BOSC REVIEW OF NITROGEN ROADMAP FY16 ANNUAL REPORT

List of Acronyms

ACE	Air, Climate, and Energy
BMPs	Best Management Practices
BOSC	Board of Scientific Counselors
CAA	Clean Air Act
CSS	Chemical Safety and Sustainability
EPA	U.S. Environmental Protection Agency
FY	Fiscal Year
HHRA	Human Health Risk Assessment
HS	Homeland Security
INC	Integrated Nitrogen Committee
N	nitrogen
N_2O	nitrous oxide
NO_x	nitric oxide
ORD	Office of Research and Development
P	phosphorus
SAB	Science Advisory Board
SHC	Sustainable and Healthy Communities
SSWR	Safe and Sustainable Water Resources
StRAP	Strategic Research Action Plan
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

Background

This report was drafted by the following members of the BOSC Executive Committee:

- Viney Aneja, Ph.D., Professor, Department of Marine, Earth, and Atmospheric Sciences, North Carolina State University
- James Galloway, Ph.D., Sidman P. Poole Professor, Department of Environmental Sciences, University of Virginia
- Ponisseril Somasundaran, Ph.D., La von Duddleson Krumb Professor, Columbia University
- Tammy Taylor, Ph.D., Chief Operating Officer, National Security Directorate, Pacific Northwest National Laboratory

Within the past year, EPA's Office of Research and Development (ORD) released its cross cutting Research Roadmaps (https://www.epa.gov/research/research-roadmaps) to describe current research and facilitate future integrated ORD research across four prominent cross-cutting areas: Nitrogen and Co-Pollutants, Children's Environmental Health, Environmental Justice, and Climate Change. The cross-cutting Research Roadmaps are not stand-alone research programs; rather they integrate research in these priority areas across ORD's Strategic Research Action Plans (StRAPs) (https://www.epa.gov/research/strategic-research-action-plans-2016-2019) developed by the six ORD National Research Programs: Air, Climate, and Energy (ACE); Chemical Safety for Sustainability (CSS);

Human Health Risk Assessment (HHRA); Safe and Sustainable Water Resources (SSWR); Sustainable and Healthy Communities (SHC), and Homeland Security (HS). This integrative vision focuses ORD's investment on areas where EPA can play a significant leadership role and ensures that cross-cutting research is the foundation of sustainable decisions and actions in these four priority areas.

This first issue of the Annual Reports for each of the Research Roadmaps captures progress on research goals and activities during Fiscal Year (FY) 2016 (FY16; October 1, 2015 to September 30, 2016) in each of these four areas. The Annual Reports highlight successes and challenges of implementing an integrative approach to ORD's cross-cutting research. The Annual Reports also provide a preview of research activities in the upcoming fiscal year.

This document assesses two charge questions to the Board of Scientific Counselors (BOSC) concerning the Annual Report of the Nitrogen and Co-pollutant Research Roadmap for FY16. By way of introduction, the Nitrogen and Co-pollutant Research Roadmap was created in response to the EPA's SAB Integrated Nitrogen Committee (INC) recommendations provided via the SAB (https://yosemite.epa.gov/sab/sabproduct.nsf/WebBOARD/INCSupplemental?OpenDocument)

The overall Science Advisory Board (SAB) recommendations in the 2011 report were: (1) the use of the nitrogen cycle as an essential framework to address the environmental loading of reactive nitrogen; (2) an integrated cross-media approach to more effectively manage reactive nitrogen; (3) and monitoring and research to support management of reactive nitrogen.

Of all the Roadmaps of EPA, this one is the oldest, and the most advanced. The annual report details extensive accomplishments in FY16 and lays out the plans for FY17.

This review focused on two charge questions, noted below together with the Subcommittee's responses. Following that section, are additional comments from the Subcommittee.

Charge Questions and Responses

Charge Question 1. Comment on progress towards successful integration and implementation as articulated in the related Roadmap. This may include, but is not limited to, the following:

- Levels of commitment to Roadmap recommendations as incorporated into the ORD StRAPs;
- Coordination across ORD's six National Research Programs;
- Communication and outreach to partners and stakeholders; and
- Areas of innovation

Charge Question 2. Provide suggestions for improving implementation of the roadmaps and research integration across the National Research Programs.

- Are there additional opportunities for implementation or integration not highlighted in the annual report?
- Does "The Year Ahead section" adequately describe the next steps and short-term research areas and commitment?

Levels of Commitment

The Subcommittee was very impressed with the level of commitment to the Roadmap recommendations. In fact, their planned areas of action go beyond the recommendations and make the effort even more impressive.

Coordination across National Research Programs

The coordination across ORD's six National Programs is both necessary and good.

Communication and Outreach

The communication and outreach to partners and stakeholders is good. The one area where we think there could be improvement is more opportunities to engage the public.

In addition, we need to consider the integration of N with 'co-pollutants'.

Recommendation

Recommendation 1: Given that the term co-pollutants can include any compound that cause environmental problems, we recommend that EPA focus on the major nutrients—nitrogen (N) and phosphorus (P). And, since nitrous oxide (N_2O) is a long lived reactive nitrogen compound and therefore its emission has global consequences primarily as a greenhouse gas, international partners and stakeholders can help facilitate in its mitigation.

Areas of Innovation

1. The One Biosphere Modeling Project is impressive. The two 2016 roadmap products sound like heavy lifts–very impressive.
2. The example projects in the Ongoing Activities Across Research Programs are very good. They are not uniformly succinctly summarized as the material before it in the document, but that is fine.
3. The Challenges are well summarized, point to specific needs, and appear to be achievable.
4. Increasing population has the potential for increasing N into the environment. While we have a good track record at decreasing nitric oxide (NO_x) emissions via the Clean Air Act (CAA) (and further efforts should be encouraged), managing emissions of ammonia remains a challenge. While Best Management Practices (BMPs) may be temporary short-term solution to such emissions, emerging engineered solution to managing emissions of ammonia needs to be examined (e.g., enhanced use of controlled release of N using smart Nano systems and sensors).
5. Improving ammonia emissions inventory especially from agricultural sources and biomass burning (which is on the increase) is crucial. Ammonia emissions development may be facilitated by the use of satellite technology which has the potential of enhanced spatial and temporal coverage.
6. Partnering with the U.S. Department of Agriculture (USDA) with targeted opportunity on ammonia related research is suggested.

Recommendation

Recommendation 2: We recommend integrating expertise from the social sciences to examine effective modes of communication to the public with respect to their contribution to N pollution issues, and to examine the willingness of stakeholders to confront tradeoffs related to N pollution.

Opportunities for Implementation and Integration

1. Sustainability related issues (e.g., air, water, and soil) surrounding N need to be explored.
2. The two case studies discussed in the document are both related to water bodies.

Recommendation

Recommendation 3: For the 2017 Annual Report, we recommend that examples be given for other media (e.g., air).

Next Steps and Short Term Research Areas and Commitment

Both the webinar to introduce research gaps and needs and the research integration summit (2016–2019) are good ideas.

Recommendation

Recommendation 4: We recommend continued participation by other federal partners (USDA, the U.S. Geological Survey [USGS], etc.).

Summary List of Recommendations

- **Recommendation 1:** Given that the term co-pollutants can include any compound that cause environmental problems, we recommend that EPA focus on the major nutrients—nitrogen (N) and phosphorus (P). And, since nitrous oxide (N2O) is a long lived reactive nitrogen compound and therefore its emission has global consequences primarily as a greenhouse gas, international partners and stakeholders can help facilitate in its mitigation.
- **Recommendation 2:** We recommend integrating expertise from the social sciences to examine effective modes of communication to the public with respect to their contribution to N pollution issues, and to examine the willingness of stakeholders to confront tradeoffs related to N pollution.
- **Recommendation 3:** For the 2017 Annual Report, we recommend that examples be given for other media (e.g., air).
- **Recommendation 4:** We recommend continued participation by other federal partners (USDA, the U.S. Geological Survey [USGS], etc.).