed research to address environmental issues of 2020 and**  
18 **beyond**

19 *Charge Question 2b. What are the SAB/BOSC perspectives on the proposed research directions in*  
20 *the StRAP providing research to address environmental issues of 2020 and beyond?*  
21

22 ***Recommendation: Build confidence in new approaches for assessing safety.***

23 The CSS program in particular conveys an overall tone of exuberant enthusiasm, which gives the  
24 impression that the new tools are ready for use today. In reality, some new tools are very close to being  
25 ready for agency application, but many others will require much more work to prove their validity and  
26 utility. As the program contemplates its strategic direction beyond 2020, it would be extremely useful to  
27 internal and external stakeholders to have an approximate time line describing targets for transferring  
28 research products into actual practice within the agency. Such a time line would foster a methodical,  
29 step-wise transition from conventional to modern “21st century” methods and approaches, and would  
30 ultimately build stakeholder confidence. Toward this end, an iterative approach to tool creation,  
31 evaluation, and application is strongly recommended in order to maintain confidence during this period  
32 of transition. This approach should involve partnerships between researchers, end users and key  
33 stakeholders.  
34

35 A number of other activities for building confidence in new approaches also are recommended,  
36 including:

- 37 • Quality control to verify the accuracy of high throughput/high content data already collected;
- 38 • Demonstration projects in collaboration with program offices to show how new methods can be  
39 put into practice. It is recommended that highly experienced risk assessors within the agency be  
40 involved in such projects;
- 41 • Evaluation projects to qualify new methods for specific assessments;
- 42 • Leveraging of human data to evaluate the ability to predict human toxicity;
- 43 • Contingency plans to account for the possibility that predictive models may not always be  
44 predictive (especially for highly complex end points, susceptible life stages, etc.); and

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- Bridging of newer molecular and cellular level toxicity end points with conventional toxicology end points through the use of systems- and Adverse Outcome Pathway-based approaches

#### **4.3.3. Design for integration**

*Charge Question 2c. Did the presentations and plans indicate that ORD is designing for integration, where appropriate, on topics that are relevant to other research programs?*

***Recommendation: Continue integrating in a targeted and purposeful manner.***

Integration is clearly and deliberately emphasized in both StRAPs. In fact, both programs have already come a long way in terms of integrating and collaborating with other programs inside the EPA and with federal partners, in no doubt due to a robust process in place to drive this integration. CSS/HHRA are expanding integration by working with, or planning to work with, the World Health Organization, the European Commission (European Chemicals Agency, the Joint Research Centre), OECD, and China. The CSS/HHRA discussed their revised approaches to work with these groups using a targeted approach that addresses the EPA's needs. Given the time consuming and labor intensive nature of integration, ORD's targeted and purposeful approach to integration is applauded. As mentioned previously, it is important to know what other organizations are doing in this space so that the efforts to integrate are synergistic rather than duplicative.

One important area of integration which appears to have been overlooked is the need to pay close attention to large-scale chemical assessment programs in other regions of the world (e.g., European Union's REACH, Korea and China) which continue to generate animal toxicity data on hundreds, if not thousands of chemicals. Will these data preempt the need for high throughput data on these same chemicals? Can the EPA partner with these organizations on the development of alternative, non-animal approaches? Can some of the subchronic animal data generated in REACH be used to predict longer-term toxicity end points (notwithstanding issues around access to proprietary data)?

#### **4.3.4. Exposure and response assessment approaches for the HHRA program**

*Charge Question 6a. Please comment on approaches the HHRA research program might target to better tailor its exposure and response assessment approaches to address fit-for-purpose characterizations (e.g., risk prioritization, risk screening, risk assessment).*

***Recommendation: Advance exposure-based approaches.***

There was strong support for the use of risk-based approaches which combine hazard identification, dose-response assessment and exposure, as these should enable the agency to allocate resources to the problems that will have the greatest impact on public health. In fact, the effort to obtain exposure data on a large universe of chemicals in different products at a variety of life stages is truly game-changing. Incorporation of exposure into early stage screening (e.g., endocrine screening) will make such screening more effective and meaningful. Exposure data also are necessary for the field to move away from the conventional high-dose animal testing paradigm to a modern testing paradigm which is more relevant to human and ecological exposures.

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1 **4.3.5. Novel data streams**

2 *Charge Question 6b. Please comment on approaches proposed by CSS and HHRA research*  
3 *programs to identify and integrate novel data streams to develop innovative fit-for-purpose*  
4 *assessment products.*

5  
6 ***Recommendation: Take a methodical, step-wise approach to incorporation of novel data streams.***

7 As a general concept, the SAB and BOSC support the increased incorporation of novel data streams into  
8 EPA assessments. With respect to high throughput and/or high content data, there are questions about  
9 what these new data are telling us and how they will be used in different types of assessments. As  
10 mentioned previously, the StRAPs would benefit from more clarity and detail around the intended uses  
11 of these new data for various agency programs as the approach to using new data streams will vary  
12 between different tiers of assessments (e.g., screening vs. quantitative risk assessment). As the field  
13 moves away from animal-based approaches toward models based on human cells, the SAB and BOSC  
14 recommend that the CSS and HHRA leverage human disease literature and human epidemiology data  
15 from sources such as the National Institutes of Health, Food and Drug Administration, and National  
16 Health and Nutrition Examination Survey (NHANES). Lastly, it is also recommended that ‘omics’  
17 technologies be incorporated into the array of bioprofiling tools in the ToxCast program. Such methods  
18 enable extremely broad coverage of biological responses to chemical exposure.

19  
20 ***Recommendation: Continue to emphasize communication, education and outreach.***

21 The CSS program in particular has realized that the tools it is developing are transformative and may be  
22 unfamiliar to staff in program offices and regions that are distant from the research and have long-  
23 standing ways of doing their work. As such, the initiatives dealing with education, training, and outreach  
24 are strongly encouraged and are considered essential for stakeholder understanding and acceptance of  
25 new approaches.

26 **4.3.6. Other approaches**

27 *Charge Question 6c. Are there other areas of fit-for-purpose characterizations (e.g., risk*  
28 *prioritization, risk screening, risk assessment) that are ripe for such collaboration/ integration?*  
29

30 ***Recommendation: Develop novel approaches to address cumulative risk in a holistic manner.***

31 Some of the new tools for both toxicity testing and exposure assessment are expected to lead to novel  
32 approaches for assessing cumulative risk which were not possible before. In addition, there is strong  
33 support for holistic approaches which consider both chemical and non-chemical stressors. In the future,  
34 cumulative risk could become the next new cross-cutting road map area.

35 **4.4. Sustainable and Healthy Communities**

36 ORD’s Sustainable and Healthy Communities (SHC) StRAP provides a thoughtful, applied roadmap for  
37 advancing high priority agency research. SHC focuses on conducting basic research on community-  
38 oriented environmental and health issues and providing information, tools, and data to communities and  
39 the agency’s regional offices concerning the development and application of sustainable practices that  
40 address environment, society and the economy.  
41

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Listed below are recommendations for addressing the complex challenges associated with developing sound approaches to SHC research. In identifying these challenges, the SAB and BOSC recognize that the SHC StRAP is intended to serve as a high-level guidance document, not as a detailed accounting of its research agenda. The SAB and BOSC strongly recommend that ORD revise the StRAP to acknowledge these challenges both up-front and throughout the document.

**4.4.1. Support for the EPA Strategic Plan**

*Charge Question 2a. How well will the research directions in each Early Draft StRAP (2016-2019) support EPA in achieving the relevant Agency objectives and cross-cutting strategies, as described in the EPA Strategic Plan (2014 -2018)?*

***Recommendation: Address the challenges of developing good community-based decision support tools and maintaining and sustaining partnerships.***

The SHC StRAP does a good job of addressing the need for a multi-criteria approach to decision-making, and supporting the establishment of partnerships and community decision-making. However, it may underestimate the difficult of developing good decision support tools general enough for broad application and flexible enough to address decision making in a regional context.

A key element of the SHC StRAP is to establish a research agenda focused on collecting information, and developing methods and tools for supporting agency and community decision-making. The desire for improved decision-making runs the gamut from agency to community concerns (e.g., air, water, contaminated sites) and involves differing temporal and spatial scales. The SAB and BOSC strongly endorse ORD's proposed work in this area. Advancements in how to improve the quality and defensibility of agency decision-making at the community level is needed to help the EPA achieve its sustainability goals operating as a high-performing organization responding to citizens' needs and expectations. However, the StRAP does not adequately address many of the challenges likely to be encountered in a research agenda focused on decision-making, especially at the EPA Region and community levels.

Many of these challenges are the crux of the SHC research agenda and, therefore, warrant greater attention:

- *Recognition that the development and application of effective decision-making approaches (and specific decision-making tools) will depend upon building and—importantly—maintaining effective partnerships and engagements with communities.* Effective engagement with communities is especially important when considering the unique needs of marginalized stakeholders and communities. A tight connection is needed between SHC and ORD's crosscutting research devoted to environmental justice. In addition, the StRAP needs to better distinguish between stakeholders and partners and the relationship between the two.
- *Acknowledgement of the complex, multifaceted nature of decision-making processes.* Effective decision-making processes are highly sensitive to context, with different decision problems (and decision opportunities) requiring varying levels of technical sophistication. Although ORD currently has ongoing research to identify a typology of communities and the contextual basis for decision-making, the SAB and BOSC question the ability of ORD research to provide effective

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1 decision support across all contexts. Simple solutions are unlikely to provide the best solutions  
2 for the complex problems and issues facing communities.

- 3 • *Acknowledgement that setting and implementing a research agenda focused on decision-making*  
4 *will not be easy.* In addition to the challenges outlined above, the development of decision-  
5 making approaches and tools will require careful evaluation. Evaluation will require that ORD  
6 establish systems for communication across different communities to maximize opportunities for  
7 cross-community and cross-approach learning. Community needs and priorities will change over  
8 time, so decision tools require flexibility and adaptability.
- 9 • *Recognizing that a research agenda focused on sustainability and decision-making may be a*  
10 *“tough-sell” in some communities.* Communities dealing with certain classes of problems (e.g.,  
11 contaminated sites) may simply want *straight answers*, and not *better processes*. They may want  
12 to identify how to *fix* problems, and not just *think about* or analyze problems. Thus, the SHC  
13 program should include research on more fundamental concerns around environmental health  
14 and “sustainability” as inputs to decision-making processes. Addressing this challenge will  
15 require bilateral communication channels across many very different communities, as well as  
16 with researchers working in different aspects of environmental systems.

17  
18 **Recommendation: Communicate that environmental health is a critical driver of overall human**  
19 **well-being and sustainability.**

20 The SHC focus on “sustainability” should include an increased focus on environmental health. Some  
21 members found that the current emphasis on community sustainability did not adequately account for  
22 the environmental risks and ecological concerns identified in the agency Strategic Plan. In other terms,  
23 the planned SHC research on sustainability indicators and sustainability objectives related to decision  
24 making focus too much on social and economic metrics that may be at odds with ecological constraints  
25 and may result in the EPA (and the communities the agency serves) inadvertently failing to account for  
26 the critical importance of environmental health as a driver of overall human well-being.

27  
28 “Sustainability” in this StRAP relies on the concept of the “three-legged stool” (i.e., environment,  
29 society, economy), and how each of these contributes to community well-being. ORD should revise the  
30 StRAP to acknowledge the reliance of societal and economic metrics on environmental constraints  
31 (Rockström et al. 2009, Baronsky et al. 2012; Costanza et al. 2012), particularly as communities may  
32 not be aware of how to reconcile economic and societal goals with environmental limits.

33 **4.4.2. Overall perspectives on proposed research to address environmental issues of 2020 and**  
34 **beyond**

35 *Charge 2b. What are the SAB/BOSC perspectives on the proposed research directions in the StRAP*  
36 *providing research to address environmental issues of 2020 and beyond?*  
37

38 **Recommendation: Plan for robust and flexible decision tools.**

39 The state-of-the-art in the different disciplines that comprise the science of decision-making continue to  
40 evolve, and the data and information used to inform decision making is always in flux. Therefore, the  
41 approaches and tools being developed by ORD should be sufficiently robust and flexible to address both  
42 present and emerging environmental issues and take advantage of new information. From the  
43 information provided, it was unclear to reviewers whether the planned SHC research considered  
44 expected changes such as aging populations, immigration, flooding of coastal communities with sea-

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1 level rise, or the changes occurring in legacy cities (e.g., Detroit) or whether planned tools and decision  
2 support systems were adaptive enough to respond efficiently to changing conditions.

3  
4 ***Recommendation: Assess emerging environmental issues with special attention to changing***  
5 ***demographics, cumulative impacts, and energy-related environmental impacts.***

6 The SAB and BOSC recommend that ORD devote some of its resources to assessing current and  
7 emerging environmental issues, with specific attention paid to those that may appear to be at the fringes  
8 of agency, community, and stakeholder concern (which, themselves, will be sensitive to changing  
9 demographics at the community level). These kinds of fringe issues, which may initially appear  
10 relatively unimportant or insignificant, have the potential to develop into those that pose the greatest  
11 challenges to the EPA in 2020 and beyond. In addition, the committees recommend that ORD closely  
12 monitor issues for which cumulative effects might likely be problematic. For example, ORD should  
13 monitor concerns that arise also on the chain of energy development, from site-specific environmental  
14 concerns to energy transport (e.g., interstate and—in many cases—international risks from pipelines,  
15 rail, and ship transport) to energy use (e.g., carbon pollution and air quality concerns), which, clearly,  
16 will involve integration and cooperation with ACE and other programs.

17 **4.4.3. Design for integration**

18 *Charge Question 2c. Did the presentations and plans indicate that ORD is designing for integration,*  
19 *where appropriate, on topics that are relevant to other research programs?*

20  
21 By and large, the answer is *yes*. Integration is very evident at the conceptual level of the StRAP. And,  
22 where specific discussions of integration across the other five national research programs—as well as  
23 the different crosscutting roadmaps—were absent, reviewers found it easy to see the connections  
24 between those activities and planned SHC research activities.

25  
26 ***Recommendation: Make integration of research planning a priority for management and capacity***  
27 ***building.***

28 Although integration is evident at the conceptual level of the SHC StRAP, it was not clear that the  
29 reality of implementing research described in the EPA StRAPs and road maps will achieve needed  
30 implementation. Without management attention, the six national program areas could devolve into six  
31 isolated silos. The SAB and BOSC observe that, while *specific* recognition of collaboration among the  
32 six national program areas was evident in the presentation made by ORD at the SAB-BOSC meeting of  
33 July 24-25, 2014, such detailed information was not discussed in the StRAP.

34  
35 The SAB and BOSC recommends that ORD senior leadership ensure that effective communication and  
36 integration across the six national program areas takes place. Both leadership on, and resources devoted  
37 to, building transdisciplinary capacity within the EPA will be required to effect and maintain integration.

38 **4.4.4. Providing tools to effectively support communities**

39 *Charge Question 4a. Does the research program contain the elements necessary to integrate two*  
40 *critical elements (ecological and human health) of EPA's mission?*

41  
42 Broadly speaking, the answer to this question is, *yes*. However, greater clarity is required in the StRAP  
43 with respect to the extent to which human health and ecological health are being addressed as parts of

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1 *integrated systems* or being developed separately from each other following a traditional stressor-  
2 response paradigm.

3  
4 ***Recommendation: Address ecological and human health as parts of integrated systems.***

5 SHC research should treat ecological and human health as components of coupled natural-human  
6 systems. The SAB and BOSC identified weaknesses in the StRAP's discussion of systems-based  
7 approaches and topics requiring transdisciplinary research. For example, some of the individual research  
8 examples outlined in the StRAP seemed to focus on individual elements of systems, and not the  
9 coupling of different human and natural dimensions within systems. The SAB and BOSC recommend  
10 that specific and direct lines of collaboration be developed between SHC and the Human Health Risk  
11 Assessment programs. The SHC StRAP should include a focus on life-cycle analysis and recognize  
12 explicitly that sustainability is largely a function of the tradeoffs made between environmental, social,  
13 and economic priorities.

14 **4.4.5. Increased well-being**

15 *Charge Question 4b. Is increased well-being the appropriate outcome to aim for, rather than*  
16 *amelioration of specific health conditions? If so, does the SAB/BOSC have recommendations for*  
17 *shaping the Community Public Health research project more toward broader well-being impacts?*  
18

19 The SAB-BOSC answer to the charge question is a definite yes. However, the committee recommends  
20 that the StRAP be more explicit about that fact that there is more to “well-being” than environmental  
21 and human health. For example, well-being can be connected to economic security, as well as various  
22 social and psychological considerations that are likely to be evident at both the community and  
23 individual levels. Moreover, well-being—much like the concept of sustainability—will have an evolving  
24 definition based on the decision context for which it is being considered. Further, the definition of well-  
25 being may differ *within* and *between* communities.

26  
27 ***Recommendation: Continue and expand research focused on defining and measuring well-being,***  
28 ***building on existing resources on this topic.***

29 The SAB and BOSC recommend that ORD continue and expand its research focused on measures of  
30 human well-being and its relationship to environmental health. This report strongly recommends that  
31 ORD review the wealth of existing research, across a broad range of disciplines, focused on defining and  
32 measuring well-being (McGillivray and Clarke, Eds. 2007; McGillivray 2008; ecoAmerica 2014). This  
33 research can provide a valuable basis for assessing and determining well-being across different  
34 communities. Moreover, under its research efforts devoted to decision-making, ORD should attempt to  
35 identify the varied objectives of stakeholders that will comprise “well-being” and the attributes and  
36 measures that characterize these objectives (Diener 2009, United Nations 2012).

37 **4.4.6. Science of sustainability**

38 *Charge Question 4c. SHC is interested in thoughts and suggestions from the SAB/BOSC on ways to*  
39 *conduct research on the science of sustainability.*  
40

41 The SHC's emphasis on research in decision-making processes and the foundational data to support  
42 those processes is precisely where ORD should be focusing its efforts. However, to inform decisions  
43 regarding ways to conduct research on the science of sustainability, the SAB and BOSC provide the  
44 recommendations below.

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1  
2 ***Recommendation: Conduct a thorough review of ongoing research in the science of sustainability.***

3 There are extensive a number of publications focused on research on the science of sustainability that  
4 can inform ORD’s thinking about ways to conduct its own research. Sustainability science is  
5 increasingly well-defined and research agendas have been published; presumably these are known to  
6 ORD and can provide additional perspective (see, for example, NRC 1999a; NRC 1999b; Kates et al.  
7 2001; Clark and Dickson 2003; Swart et al. 2004; Kates, 2011; NRC 2012a; NRC 2012b).

8  
9 ***Recommendation: Look outside the agency for ideas about research methods.***

10 The generation of ideas from outside ORD would add significant value for the agency. Calls for research  
11 proposals from scientists outside the EPA through EPA’s Science to Achieve Results (STAR) program,  
12 as well as through partnerships with other government agencies and foundations (e.g., the National  
13 Science Foundation), would almost certainly lead to the development of new research approaches and  
14 practices that would be applicable to the SHC’s mission.

15  
16 ***Recommendation: Build transdisciplinary and applied social science research capacity within ORD.***

17 There is a need to build capacity in the social and behavioral sciences and to effectively integrate these  
18 sciences with ORD’s traditional strengths in the natural sciences. The SAB and BOSC recommend that  
19 ORD, when hiring opportunities occur, explore adding personnel with training in transdisciplinary  
20 approaches to addressing issues and opportunities at the environment-human nexus, in addition to  
21 additional personnel with expertise and skills in the applied social and behavioral sciences.

22  
23 ***Recommendation: Clarify the “three pillar” approach to sustainability.***

24 “Sustainability” in this StRAP relies on the concept of the “three-legged stool” (i.e., environment,  
25 society, economy), although this is not the definition offered by any other StRAP or the Strategic Plan.  
26 The more recent sustainability literature critiques the pillars (which lend themselves to silos) in favor of  
27 more holistic representations in recognition of the hard constraints imposed by environmental limitations  
28 (Dawe and Ryan 2003; Raskin et al. 2010; Díaz et al. 2011; Costanza et al. 2012). This latter view of  
29 sustainability seemed to be the focus of the information presented in the SHC overview slides presented  
30 at the SAB-BOSC meeting, but not in the StRAP itself. Systems-based approaches, emphasized as  
31 necessary across all the StRAPs, will by definition require integrated approaches to achieve agency  
32 objectives.

33 **4.5. Homeland Security**

34 Within ORD, the Homeland Security research program (HSRP) has a primary mandate of performing  
35 research related to the EPA goals of protecting water supplies and on post-disaster clean-up, both  
36 outdoors, and indoors. The original focus was on chemical, biological, and radiological threats from  
37 terrorists but the mission has recently been broadened in the draft StRAP to include "all threats" to water  
38 supplies or requiring post-disaster cleanup.

39 **4.5.1. Support for the EPA Strategic Plan**

40 *Charge Question 2a. How well will the research directions in each Early Draft StRAP (2016-2019)*  
41 *support EPA in achieving the relevant Agency objectives and cross-cutting strategies, as described*  
42 *in the EPA Strategic Plan (2014 -2018)?*  
43

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1 The HSRP’s historical focus and new “all threats” mission supports many agency objectives including,  
2 protecting America’s waters, preventing pollution, clean-up from long term pollution releases as well as  
3 immediate disasters, and enhancing community resilience / reducing community vulnerabilities.  
4

5 ***Recommendation: Explore a systems approach and develop partnerships to stretch limited resources***  
6 ***to help meet the HSRP historical focus and new “all threats” mission.***

7 The main question of concern is how the HSRP can widen its focus to include all threats, given that  
8 HSRP resources are not being expanded. While the review of the StRAP does not provide an  
9 opportunity to provide detailed advice, the SAB and BOSC suggest that the EPA utilize systems  
10 approaches to meeting the agency’s overall mandates, exploiting commonalities between threats,  
11 cleanup-measures etc. Section 4.5.5. addresses the systems approach topic further. In addition, the  
12 HSRP should seek creative partnerships with other agencies and entities conducting research on topics  
13 relevant to the EPA HSRP mission.

14 **4.5.2. Overall perspectives on proposed research to address environmental issues of 2020 and**  
15 **beyond**

16 *Charge Question 2b. What are the SAB/BOSC perspectives on the proposed research directions in*  
17 *the StRAP providing research to address environmental issues of 2020 and beyond?*  
18

19 Overall, the general strategy of providing tools, technology, and data for threat prevention,  
20 decontamination or cleanup, is relevant to threats likely to be faced in 2020 and beyond. Some of the  
21 threats to water supplies and cleanup requirements to be faced are potentially predictable on the basis of  
22 today's knowledge as infrastructure ages and as *ad hoc* containment systems fail, although assembling  
23 and maintaining databases and providing new tools to identify the most vulnerable aging infrastructure  
24 is a daunting task.  
25

26 On the other hand, there are inherent uncertainties in other future threats. For example, identifying the  
27 locations at primary risk of future flooding due to global warming and the resulting flood-related  
28 chemical and biological contaminations and cleanup needs are dependent upon uncertain speeds of  
29 ocean rise. Specific terroristic threats are also uncertain. Based on today's knowledge, it is difficult to  
30 know whether future failures in cyber security could allow terrorists at a distance to perpetrate major  
31 threats to water supplies through contamination releases from highly automated modern factories or  
32 storage locations. More generally all terrorist threats depend upon the unknown levels of specific  
33 expertise and access, technological sophistication, and the motivations of the future actors in future  
34 events.  
35

36 ***Recommendation: Plan for tools relevant to multiple related hazards and invest in innovation***  
37 ***programs.***

38 Overall the HSRP tends to be driven by many short-term immediate demands in highly applied research  
39 topics, and indeed flexibility is very important for the response to disaster needs. It is, however, also  
40 very important to make efforts to build tools that will be relevant to multiple related hazards when  
41 responding to specific disasters or prevention requirements.  
42

43 Because the HSRP is producing outputs on a continuous basis and getting continuous input, the HSRP  
44 research products will be coming out in a phased manner, so that as 2020 approaches these needs will be  
45 better identifiable and addressable.

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The SAB and BOSC recommend that the HSRP participate in ORD’s innovation programs to allow interesting potentially high reward research ideas and projects to be considered.

**4.5.3. Design for integration**

*Charge Question 2c. Did the presentations and plans indicate that ORD is designing for integration, where appropriate, on topics that are relevant to other research programs?*

**Recommendation: Maintain the current high level of integration with ORD research programs and terrorism-related research of other agencies and build partnerships with non-terrorism, disaster-related agencies as well as EPA regional offices.**

The HSRP is best designed to deal with a higher level of uncertainty about its future research directions than most other ORD programs. Nevertheless, there are many tasks of the HSRP that are clearly joint projects with other portions of ORD and other agencies. These include but are not limited to: further developing knowledge about the transport and long term fate of specific contaminants; contaminant detection; exposure assessment; and risk assessment. Overall the draft StRAP describes collaboration within ORD very well. It is clear also that the HSRP is very well integrated with the terrorism-related areas of other agencies. The HSRP is probably less well-integrated with the non-terrorism, disaster-related agencies. Such integration will need to be deepened as HSRP fully embraces its "all threats" mandate. The SAB and BOSC specifically encourage the HSRP to work through the EPA regional offices in an effort to expand its understanding of potential threats to be faced as well as to reach all relevant stake holders

**4.5.4. All-hazards research**

*Charge Question 7a. What advice (e.g., strategic, tactical, structural) can the SAB/BOSC give to further guide the program toward this broader role?*

**Recommendation: Plan to integrate terrorism-related and non-terrorism disaster response and prevention research.**

An overriding issue is how the HSRP can broaden its mission without weakening its role in security research, especially given budgetary constraints. Whenever possible the HSRP should aim to exploit the tools, lessons, and science developed for terrorism-related research to all hazards rather than starting from scratch if the problems addressed are similar enough. Employing systems thinking will also help identify specific research projects which address multiple hazards. The program should avoid developing two silos of programs, one related to terrorism response and prevention and the other related to non-terrorism disaster response and prevention.

The HSRP should continue to develop strategic and synergistic partnerships with other agencies and stakeholders. The HSRP already is well integrated with terrorism-related agencies and research programs. Generalizing these sorts of synergies and integrations to the all-threats component of the program will be extremely helpful in meeting the expansion of the HSRP mission.

**4.5.5. Systems approach**

*Charge Question 7b. How could the research program better incorporate this systems thinking and engage its partners in this systems thinking from a strategic and tactical standpoint?*

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***Recommendation: Clarify in the StRAP what is meant by the HSRP systems approach and how it will be used in research planning.***

The HSRP StRAP should include a clearer explanation of its systems approach, clarifying which models are being applied, the level of complexity of the models, and describing how they will be implemented. It is important to clarify how much investment is being made in formalizing the systems approaches to be used, e.g. by use of specific systems engineering software or specific tools for graphical representation of the life cycle of projects. More generally, the StRAP should clarify how a systems approach is to be differentiated from approaches that do not take a systems approach in actual practical application and how a systems approach is to be used in the prioritization or HSRD research.

Expanding on comments above, the HSRP should inform multiple federal partners about this research (e.g., Department of Health and Human Services, Federal Emergency Management Agency), as well as the EPA regional offices since having such partners informed and involved will help HSRP achieve goals related to the systems research being planned. Clear explanation of how ORD plans to use system approaches in planning and prioritization will help partners understand ORD research and how to complement it.

The SAB and BOSC note that HSRP is in a position to be a lead federal government research arm on environmental fate and transport issues that are currently associated with Homeland Security threat agents but involve environmental pollutants and particles. Outside of DOE, there may not be another focused federal agency research effort on this topic. ORD should continue to build a leadership role in this valued area.

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1 **5. RECOMMENDATIONS FOR INTEGRATION**

2  
3 ORD requested the SAB and BOSC to address the following charge question for four crosscutting  
4 topics: *Charge Question 8. How effective is each Draft Roadmap in presenting a problem statement,*  
5 *elucidating key research topics, capturing relevant research in each of the six programs, and identifying*  
6 *any important scientific gaps?* The four crosscutting topics are Children’s Environmental Health,  
7 Nitrogen and Co-pollutants, Climate Change, and Environmental Justice. ORD’s specific charge  
8 question is addressed for each of these topics and additional technical comments for each topic are  
9 included in Appendix B. This section also responds to ORD’s request for general advice on enhancing  
10 integration across all of ORD’s programs.

11 **5.1. Children's Environmental Health**

12 Research in Children’s Environmental Health (CEH) spans and develops links from basic science,  
13 models, and mechanisms to the health and well-being indicators of the next generation and their  
14 neighborhoods. Consequently, it is an excellent choice for crosscutting research and integration across  
15 ORD program areas. The CEH preliminary draft is well developed and provides a sound framework for  
16 integrating research on CEH across the six ORD Program areas. This type of integrative research is not  
17 being done in any other research program or organization.

18 **5.1.1. Problem statement and key research topics**

19 The research directions outlined in the CEH cross-cutting roadmap preliminary draft contribute to a  
20 more holistic science base in support of children’s environmental health with specific calls for applied  
21 research under the general goals, articulated in EPA’s Strategic Plan, of cleaning up communities and  
22 advancing sustainable development, and ensuring safety of chemicals and preventing pollution).

23  
24 The importance of research that incorporates cumulative impacts of chemical and non-chemical stressors  
25 across life stages is noted and of key importance. The key research topics (four research priority areas)  
26 are well presented in the context of their “drivers”. The Introduction effectively summarizes the recent  
27 actions in children’s environmental health and explains the current drivers that define the need and focus  
28 of the CEH. The translational framework for CEH (Figure 2 in the roadmap) is excellent in its clarity  
29 and comprehensiveness, and the summary of key governmental and international actions (Table 1 in the  
30 roadmap) is excellent and helpful, however, it is unclear as to why some international programs were not  
31 included (e.g., *Canada 2010 National Strategic Framework on Children’s Environmental Health*  
32 ([http://www.hc-sc.gc.ca/ewhsemt/pubs/contaminants/framework\\_childrencadre\\_enfants/index-](http://www.hc-sc.gc.ca/ewhsemt/pubs/contaminants/framework_childrencadre_enfants/index-eng.php#a0)  
33 [eng.php#a0](http://www.hc-sc.gc.ca/ewhsemt/pubs/contaminants/framework_childrencadre_enfants/index-eng.php#a0)); European Union Helix Project (<http://www.projecthelix.eu/>))

34  
35 ***Recommendation: • Develop a more comprehensive translation research strategy to enhance the***  
36 ***links from basic and observational science to intervention/implementation science to community***  
37 ***action/policy toward the goal of improving children’s health.***

38 There seems to be much greater emphasis on the ends of the translational research spectrum (metrics,  
39 tools and policies) and less emphasis on the “middle” of this spectrum (key perturbations, targets and  
40 exposures; individual and community risks). The emphasis appears to be on both foundational  
41 research (animal models, toxicology studies and tools, observational cohorts) and then, at the other  
42 end, community action. The pieces that appear to be quite limited are: the development of

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1 interventions, the science of implementing proven interventions, the science of assessing the impact of  
2 implementing the intervention on environment and health outcomes, and the science of dissemination.  
3

4 ***Recommendation: Clarify and support research on communities' roles and involvement.***

5 In a community context, there is emphasis on the development of tools that can be used by  
6 communities to assess risk and plan, but it is not clear that there is a plan to support research aimed at  
7 understanding how often the various tools are used, by whom, whether they lead to any change in the  
8 community or action by the community, and whether that change has beneficial effects.

9 **5.1.2. Relevant research in each of ORD's six programs**

10 ***Recommendation: More clearly describe how research themes in the StRAPs will be integrated to***  
11 ***support the issues described in the CEH roadmap.***

12 Direct links are made to strategic goals on communities and chemical safety, but links to other goals  
13 are deep into the report and not fully elaborated. For example, highlighting the role of water and air as  
14 pathways for toxicity toward children as a vulnerable population seems highly relevant (CEH  
15 Roadmap, p. 18). Further, the extensive risk assessment and decision-support tools from HHRA could  
16 be better integrated into the CEH Roadmap. The list of activities in Appendix B is helpful, but  
17 attention to these links could be better integrated into the text.

18 **5.1.3. Important scientific gaps**

19 ***Recommendation: Recognize and optimize the role of leveraging partnerships and prior investments.***

20 Environmental health research now encompasses human epidemiologic and clinical trial studies that  
21 require very large sample sizes. Specific examples of the kinds of studies that are needed include those  
22 that examine gene-environment interactions, Epigenome-Wide Association Studies (EWAS), and  
23 exposome and mixture studies, along with chronic exposure studies. These require extremely large  
24 sample sizes and longitudinal designs. Maintaining the investments made in successful, established  
25 large studies and enhancing partnerships across studies are ways to make progress with limited  
26 resources. Leveraging U.S. population-based surveys such as the NHANES and National Health  
27 Interview Survey (NHIS) offer additional opportunities for maximizing the impact of ORD funds. In  
28 particular, data on environmental contaminant uptake in children using biomarkers in the age group  
29 under six years is needed to complement the current national CDC biomonitoring program, which does  
30 not routinely include this life stage.

31 ***Recommendation: Research gaps are noted but more specificity and synthesis is needed.***

32 Important research gaps are identified but in broad, unspecific terms. Examples of specific gaps that  
33 are not highlighted that should be considered include expanding the priority health outcomes to  
34 include pediatric cancer (in addition to birth outcomes, neurodevelopment/neurobehavior, metabolic  
35 (obesity), and asthma/airway function and elucidating the human microbiome within children's  
36 environmental health research.

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1 **5.1.4. Implementation**

2 ***Recommendation: Describe how research priorities will be set.***

3 This roadmap comprises ambitious and broad crosscutting activities. The list of research objectives  
4 and future projects is reasonable for significant progress to be achieved by 2019. However given  
5 uncertainties of resource allocation, the roadmap would benefit from a description of how  
6 prioritization might be achieved.

7  
8 ***Recommendation: Identify mechanisms for motivating and evaluating the responsiveness of ORD's  
9 research programs to the CEH roadmap.***

10 The roadmap lacks a description of the stewardship needed to foster its implementation and success.  
11 Experience suggests that achieving and sustaining the needed level of commitment often depends  
12 upon how research budgets are determined and distributed and on how well individual scientist's  
13 professional goals are supported and their work is recognized and rewarded in the context of this and  
14 the other cross-cutting research enterprises.

15 **5.2. Nitrogen and Co-pollutants**

16 Research on the biogeochemical cycling of nitrogen and co-pollutants spans multiple environmental  
17 media and requires integration of basic science, models and mechanisms across multiple EPA program  
18 areas. Consequently it is an excellent choice for cross-cutting research and integration across ORD  
19 program areas. The Nitrogen and co-pollutants roadmap is well written and well organized. It is highly  
20 responsive to previous SAB input and recommendations (U.S. EPA SAB 2011b).

21 **5.2.1. Problem statement and key research topics**

22 The six over-arching science questions and challenges in the Nitrogen and co-pollutants roadmap are  
23 well-formulated and provide an effective framework. The overarching goals, outcomes, and output of  
24 the roadmap are explicitly articulated, and well-oriented to informing policy and decisions, however, the  
25 summary in the roadmap is too short.

26  
27 ***Recommendation: Include a discussion of the scale of important components of environmental  
28 problems associated with nitrogen and co-pollutant discharges.***

29 In presenting the science challenges, the issue of scale is not called out and discussed explicitly. The  
30 concept of scale as a key variable and important challenge should be discussed. The large-scale aspect of  
31 important components of the problem of nitrogen and co-pollutant discharges will require flexibility in  
32 responses, and this should be recognized in the roadmap.

33  
34 ***Recommendation: Provide a more balanced discussion of the benefits nitrogen provides and the  
35 impacts of treatment and control of nitrogen and co-pollutants.***

36 The roadmap should discuss more in its Introduction the benefits that nitrogen provides to society, and  
37 the cost-benefit analysis involved in deciding how much control to undertake. Treatment and control of  
38 nitrogen and co-pollutants has associated environmental impacts, e.g., the energy and chemicals required  
39 to remove nitrogen from municipal wastewater. In the interest of providing balanced R&D to inform  
40 decisions, benefits of nitrogen and impacts of control measures should be recognized in the roadmap.

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1 **5.2.2. Relevant research in each of ORD’s six programs**

2 The roadmap makes connections to the StRAPs for the six ORD research programs, especially SSWR,  
3 but this could be strengthened in the document. Conceptual mappings to the six ORD program areas  
4 (e.g., Table 1) should be expanded.  
5

6 ***Recommendation: Strengthen discussion of nutrient resource recovery and related technologies.***

7 The roadmap should make a stronger connection to the priority area in the SSWR StRAP on  
8 transforming the concept of “waste” to “resource” in management of “wastewater,” especially the  
9 capture of nutrients. The roadmap is weak in the area of development and demonstration of nutrient  
10 resource recovery technology. More generally, the roadmap can be more explicit about the relationship  
11 between prioritized research needs as presented in the StRAPs and research gaps.  
12

13 There has been great progress made on the ability to remove nitrogen from municipal wastewater. The  
14 roadmap should note this, and discuss how this technological advancement can be leveraged and  
15 incorporated in ORD programs to help address the challenge of controlling nitrogen and co-pollutants.  
16

17 ***Recommendation: Expand discussion of linkages with the SHC and ACE programs.***

18 The roadmap mentions linkages with the SHC research program, but there are more overlaps with SHC  
19 that could be discussed. A number of the science challenges presented in the roadmap involve value  
20 judgments, and relate to ongoing research in the SHC program.  
21

22 There are also linkages with the ACE research program that should be discussed. The roadmap has little  
23 discussion of releases of nitrogen to the atmosphere and atmospheric inputs of nitrogen to land and  
24 water. What research is needed to enable adequate reduction of nitrogen emissions to the atmosphere?  
25 Also, considering the uncertainty in the recently updated national climate assessment about whether  
26 nitrogen emissions will induce cooling, it would be useful to have more discussion about nitrogen  
27 impacts on climate.

28 **5.2.3. Important scientific gaps**

29 ***Recommendation: Expand discussion of agriculture and agriculture-related research.***

30 The importance of agriculture and related EPA research needed should be addressed more in the  
31 document. One member of the SAB stated: “It is striking how little the word ‘agriculture’ is used in this  
32 narrative document given the preponderance of evidence that [agriculture] is a key driver of nutrient  
33 loading.” It is recommended that the roadmap should include study of the effectiveness of voluntary  
34 approaches for control of agricultural runoff of nitrogen and co-pollutants from non-point sources, and  
35 should make clear the need for substantial engagement with and leveraging of USDA programs and  
36 resources. In the context of USDA engagement, the USDA Mississippi River Basin Healthy Watersheds  
37 Initiative is a research and demonstration program of national importance in which ORD should be  
38 engaged.  
39

40 The roadmap also makes only brief mention of the Chesapeake Bay program, the national, full-scale  
41 experiment in how to control nutrients on land and discharge to water. There should be more discussion  
42 about ORD engagement with the CBP and the importance with respect to the roadmap.  
43

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1 ***Recommendation: Provide a more explicit discussion of the process for cross-agency, industrial, and***  
2 ***international cooperation.***

3 There is discussion in the roadmap about the importance of research coordination, and about an  
4 envisioned cross-agency team to identify research that informs the development of effective policies for  
5 implementation of an integrated and sustainable reactive nitrogen and co-pollutant management  
6 program, but no specific recommendations are made about the envisioned team.

7  
8 The discussion of cross agency, industrial, and international cooperation is insufficient. The Gulf of  
9 Mexico and Great Lakes are obvious candidates for international cooperation. There is also great  
10 opportunity for coordinating with and making use of research on control of nutrients and co-pollutants  
11 being conducted in other countries. There should be more discussion of cooperation and collaboration  
12 opportunities in the roadmap.

13  
14 ***Recommendation: Include an extended discussion of uncertainties associated with modeling and***  
15 ***assessment of impacts of proposed management actions.***

16 There is little mention of scientific uncertainty; this is a serious omission. Modeling and assessments of  
17 impacts of proposed management actions should be accompanied by a defensible quantitative statement  
18 of uncertainty. If stakeholders and/or decision makers are considering management actions based in part  
19 on modeling/assessment, they must be provided with some measure of the confidence (uncertainty) in  
20 the science. For too long and too often, the EPA has failed to insist on this requirement for predictive  
21 models. As a consequence, ORD has tended to stress large elaborate models, such as that described in  
22 the section on integrated multimedia modeling, that appear to be motivated by the assumption that  
23 models must be sufficiently detailed so the modelers can “get the processes right.” The result of  
24 stressing the development of elaborate models is that these models can become over-parameterized.  
25 Among experienced modelers, it is well-recognized that many sets’ of parameter values will fit large  
26 simulation models about equally well; similar predictions can be obtained by simultaneously  
27 manipulating several parameter values in concert. This is expected because all models are  
28 approximations of actual ecosystem processes, and because all parameters represent aggregate processes  
29 (spatially and temporally averaged at some implicit scale) and are unlikely to be represented by a fixed  
30 constant across scales. In addition, many mathematical structures impart extreme correlation among  
31 model parameters, even when the model is over-determined. It is recommended that ORD routinely  
32 require uncertainty analysis of model forecasts.

33  
34 ***Recommendation: Clarify how research priorities are set based on gap analyses and consider a***  
35 ***“value of information assessment” approach.***

36 It is good to see frequent referral to gap analysis however, it is unclear how research priorities will be  
37 established based on the gap analysis. This should be clarified in the document

38  
39 “Adequate” is a word that is frequently used in the draft roadmap to characterize expectations for new  
40 research (e.g., “to determine if an approach is adequate”). However, the document does not address how  
41 “adequacy” of a research program is to be rigorously assessed.

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1 **5.2.4. Implementation**

2 ***Recommendation: Address how the roadmap will be implemented.***

3 There is no implementation plan in the roadmap. Who will be responsible for overseeing, monitoring,  
4 and coordinating implementation of the roadmap? This is a very important concern for the SAB and  
5 BOSC.

6 **5.3. Climate Change**

7 Although climate is explicitly a part of one of ORD's ACE program, the science and impacts of climate  
8 change span all ORD Program areas, and therefore it is an excellent choice for cross-cutting research  
9 and integration across ORD. Creating the EPA climate change cross-cutting roadmap is a challenge and  
10 the current draft roadmap on climate change is somewhat disappointing. The EPA's resources devoted  
11 to climate change, a critical, crosscutting environmental issue, are a small percentage of the overall  
12 federal climate change budget. ORD can best approach this budget challenge by focusing resources on  
13 "actionable science" that informs ways the EPA can help address how climate influences air and water  
14 quality.

15 **5.3.1. Problem statement and key research topics**

16 ***Recommendation: Describe how planned research will inform future EPA decision making.***

17 The roadmap should address what science can be brought to bear on the consequences of some high  
18 profile decisions (e.g., Corporate Average Fuel Economy (CAFE) standards, power plant emissions,  
19 renewable fuel standards). Moving forward, the EPA should focus on what the life cycle consequences  
20 of renewables—solar, wind, tidal, and biofuels—might be. For biofuels and biochar, in particular,  
21 knowledge of the impacts on water availability, crop production and disease needs improvement. Many  
22 agricultural activities have substantial impacts on air pollution and human health, which need  
23 investigation. In contrast, the impacts of cookstoves, at least in the United States, are likely to be very  
24 small and less important to pursue as a research topic.

25  
26 ***Recommendation: Describe more clearly the ORD climate change research niche ("actionable  
27 science" and its plan to work with other international and federal partners to ensure EPA's science  
28 needs are met).***

29 The roadmap should describe integration with key domestic and international research efforts on  
30 mitigation/adaptation. Although some of this information was communicated verbally in the Climate  
31 Change Roadmap presentation at the July 24-25, 2014 SAB-BOSC meeting, the roadmap should include  
32 this basic information. The road map should address how ORD accounts for research needs not currently  
33 addressed by its own research programs. An example is the water-climate question, i.e., why ORD  
34 seems only to analyze a one-way relationship, considering only the climate impact on water and not how  
35 water affects climate. If other agencies are focusing on the water-climate question, how is that  
36 incorporated? A clear guideline for such partnerships should be included in the roadmap. The roadmap  
37 should also communicate more clearly the unique role that ORD has in climate change research relative  
38 to other federal partners.

39  
40 ***Recommendation: Improve the presentation and flow of the climate change roadmap.***

41 The roadmap would be improved by the addition of diagrams, model schematics, and other organizing  
42 approaches to help convey the systematic approach that ORD is taking in this important cross-cutting  
43 area.

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1 **5.3.2. Key research topics and relevant research in each of ORD’s six programs**

2 ***Recommendation: Identify research priorities associated with the problem statement***

3 The climate change topic is broad and the EPA research role is not well defined in the roadmap.  
4 Outlining a few basic components of research to inform future EPA decision making would be useful.  
5 The roadmap should more clearly identify its relationship to the EPA’s *Climate Change Adaptation*  
6 *Plan*. The roadmap should also more clearly communicate the rationales for the EPA program-identified  
7 “Research Needs” listed in Appendix C.

8 **5.3.3. Important scientific gaps**

9 ***Recommendation: Expand the roadmap discussion of “Research gaps and priority research needs”***  
10 ***(social sciences, uncertainties, decision-relevant scale, and synthesis).***

11 The SAB and BOSC recommend that the roadmap describe more clearly the research intended to  
12 address these gaps. In regard to the social sciences, there is an opportunity in the climate change  
13 roadmap to clearly identify what is meant by social science research supporting the EPA’s mission and  
14 how such research would be used. It is important to “unpack” the heterogeneity of social sciences and to  
15 learn what is most needed for the agency. The social sciences may be especially important for ORD to  
16 consider because EPA’s climate change science must be communicated clearly to and with the public.  
17 The SAB and BOSC also are interested in how ORD plans to help inform decision makers of the timing,  
18 magnitude and uncertainties of climate change. Communication to decision makers regarding these  
19 topics is an additional area of important research.

20 **5.3.4. Implementation and intended use of the roadmap**

21 ***Recommendation: Provide a discussion of how the roadmap will be used to guide research.***

22 Many of the suggestions above indicate a need for further development of the road map. A revised  
23 roadmap should include discussion of implementation factors (e.g. dependency on personnel, resources),  
24 and the intended use of the roadmap. Will the road map evolve and will there be built-in indicators or  
25 milestones? Successful integration depends on how participating programs and laboratories commit to  
26 collaborations proposed. How does budget and personnel affect that? Have these concerns been factored  
27 into the roadmap planning?

28 **5.4. Environmental Justice**

29 Research in Environmental Justice (EJ), as was the case with CEH, spans and develops links from basic  
30 science, models, and mechanisms to the health and well-being indicators of the communities and their  
31 neighborhoods. Consequently, it is an excellent choice for cross-cutting research and integration across  
32 ORD program areas. The EJ roadmap provides a good framework for a research path in environmental  
33 justice.

34 **5.4.1. Problem statement and key research topics**

35 Although the problem statement is well described, specific goals and objectives are not. Without  
36 anticipated achievements, it is difficult to know which steps should be taken in a research roadmap to  
37 lead to effective results.

38

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1 ***Recommendation: Incorporate input from communities to identify problems associated with***  
2 ***environmental, biological, behavioral, social, economic and spatial stressors, and how they***  
3 ***interrelate.***

4 The roadmap mentions the involvement of stakeholders but doesn't specifically describe their expertise  
5 or experience, or what demographics they represent. ORD should partner with individuals from a variety  
6 of communities that represent various situations and circumstances. International partnerships are also  
7 lacking. The roadmap does include non-chemical stressors, which provides the broad approach to  
8 problem identification and evaluation. However, conducting conversations with communities is critical  
9 in identifying these problems and possible desired solutions, as well as strategizing effective research  
10 approaches. This type of expertise that can only be obtained from community partners is lacking in the  
11 draft roadmap. Incorporating this input would allow for the identification of problems related to  
12 environmental, biological, behavioral, social, economic and spatial stressors, and how they interrelate.  
13 Community involvement also fosters a "practice" approach to problem-solving, as well as a research-  
14 based regimen.

15  
16 ***Recommendation: Integrate community participation throughout each science challenge and have***  
17 ***community individuals inform the research process.***

18 The draft roadmap does not include specific research topics or proposed methods to address  
19 environmental justice issues. As such, research priorities are not identified, along with the trade-offs of  
20 their inclusion. Three science challenges are listed, with community engagement included as a separate  
21 item. It is suggested to integrate community participation throughout each science challenge and have  
22 community individuals inform the research process. Community involvement will also help identify  
23 research priorities. Section B.4. in Appendix B provides suggestions for research topics/approaches to  
24 explore. Involving individuals within communities as research partners at the onset of developing  
25 environmental justice research strategies and throughout the research process ensures that the research is  
26 "highly relevant and responsive" (Environmental Justice Roadmap goal).

27 **5.4.2. Relevant research in each of ORD's six programs**

28 ***Recommendation: Add text to Appendix A that explains specific connections to each program area,***  
29 ***using the CEH roadmap as a model format.***

30 The draft roadmap demonstrates the need for environmental justice across ORD's six research programs  
31 showing some synergies, particularly with the SHC program area. More detail, however, is needed.  
32 Table 1 and Appendices A and B begin to show how environmental justice can provide a research  
33 foundation for the research program areas, but there are not as many examples of an environmental  
34 justice presence within some research programs as might be expected. It is suggested to add text to  
35 Appendix A that explains specific connections to each program area. Although sets of projects are listed  
36 that show how environmental justice can be integrated, the current format is disjointed rather than an  
37 informative, "stand-alone" document. It is suggested to use the CEH roadmap as a model for  
38 communicating such information.

39  
40 ***Recommendation: Consider including examples to illustrate relationships to ORD's six research***  
41 ***areas and employing Community-Based Participatory Research (CBPR) to promote research***  
42 ***relevance.***

43 The inclusion of non-chemical stressors in the Environmental Justice draft roadmap helps address the  
44 cross-cutting issues related to the six research program areas, but including specific examples would  
45 better illustrate these relationships. To promote research relevance, CBPR could be employed in each

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1 research program area. This could lead to the incorporation of environmental justice issues and help  
2 develop relevant Requests for Proposals (RFPs). This roadmap could provide the needed intersections  
3 for each of the six research programs, which would provide an overall framework for ORD's research  
4 strategy.

5 **5.4.3. Important scientific gaps**

6 The draft Roadmap does not identify scientific gaps. As details regarding key research topics and how  
7 they relate to the six research program areas emerge, scientific gaps should become apparent.

8 **5.4.4. Implementation and intended use of the roadmap**

9 Although the Environmental Justice cross-cutting roadmap well documents the need for cross-cutting  
10 research in this area, it provides a relatively abstract discussion of the science. The issues are discussed  
11 in general, but the specific science proposed to address needed knowledge gaps is either omitted or  
12 discussed in general terms. Because of the preliminary nature of the document, sections on research gaps  
13 and research needs, examples of ORD integration, and opportunities for additional integration are not  
14 included. While the underlying science challenges are well-described in a general sense, the cross-  
15 cutting roadmap should include discussions of these topics so that ORD research in this area is  
16 coordinated as a well-organized whole.

17 **5.5. Integration across ORD programs**

18 *Charge Question 9. Do ORD's plans, taken collectively, indicate that integration, where*  
19 *appropriate, will develop the needed scientific knowledge and produce results that advance*  
20 *EPA's ability to address complex problems?*  
21

22 Integration is critical given the EPA's resource-limited environment and the interdisciplinary and cross-  
23 program nature and application of ORD's data, tools, knowledge and products in EPA decision-making.  
24 Integration must occur internally within the EPA, external to the EPA within the United States with the  
25 agency's partners, and internationally. The ORD's cross-cutting roadmaps represent a very important  
26 step forward for the EPA in providing a framework for research integration on large-scale, complex  
27 environmental challenges. These roadmaps provide frameworks for integrating research across ORD  
28 programs and offices, and with other agencies, and for keeping ORD research forward looking.  
29

30 The SAB and BOSC commend ORD's progress in undertaking this integrated planning, and offer  
31 recommendations for strengthening the roadmaps and making them more consistent, moving from  
32 research planning to research execution, and defining a successful process for providing research to  
33 decision makers that incorporates institutional learning about that process. Until progress is made or  
34 more information is available regarding those points, the SAB and BOSC cannot determine whether the  
35 integrated research described in the StRAPs will produce the results the EPA needs to advance the  
36 complex problems it faces.  
37

38 ***Recommendation: Strengthen the roadmaps and make them more consistent with each other and with***  
39 ***the StRAPs.***

40 Sections 5.1 through 5.4 of this report provide recommendations for revising and strengthening  
41 individual roadmaps. ORD has acknowledged that the draft roadmaps were at different stages of  
42 development and completion. In revising the roadmaps and StRAPs, the SAB and BOSC recommend

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1 that additional attention in each StRAP and roadmap be given to: (1) communicating a clear vision for  
2 that lays out the key science needs and ORD's research niche *vis à vis* its research partners; (2)  
3 describing the current state of knowledge to provide baseline data in the research topic areas and where  
4 EPA's current projects fit; (3) describing other actors in the environmental protection scene and what  
5 they contribute to the specific goals and objectives in the plans. (there are frequent references to  
6 "partners," but no definition of the term); (3) clarifying and making more consistent the reciprocal  
7 relationships between the sources of research and the targets (in many cases, one program says they are  
8 producing products for another, yet the target program is silent); and (4) including in each StRAP a  
9 section along the lines of "Relationships to other StRAPs."

10  
11 ***Recommendation: Identify and communicate ORD research priorities in the roadmaps and commit***  
12 ***ORD resources to them.***

13 Plans alone cannot guarantee that needed future integration across ORD program areas will occur. Given  
14 the planning necessary to conduct integrated research and the heavy demand on research resources to  
15 conduct the work, a data-driven prioritization of the questions ORD chooses to address is necessary. The  
16 roadmap mechanism appears appropriate for fostering integration across programs, but it must be clear  
17 who is the steward of priority topics in the roadmap and who implements and makes sure the research  
18 happens.

19  
20 ***Recommendation: Acknowledge and plan for actual integration, which requires active collaboration***  
21 ***from the onset.***

22 Attempts at cross-program integration are evident within the StRAPs and ORD briefing materials  
23 provided for the July 24-25, 2014 SAB-BOSC meeting. Whether these efforts develop the needed  
24 scientific knowledge to advance EPA's ability to address complex problems depends on the  
25 implementation of these proposed linkages. Often, linkages and relationships proposed in strategic  
26 planning documents occur at only a superficial level – for example sharing final results only at the end  
27 of research projects. In other cases, one research program may independently produce research projects  
28 that are reported to be "relevant" to other research programs. To the extent that these linkages are of this  
29 superficial nature, they may not provide the needed scientific knowledge. However, if the proposed  
30 linkages are implemented in a meaningful, in-depth and ongoing manner, they should help provide the  
31 integrated scientific knowledge required by the agency.

32  
33 To be most useful, cross-program integrations should involve active collaborations from the outset of  
34 research projects – so that each project benefits from the combined expertise of multiple programs. The  
35 extent to which linkages reported in the StRAPs will promote truly integrated work is unclear. The  
36 StRAPs and briefing materials characterize cross-program linkages only in abstract terms, for example  
37 reporting broad research topics within each program that are relevant to other programs, or over which  
38 some type of otherwise unspecified interaction is planned. For example, page 8 in the SSWR StRAP  
39 states, "Watershed Sustainability has clear linkages to SHC through the EnviroAtlas and Report on the  
40 Environment, and to ACE, particularly in the realms of climate change and prediction and management  
41 of materials and waste." It is unclear to what extent these "clear linkages" will include active cross-  
42 program collaborations, and how areas such as this will benefit from this integration.

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1 ***Recommendation: Plan for the human resource and information needs required to carry out***  
2 ***integrated research programs.***

3 The SAB and BOSC recommend that the EPA develop a long-term plan (versus short-term hiring of  
4 postdocs or supporting external research) to better integrate behavioral science into their long term  
5 research. ORD should institute a formal means for broad communication and interaction among ORD  
6 technical staff to support its integrated research program. ORD would benefit from widespread use of  
7 the communities of practice approach undertaken by the computational toxicology program for sharing  
8 information and collaborating on environmental research.  
9

10 Because transparency is identified as a core value in the EPA Strategic Plan and accessibility to within-  
11 EPA and extramural data/information is a key challenge, ORD would benefit from an developing state-  
12 of-the-art information management to provides the optimal interface(s) for the interdisciplinary  
13 scientists engaged in EPA research and science products held or used by the agency programs.  
14 Development of overall strategic plan goals in the arena of information management science that serves  
15 and integrates the national research programs and cross cutting areas may help assure resources and  
16 commitment to this need.  
17

18 ***Recommendation: Identify the criteria or a process for evaluating research “results that advance***  
19 ***EPA’s ability to address complex problems.”***

20 There is a need for identification of criteria or a process for determining whether a product or research  
21 activity has been successful and advanced the EPA’s ability to address complex problems. Regulatory  
22 and research activities within the agency must, to be effective, continually absorb, synthesize, adapt, and  
23 use information from within and outside the agency. “Absorptive capacity” is known to vary greatly  
24 among organizations. ORD hears needs from the offices and regions, does research, and feeds  
25 information back to the offices and regions. The offices and regions translate the information into  
26 regulations and procedures and work with local authorities to protect human health and the environment.  
27 There is some recognition in research plans of the need for information loops rather than one-way  
28 transmission, but no consistent or systematic attention to this challenge.  
29

30 In addition, ORD should more clearly define the success of research that meets community needs In  
31 many places throughout the planning documents, tools to support communities are emphasized, but  
32 “community” is emphasized, is rarely defined with any precision and “community engagement” is rarely  
33 operationalized into a coherent process.  
34

35 ***Recommendation: Implement a process for identifying ORD cross-cutting research topics and***  
36 ***managing their life cycle***

37 The four cross-cutting research projects reviewed by the SAB and BOSC are all appropriate choices. At  
38 the July 24-25, 2014 meeting, ORD explained that the four current cross-cutting topics were developed  
39 in the following way. ORD convened its Executive Council whose members brainstormed topics and  
40 developed a “heat map” showing their relationship to ORD’s national research programs. ORD looked  
41 for research topics related to agency priorities where ORD could make a difference. The number of  
42 topics was capped at four to keep the planning and coordination efforts manageable. The SAB and  
43 BOSC note that the individual draft roadmaps did not include a description of this selection process.  
44

45 Moving forward, it is not clear how current efforts will mature and brought to closure or how future  
46 topics will be initiated. If there is no plan to initiate new cross-cutting projects, the four existing efforts,

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- 1 while highly meritorious, will not fully represent the diversity of integration challenges faced by the
- 2 agency. If there is no plan for bringing the efforts to conclusion, then there is the danger of proliferation
- 3 of the efforts, diluting their effectiveness.

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**APPENDIX A: CHARGE TO THE SAB AND THE BOSC**

**1. ORD's Strategic Directions**

In 2011, a joint SAB/BOSC committee provided advice to ORD on strategic directions as ORD realigned its research into six integrated programs. The initial research plans guided ORD for 2012-2016. ORD is now beginning the development of Strategic Research Action Plans (StRAPs) to cover the period 2016 -2019 for the six programs:

- Air, Climate and Energy
- Safe and Sustainable Water Resources
- Chemical Safety for Sustainability
- Sustainable and Healthy Communities
- Human Health Risk Assessment
- Homeland Security

The update of these plans is in the formative stages, providing an opportunity to receive early input and insights from the Chartered SAB and the BOSC Executive Committee. ORD is preparing plans that aim to provide the science needed to meet EPA's priorities, as described in the new EPA Strategic Plan (2014-2018). Also, the ORD plans need to anticipate the science that will be needed for environmental protection for 2020 and beyond.

**Charge Questions**

- 1a.** Considering the proposed research directions and focus, how well is ORD as a whole poised to support EPA in meeting the goals of the EPA Strategic Plan?
- 1b.** What are the SAB/BOSC perspectives overall on the proposed research directions providing research to address environmental issues of 2020 and beyond?

**2. Program Specific Charge Questions**

In the first Charge questions above, ORD is asking the for SAB/BOSC's view on the ORD research program as a whole. Additionally, ORD asks for the SAB/BOSC's advice on strategic directions for each of the six research programs.

**Charge Questions**

- 2a.** How well will the research directions in each Early Draft StRAP (2016-2019) support EPA in achieving the relevant Agency objectives and cross-cutting strategies, as described in the EPA Strategic Plan (2014 -2018)?
- 2b.** What are the SAB/BOSC perspectives on the proposed research directions in each StRAP providing research to address environmental issues of 2020 and beyond?
- 2c.** For each program, do the presentations and plans indicate that ORD is designing for integration, where appropriate, on topics that are relevant to other research programs?

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1 **3. Air, Climate and Energy Charge Questions**  
2

3 The ACE Research Program includes a focus on the environmental impacts of energy production and  
4 use, including decisions regarding energy choices. Initially, ACE work addressed impacts of biofuel s,  
5 as well as the development of models and decision tools that evaluate the outcomes of energy  
6 choices. The support to the biofuels program has diminished substantially. As we look to the future,  
7 we face a continually changing energy landscape, and an urgent need to anticipate the likely  
8 environmental impacts of an evolving mix of energy sources. The ACE Program wants to effectively  
9 target its resources to produce models and decision tools that illuminate environmental impacts and  
10 that will aid individuals, communities and governments in understanding the consequences of energy  
11 choices.

12 Charge Question

13  
14 3a. Does the SAB/BOSC have suggestions regarding how ACE should target its efforts to  
15 understand, model, and convey the potential environmental impacts of possible energy choices?  
16

17 **4. Sustainable and Healthy Communities**  
18

19 SHC has committed to integrating ecological and human health to better address issues of human and  
20 community well-being.

21 Charge Question

22  
23 4a. Does the research program contain the elements necessary to integrate these two critical elements  
24 of EPA's mission?  
25

26 SHC's research and development on indicators and indices, ecosystem goods and services, and the  
27 EnviroAtlas make reference to specific health conditions such as asthma, but are largely oriented  
28 toward protection and promotion of more broadly-defined individual and community well-being.

29 Charge Question

30  
31 4b. Is increased well-being the appropriate outcome to aim for, rather than amelioration of specific  
32 health conditions? If so, does the SAB/BOSC have recommendations for shaping the Community  
33 Public Health research project more toward broader well-being impacts?  
34

35 As EPA moves to implement a sustainability paradigm, ORD's role is to conduct research that  
36 supports this paradigm. SHC's plan is to conduct research on sustainability using a systems-based  
37 approach and by using case studies to illustrate community-level sustainability.

38 Charge Question

39  
40 4c. SHC is interested in thoughts and suggestions from the SAB/BOSC on ways to conduct research  
41 on the science of sustainability.  
42

43 **5. Safe and Sustainable Water Resources**  
44

45 In many parts of the country, the quality and availability of fresh water is a serious concern, and one  
46 that will become even more challenging as the climate changes. Simultaneously, energy consumption

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1 continues to rise. To meet the increasing energy demand, domestic energy consumption is increasing,  
2 and contributing to the increasing demand for water. Water is used to cool power plants, grow  
3 feedstock for and produce biofuels, and to extract oil and gas. Additionally, large amounts of energy  
4 are used to transport and treat water for human use. This "water energy nexus" is a significant  
5 challenge as we strive for more sustainable energy and water use. Many government agencies have  
6 roles to play in energy and water development and management in the US – including the Department  
7 of Energy, Department of the Interior, Department of Agriculture, US Geological Survey and others.  
8 EPA is particularly interested in moving toward a future in which communities could have "net zero"  
9 input and output of energy, water, nutrients, and other resources reclaimable from wastewater.

10 Charge Question

11 5a. Where can EPA make a significant research contribution in moving toward a sustainable water-  
12 energy future, with consideration of energy, water, nutrients, and other resources?  
13

14 **6. Chemical Safety for Sustainability and Human Health Risk Assessment Charge Questions:**

15  
16 CSS research is conducted to provide the fundamental knowledge infrastructure and complex systems  
17 understanding required to predict potential impacts from use of manufactured chemicals and products,  
18 as well as to develop tools for rapid chemical evaluation and sustainable decisions. The CSS research  
19 program integrates advances in information technology, computational chemistry, and molecular  
20 biology to improve Agency prioritization of data requirements and science-based assessment of  
21 chemicals through signature research in Computational Toxicology. EPA investments in advanced  
22 chemical evaluation and sustainability analytics are providing decision support tools for high-  
23 throughput screening and efficient risk-based decisions. In addition, CSS research results are  
24 translated to provide solutions and technical support to our Agency partners and external stakeholders.  
25

26 The HHRA program is focused on development of assessments to support Agency program decisions  
27 (i.e., Integrated Science Assessments, Integrated Risk Information System assessments, Provisional  
28 Peer Reviewed Toxicity Value assessments) and on development and application of new methods to  
29 improve risk assessments. The focus of the 2014 SAB/BOSC review is on the development and  
30 application of new methods for risk assessment, rather than on the assessment products (which are  
31 reviewed by SAB and other peer review panels).  
32

33 Tailoring analytical assessment approaches to provide characterization of new endpoints as  
34 biotechnology advances requires development of new methods of dose-response analysis to  
35 transparently incorporate and integrate data across scientific disciplines and different experimental  
36 designs (e.g., epidemiology, controlled or clinical exposures, *in vitro* / *in vivo* / *ex vivo* toxicology).  
37 As our understanding of the key events for different diseases evolves, building bridges to systems  
38 biology requires construction of analytical methods that can incorporate data on biomarkers from  
39 various disease dimensions (e.g., early or late-stage) in various tissues (e.g., blood or liver) of  
40 different species, and the ability to incorporate high-throughput data and adverse outcome pathways  
41 (AOP) with different degrees of verification. To this end, the HHRA and CSS programs are  
42 collaborating to develop new science (CSS) and support and evaluate its application in various  
43 assessment products (HHRA).  
44

Charge Questions

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1 6a. Please comment on approaches the HHRA research program might target to better tailor its  
2 exposure and response assessment approaches to address fit-for-purpose characterizations (e.g., risk  
3 prioritization, risk screening, risk assessment).

4 6b. Please comment on approaches proposed by CSS and HHRA research programs to identify and  
5 integrate novel data streams to develop innovative fit-for-purpose assessment products.

6 6c. Are there other areas of fit-for-purpose characterizations (e.g., risk prioritization, risk screening,  
7 risk assessment) that are ripe for such collaboration/integration?  
8

9 **7. Homeland Security Charge Questions**

10  
11 In past years the HSRP conducted research primarily to support the Agency's responsibilities related  
12 to the terrorism portion of Homeland Security incidents. The Agency has broadened the definition  
13 of Homeland Security to include all hazards (e.g., natural disasters, industrial accidents) and the  
14 HSRP aims to be in line with this new direction. The revised StRAP applies the research in the all  
15 hazards framework and provides new strategic directions related to all hazards research.

16 Charge Question

17 7a. What advice (e.g., strategic, tactical, structural) can the SAB/BOSC give to further guide the  
18 program toward this broader role?  
19

20 While developing the 2016-2020 StRAP, the HSRP utilized a systems approach when constructing its  
21 research to support the Agency's responsibilities related to water security and resilience and  
22 indoor/outdoor cleanup. This systems thinking is incorporated into the research objectives, science  
23 challenges, and research topics and projects.

24 Charge Question

25 7b How could the research program better incorporate this systems thinking and engage its partners  
26 in this systems thinking from a strategic and tactical standpoint?  
27

28 **8. Roadmaps for Cross-cutting Issues**

29  
30 ORD's six research programs are designed to focus on six key Agency priority areas. Inevitably,  
31 significant environmental issues arise that cut across these six programs. For example, climate change,  
32 while an important component of the Air, Climate and Energy research program, is highly relevant to  
33 the other research programs.  
34

35 Rather than create additional research programs for every cross-cutting issue, ORD is developing  
36 Roadmaps for climate change research, children's environmental health, nitrogen and co-pollutants,  
37 and environmental justice. They "map" out the ongoing and planned research from each StRAP.  
38 ORD intends that each Roadmap include: articulation of the problem and why this is an area where  
39 ORD can play a leadership role; identification of several relevant topics for research; description of  
40 research in the StRAPs (ongoing or planned) that will address the issue; and identification of  
41 scientific gaps in these cross cutting issues that will inform the national research programs in the  
42 development of the next StRAPs. As new, high priority, cross-cutting issues emerge, ORD expects  
43 to use this approach to integrate existing research efforts and identify needed work. ORD notes that  
44 the Environmental Justice Roadmap is still in an early stage of development.  
45

Charge Question

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1 8a.How effective is each Draft Roadmap in presenting a problem statement, elucidating key  
2 research topics, capturing relevant research in each of the six programs, and identifying any  
3 important scientific gaps?  
4

5 **8. Integration across the Programs**  
6

7 In addition to cross cutting issues that are germane to most or all of the research programs, there are  
8 issues that are highly relevant to two or three of the programs. ORD is actively working to prevent  
9 research falling into six silos by strengthening ties across the programs. The alignment into six  
10 programs has been underway for two years and integration efforts between any two of the research  
11 programs are growing or are newly beginning. In some cases, integration requires formal planning  
12 while in others coordination and collaboration occurs in less formal ways as the research programs  
13 are planned and implemented. The goal is for integration across the programs to improve the science  
14 and better address environmental issues.  
15

16 Charge Question

17 9a. Do ORD's plans, taken collectively, indicate that integration, where appropriate, will develop the  
18 needed scientific knowledge and produce results that advance EPA's ability to address complex  
19 problems?  
20  
21

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**APPENDIX B: TECHNICAL COMMENTS ON CROSS-CUTTING TOPICS**

**B.1. Children’s Environmental Health**

Translational framework

- The following statement is vague and needs further development to be meaningful: “The second translational route lies through using knowledge of individual patterns of exposure and disease predisposition to develop community-based approaches to health promotion and risk management. Here, environmental health research and public policy can only fully empower communities to manage risks by providing a clear understanding of important exposures and where these can be locally controlled.”
- The statement “the framework presented in Fig. 2 facilitates translation of advances and findings in computational toxicology to information that can be directly used to support risk assessment for decision making and improved public health” seems to be overstated. Please elaborate to explain how.

Research area 1.

- Regarding “knowledge systems, the Roadmap states that “Integrated impact: Systems information across all levels of organization associated with development and childhood disease and wellbeing is incorporated into predictive modeling to inform Agency risk assessments and environmental programs.” This lofty goal needs to be more carefully outlined and developed.
- 1.2.1 Enzyme Ontogeny Databases (CSS) - Can this be elaborated to link to epidemiologic studies and risk assessments of children’s environmental health questions?
- 1.3.3 Adverse Outcome Pathway Wiki (CSS) - It would be useful to consider how this is/may be applied outside ORD. Describe the stage of development of this concept across the four outcomes of interest and other outcomes.
- The tables present the EHC initiatives including research agendas and community engagement but they are lacking in any information regarding the National Institute of Child Health and Development and/or the Children’s Health Study’s research agendas.
- “EPA’s Strategic Plan translates this fundamental knowledge to provide a systems understanding that is necessary to adequately protect the health of children.” Please explain how.

**B.2. Nitrogen and Co-Pollutants**

Gap analysis

- It is good to see frequent referral to gap analysis however, it is unclear how research priorities set based on the gap analysis. This should be clarified in the document. Research prioritization should be considered a “value of information assessment” (VOIA). That is, new monitoring/research should be undertaken if the value (for informing decisions) of the new data/research justifies funding the effort. In general, proposed ORD projects involve good science and good scientists, but that alone does not warrant funding. Funded projects should be restricted to those that provide the greatest information/knowledge gain, given ORD objectives which are aligned with direct support of the EPA’s mission. In many cases, a VOIA can be undertaken using sensitivity analysis.

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1 Use of modeling and measurement to support development of nitrogen water quality criteria.

- 2 • Research is needed to quantify the connection between a water quality criterion and a designated  
3 use; see Reckhow et al. (2005) for a discussion and example of this type of analysis. This will aid  
4 in the selection of nutrient criteria. The NRC (2001) depicted the linkages between a pollutant  
5 source and a designated use. A water quality criterion serves as an easily-measurable surrogate  
6 for the designated use. The closer the criterion is to the designated use (in the causal chain in the  
7 figure) the better the criterion is for assessing water quality standard compliance. The further the  
8 criterion from the designated use, the more hidden uncertainty that is present in determining  
9 compliance based on the criterion.

10  
11 **B.3. Climate Change**

12  
13 Revisions to the “Research Needs” listed in Appendix C

- 14 • The climate change topic is broad and the EPA research role is not well defined in the roadmap.  
15 Outlining a few basic components of research to inform future EPA decision making would be  
16 useful. The roadmap should more clearly identify its relationship to the EPA’s Climate Change  
17 Adaptation Plan. The roadmap should also more clearly communicate the rationales for the EPA  
18 program-identified “Research Needs” listed in Appendix C. This Appendix lists, for example,  
19 best practices for communities to adapt to and mitigate climate change. It was unclear, however,  
20 what would be scoped under this topic. The rationales for prioritizing some topics within the water-  
21 ecosystem-climate piece also need further explanation.

22  
23 **B.4. Environmental Justice**

24  
25 Community participation.

- 26 • Some possible research topics/approaches include:
- 27 • Conduct community-based participatory research (CBPR) to identify factors that impact  
28 individual susceptibility and vulnerability, or an individual’s ability to effectively respond to  
29 environmental stressors;
  - 30 • Identify exposures and exposure interactions between sub-populations and how they relate to  
31 health disparities;
  - 32 • Identify cultural factors and factors related to those crossing U.S. borders, and the impacts on  
33 health disparities;
  - 34 • Develop mitigation strategies to improve public health within communities; and,
  - 35 • Develop simple, analytic decision support tools.

36