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OFFICE OF THE ADMINISTRATOR  
SCIENCE ADVISORY BOARD

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Honorable Stephen L. Johnson  
Administrator  
U.S. Environmental Protection Agency  
1200 Pennsylvania Avenue, NW  
Washington, DC 20460

Subject: Science Advisory Board (SAB) Advisory on the Office of Research and Development's (ORD) Sustainability Research Strategy and the Science and Technology for Sustainability Multi-year Plan

Dear Administrator Johnson:

At the request of the Office of Research and Development (ORD), the SAB recently reviewed ORD's Sustainability Research Strategy (Strategy) and the related Science and Technology for Sustainability Multi-year Plan (Plan).

The SAB's Environmental Engineering Committee, augmented with other SAB members for this advisory, strongly endorses the Agency's proposal to establish a research program focused on sustainability because the results from such a program will improve the scientific foundation for a sustainable environment. Within the context of the current review, the Committee understood sustainability to be defined as "a means to create and maintain conditions under which humans and nature can exist in productive harmony and that permit fulfilling the social, economic and other requirements of present and future generations of Americans".

Environmental protection has primarily been achieved through regulations and enforcement. The Committee applauds the Agency's steady movement towards a systems-based approach to environmental decision-making that reflects the complexity of the world in which we live and effectively balances environmental protection and societal interests.

The Strategy, which emphasizes interdisciplinary approaches to environmental protection, provides an effective road map for the transition of the ORD's Pollution Prevention and New Technologies program to the new Science and Technology for Sustainability program.

The Strategy identifies research that will support risk-based environmental protection decisions without compromising society's economic or social development goals. The Plan, which describes the Agency's proposed sustainability research and technical activities, explicitly supports the Strategy while establishing a scientific framework for generating the environmental and public health information vital for achieving the Agency's short and long term sustainability research goals.

Although the science in the Plan is sound, it is unlikely that the Agency's sustainability outcomes will be achieved within five-years. Success in that time frame requires greater resources, both human and financial. Obviously, a workforce with experience and expertise relating to sustainability is necessary. A management structure aligned with a systems-based approach to environmental decision-making is also vital. Creative human resource programs can draw on both expertise within the Agency's current workforce and uniquely trained individuals from outside the Agency to foster a capable sustainability workforce. Less than one percent of the Agency's Science and Technology appropriation is budgeted for the sustainability research program. Given the Strategy's stated goal of integrating the concept of sustainability throughout the Agency's science and research programs, the SAB was concerned by this proposed level of funding. The sustainability research program funding level should be commensurate with its value to Agency decision-making. As such, a substantially higher budgetary commitment is critically needed for a viable sustainability research program.

The Agency is a scientifically credible steward of environmental protection. That credibility allows the Agency to assume a substantive and visible role in sustainability research. A number of government agencies, private industry and non-governmental organizations have already endorsed and adopted environmental sustainability as a framework for environmental management. Therefore, the SAB encourages the Agency to use the opportunity that ORD's sustainability research program provides to promote and coordinate sustainability-based science and research activities across the federal and private sectors.

Thank you for the opportunity to provide advice on this important and timely topic. The SAB applauds the Agency's leadership in advancing the scientific foundation for environmental sustainability. The SAB would also like to acknowledge its pleasure in working with a very dedicated, knowledgeable and responsive ORD scientists and managers. The SAB looks forward to receiving your response to this advisory.

Sincerely,

*/Signed/*

Dr. M. Granger Morgan, Chair  
EPA Science Advisory Board

*/Signed/*

Dr. Michael J. McFarland, Chair  
Environmental Engineering Committee

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**U.S. Environmental Protection Agency  
Science Advisory Board  
Environmental Engineering Committee Augmented for Sustainability  
Advisory**

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## Table of Contents

Summary	1
General Recommendations	1
Recommendations on the Sustainability Research Strategy	4
Recommendations on the Science and Technology for Sustainability Multi-year Plan	7
Responses to Charge Questions on the Strategy	11
Responses to Charge Questions on the Plan	21
Discussion of General Recommendations	29

## Summary

The SAB Environmental Engineering Committee, augmented with other SAB members, was in unanimous agreement that, together, the Strategy and Plan form an excellent first step in the Agency's transition from the historical single media or "stovepipe" approach to environmental protection to a systems approach that continues to focus on and achieve environmental protection. The Strategy, which basically describes a research framework for addressing the technical, social and economic complexity of current and emerging environmental protection issues, constitutes a new paradigm that explicitly embraces the application of life-cycle principles in support of short and long-term risk management decisions. On January 24, 2007, the White House issued an Executive Order *Strengthening Federal Environmental, Energy, and Transportation Management*, that said sustainable, "means to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations of Americans." This definition is consistent with the Committee's understanding of sustainability in the context of the current review.

Accompanying the Strategy is the Agency's sustainability Plan, which describes the specific research and technical activities proposed by the Agency that will support future sustainability-focused environmental decision-making. The Committee fully endorses the Plan as the blueprint for the Agency to achieve both its short and long term sustainability outcomes. However, the Committee also recognizes that ensuring successful sustainability outcomes depends on the Agency's ability to commit sufficient resources to support the development, dissemination and application of new environmental monitoring and assessment technology as well as the design and implementation of suitable sustainability metrics and indicators. The Committee is confident that full implementation of the sustainability Plan will generate vital scientific and technical information that will enable Agency decision-makers to better address both present and emerging environmental issues.

The Committee strongly supports the Agency's decision to establish a sustainability research program to address the multifaceted nature of current and emerging environmental problems. The Committee applauds the Agency's determination to look beyond the media-specific regulatory model to explore a more integrative approach to environmental protection that is cognizant of the economic and social impacts of environmental decision-making. Environmental protection decisions that also support the economic and social well being of future generations is of paramount importance to Agency decision-makers and the Strategy clearly establishes the path for achieving that goal.

Similarly, given the expanding technical and social science based information needed to support sustainability-focused environmental decisions, internal restructuring of the Agency's current programs is required to manage and direct data collection and processing. To this end, the Committee acknowledges that the Strategy provides a clear road map for facilitating the Agency's transition from the Pollution Prevention and New Technology (PPNT) program to the Technology for Sustainable Outcomes program.

Of particular importance to achieving broad Agency adoption of the sustainability paradigm is the creation and deployment of a technical workforce effectively trained in the practical application of environmental sustainability concepts and methods. The Committee encourages ORD to work with senior Agency management to establish and reinforce the institutional changes necessary to foster a greater understanding and appreciation for the economic and societal benefits of sustainability-centered environmental protection.

The Committee strongly supports the Agency's decision to advance environmental stewardship and collaborative problem solving to achieve measurable, sustainable outcomes. The Committee applauds the Agency's progression from pollution control to pollution prevention to sustainability.

Because of the Agency's international reputation as a scientifically credible steward of environmental protection, the Committee strongly encourages the Agency to assume a more substantive and visible role in conducting and disseminating results of sustainability research. Other government agencies (both national and international), commercial industry and a myriad of non-governmental organizations and private citizens have endorsed environmental sustainability. Moreover, as global recognition of the economic and societal impacts on environmental decision-making increases, the interdisciplinary approach to solving environmental issues endorsed by the Strategy and Plan elevates the Agency's environmental stewardship profile. EPA's scientific capability can be of great value to the sustainability concepts for environmental management. By providing a scientific foundation for sustainability approaches, EPA provides a sound basis for its own sustainability programs and for those of others.

### **General Recommendations**

1. The Committee recommends that the Agency better define those terms associated with the sustainability strategy and the measurement of sustainability outcomes.

To minimize the confusion and ambiguity for the targeted audience of both the Strategy and the Plan, the Committee encourages the Agency to define more clearly what is meant by the term sustainability. Both documents would benefit from explicit acknowledgement of the competing definitions of sustainability, thereby providing a context for the Agency's choice among the various definitions of this term and recognition of alternative views of this contested and often nebulous topic.

2. The Committee supports application of sustainability principles to address and resolve specific, multi-faceted environmental problems.

The Committee acknowledges that the judicious selection of research projects within the Plan will help to facilitate the diffusion and adoption of the sustainability paradigm both within and outside the Agency. To ensure a successful Agency transition from the traditional media-specific "stove pipe" approach to a more integrated systems approach to environmental protection requires that the sustainability research activities be scientifically compelling and have wide national visibility. Moreover, the sustainability research products should strategically integrate

into the Agency's other 16 multi-year plans and provide the technical focus that guides the sustainability research activities conducted by other federal agencies.

The Agency should be prepared to undertake some "higher risk – higher payoff" projects, i.e., projects that because of complexity, data requirements, methodological novelty, and interdisciplinary focus may be challenging, but would have a large impact if they are indeed developed successfully. The project portfolio should also balance targeted Agency needs and geography. The project portfolio should become the basis for articulating the relationship between projects and products for the annual performance measures (APM) and annual performance goals (APG) described in the Plan.

3. To encourage broad adoption and implementation of sustainability-based approaches to environmental protection across the EPA, the Committee strongly urges the Agency to be creative and strategic in developing its human resources programs.

If the Agency is serious regarding the development of sustainability-based approaches to environmental protection, it must actively cultivate the personnel skill sets necessary to achieve their effective implementation. Sustainability champions should be strategically positioned throughout the Agency to support the diffusion and adoption of sustainability-based approaches to environmental decision-making. To ensure that the important societal concerns and aspects of sustainability are appropriately considered, the Agency should seek to employ individuals with professional backgrounds that go beyond the physical sciences, engineering and economics. Stronger social science expertise is needed in fields such as anthropology for ethnographic assessments (how individuals, households and communities think, behave and interact with products, technologies and natural systems), psychology (behavioral economics) and decision theory.

4. The Committee encourages the Agency to enhance the diffusion of environmental sustainability principles and practices within and outside the Agency

The Plan correctly points out that, as the value of the ORD sustainability program becomes recognized, other Agency program offices will understand the value of sustainability attributes, goals, and metrics, and become active in seeking out collaborative projects. This research program gives the Agency opportunities to define environmental sustainability both internally and externally and to promote the use of related research products.

To assume a leadership role in promoting the economic and societal benefits of the sustainability paradigm, a true systems approach will be needed. This means involving personnel from many different areas including various Agency program offices, regional offices and other federal agencies (e.g., Department of Defense, Department of Energy, Department of Agriculture, etc.), local environmental groups, private industry and other community stakeholders.

ORD could further solidify its leadership role in promoting sustainability-based environmental decision-making by developing greater capacity in sustainability research. This could be achieved through a combination of: hiring new personnel with training in sustainability research, establishing incentives for existing personnel to apply their technical expertise in support of the

sustainability paradigm, pioneering new models of cooperative research with industry and development of small groups of sustainability experts within the Agency who could conduct analyses and other related work.

5. Support for sustainability is widespread. Both sound science and senior management support can further the paradigm.

While not universally accepted as the sole approach to environmental protection, support for sustainability, as both a goal and a means of approaching decisions, is widespread. The concept and practice of sustainability now permeates the Agency and many other institutions. Both a strong scientific base and the overt support of EPA management can promote wider implementation of the sustainability paradigm. These activities are mutually enhancing as well. Sound science provides a basis for support by senior management and senior management can advocate for the resources with which to further strengthen the science base.

6. The Committee recommends that the Agency make judicious use of targeted collaborations with other federal agencies as well as the private sector.

The Agency's research budget for this Plan is surprisingly small. There are clear benefits to seeking opportunities for collaboration with other federal agencies and the private sector to meet program goals. Of course, there is also a risk that the focus of the research program could become diluted by demands for time and resources. The key is pursuing the most appropriate opportunities in terms of a project's level of complexity, probability of success and national visibility. If resources allow, sustainability research investments, as a whole, would benefit from the Agency providing overall leadership and focused coordination to these external entities because none presently exists.

### **Recommendations on the Sustainability Research Strategy**

The responses to the specific Sustainability Research Strategy Charge Questions are briefly summarized here. (The letter S denotes that this is a charge question relating to the Sustainability Research Strategy.)

- S1. Does the SAB agree with the central premise of the Strategy that sustainability is all about decision making and that ORD research support should aim to inform and allow decision makers at all levels of government and in the private sector to choose courses of action that will lead to achieving sustainable outcomes?

The Committee does not agree with the central premise that sustainability is "all about decision making" and "aiming to inform." The Sustainability Strategy document is a careful and thoughtful effort to capture the opportunity to implement an important paradigm shift across much of the Agency's jurisdiction.

The Strategy will serve as an important companion document to the Plan as the sustainability paradigm is adopted within the Agency. It will also be important as the Agency works externally

with other Federal agencies and stakeholders across the nation. Rather than simply focusing on decision-making and the use of sustainability-based research to inform decision-makers (albeit critically important), the Committee offers the following expansive view of the programmatic needs of the sustainability Strategy:

1. Agency-sponsored core research focused on sustainability science is needed.
2. Public stakeholders are part of the cultural aspect of responding to and implementing sustainability at the local level and should be explicitly acknowledged within the Sustainability Strategy.
3. The definition of sustainability may benefit from additional interpretation. The research portfolio would be more compelling if ORD were more explicit about the interdependence of the three pillars of sustainability (environment, social aspects and the economy).
4. ORD needs to explicitly promote and integrate a life-cycle approach to environmental protection decision-making within the Sustainability Strategy that goes beyond simply generating information and furnishing it to decision makers. The life-cycle approach would support the need for behavioral change and outcome measurement over time.

S2. Does the strategy make a compelling case for ORD and EPA that Sustainability Research is a priority for ORD?

The Committee agreed with the case made in the Strategy that a systems view is needed in order to address environmental problems and that a sustainability framework encompasses a systems approach. Allocation of resources, on the other hand, does not indicate that Sustainability Research is a priority for ORD. The level of Agency resources currently allocated to support sustainability research is woefully inadequate for a meaningful scientific research program. Further, if the resources allocated to the Sustainability Research Strategy reflect Agency priority setting, then sustainability research does not currently appear to be a priority within ORD.

S3. Does the strategy focus on priority national issues and identify the right research questions?

The Strategy is cross-media. The areas and questions outlined are quite comprehensive, and expand upon the initial themes. Nevertheless the Committee is concerned that insufficient attention is devoted to certain issues (such as climate change research), the interface of social science and economics research with chemical and /biological research, and the difficulty of developing a meaningful suite of sustainability metrics.

S4. Does the strategy identify the right implementing steps to address research questions and achieve sustainable outcomes (Advance technology, develop tools and approaches, advance systems research and disseminate and apply results.)

As the discussion of implementation progresses, the specificity of the Strategy decreases as does ORD's control over the outcomes. The Strategy should acknowledge increasing resource demands tied to coordination with multiple entities. Neither the Strategy nor the Plan specify how the Agency will identify and pursue future research opportunities, what resources will be used, or how success might be evaluated. Finally, it is unclear what happens to the Agency's focus on pollution prevention. Prevention has been an important part of the EPA message for over 15 years and one that resonates with the public, NGO community and industry.

S5. Does the strategy adequately and correctly connect to policy and/or decision-makers inside and outside EPA for achieving desired sustainability outcomes?

Policy and decision-making are two different, but related, aspects of the problem. Decision-making depends on the way policy is implemented and requires that appropriate incentives (i.e. policy tools) be established. The Strategy focuses on activities, offices, and regions within EPA, and coordination among these entities. There is limited discussion of connections to and collaborations with decision-makers and organizations outside of EPA. The Strategy does connect to EPA decision-makers by arguing that environmental sustainability research is important and appropriate for ORD as well as by seeking to negotiate with other EPA program managers and decision-makers about the content and future of sustainability research at EPA.

S6. Does the Strategy enable ORD to prioritize its research investments? Does the Strategy define an appropriate role for EPA relative to other funding agencies? Does it sufficiently encourage other Federal agencies and organizations to relate their sustainability efforts to EPA's so as to promote co-funding and/or collaboration where appropriate?

The Strategy document clearly states that it is up to the individual multi-year plans and to the National Program Directors to identify their priority sustainability research areas and presents criteria for setting priorities that are consistent with those found in the Strategy. Moreover, the Strategy emphasizes that each individual multi-year plan should develop a balanced research portfolio with a good mix of short-term and long-term projects, known and emerging issues, projects that are traditionally central to EPA's mission and others that are more on the boundaries (e.g. agriculture and energy).

The Committee had mixed reactions to this agenda and the criteria for setting priorities. Recognizing both the importance to ORD of establishing a scientifically credible presence in sustainability-based research and the reality of limited budgetary resources, the Committee recommends a two-pronged approach that (i) pursues core research on sustainability and sustainability metrics, and (ii) establishes a small number of demonstration projects that would give ORD high visibility in the sustainability arena.

- S7. Does the Strategy outline an adequate roadmap for ORD to implement this program (P2 transition to Sustainable Technology, coordination among NPD and across existing multi-year plans, leveraging interagency cooperation, and defining emerging research areas?)

The Strategy lists specific projects and programs with a sustainability emphasis or focus in other agencies. It also identifies other federal agencies with overlapping interests for each of the six broad research themes, as well as international partners. Despite these lists, however, and EPA's acute awareness of other nations' focus and recent advances on sustainability matters, the discussion and the information offered is too cursory to allow the Committee to judge whether these other agencies have sufficient incentive to establish partnerships with EPA and promote co-funding and collaborations. However, the Committee supports ORD's roadmap for implementation of the Sustainability Research Strategy" the roadmap is described in chapter 6 of the strategy.

- S8. Does the SAB believe that sustainability research is a sufficiently strong concept for integrating and coordinating across ORD research programs?

From a science perspective, sustainability is a strong concept that has value in integrating and coordinating sustainability-based activities across ORD research programs. However, there are inherent obstacles and historical impediments to such change. The SAB recommends the Administrator and senior leadership consider a variety of approaches to ensuring the success of the implementation of this Strategy throughout the Agency's research program.

### **Recommendations on the Science and Technology for Sustainability Multi-year Plan**

The responses to the Multi-Year Plan Charge Questions are briefly summarized here. (The letter P denotes that this is a charge question relating to the Multi-Year Plan.)

- P1. Does the organization of the new Sustainability Technology Plan provide a clear logical framework for implementing an element of the overall Sustainability Strategy? Does the Plan follow appropriately from the Sustainability Research Strategy? Are the research issues identified in the Plan consistent with the research questions identified within the Sustainability Research Strategy?

The Plan provides a clear and logical framework for implementing an element of the overall Strategy. Within the context of limited resources, the Plan identifies a set of issues that are consistent with the Sustainability Research Strategy and current ORD capabilities. The criteria for project selection should be reviewed to ensure that they are appropriate for identifying those research activities that will more effectively support the Strategy.

The Committee is largely satisfied with the content of the Plan through Chapter 4. The Committee did engage in extensive discussion about Chapter 5, which presents the specifics of the planned research program. The Committee's comments are included later in this document.

- P2. For each major research track addressed within the Plan (e.g., Decision Support Tools, Education, Technologies, Systems, and Metrics/Indicators), do the Annual Performance Goals (APGs) and Annual Performance Measures (APMs) represent a logical progression of activities and intended outcomes? Does the Plan identify the specific issues motivating the research program?

Within each major research goal related to metrics, tools and technologies, the respective annual program goals and measures represent a logical progression of activities and intended outcomes. Nevertheless, it is difficult to determine the overarching objective and specific goals for the research program proposed.

However, the long-term goals themselves should be re-ordered. A more logical progression is:

1. Develop the appropriate metrics
2. Develop any decision support tools required for analysis (if possible, the tools should be systems-based and linked to metrics).
3. Investigate technological options to reach the goal and try to get the technologies in place (SBIR grants, performance incentives...).

Recognizing the budgetary constraints and the desire to achieve high profile measures of success, the Agency might consider selecting one or two key demonstration projects that are focused on a real and current sustainability issues. To the extent practicable, the projects should support sustainability metrics development, development and application of sustainability decision support tools and sustainability technology development and demonstration. The actual projects identified should have a major impact for the municipality, region, or even industry that is affected with the information gained easily transferred to other entities.

- P3. Does the Plan lay out a balanced program addressing both short-term and longer-term research that meets current needs while positioning the Agency to respond to emerging issues?

The Committee is convinced that the most pressing need is for short term successes to gain further support for the research program. Looking at the longer term, the Committee is persuaded the program should have the capability to detect emerging problems and inform the Agency. A prescriptive numerical balance, in dollars, work years, number of projects, or variety of disciplines is not recommended.

- P4. Do the long-term goals address the high-priority science, engineering, and technology needs of users that will help the Agency meet its strategic goals relating to sustainability? Do the long-term goals clearly relate to the research tracks within the Plan framework? Do they provide a picture of what the program is trying to achieve? Will the proposed research activities lead to progress towards these goals? Are the goals appropriately linked to long-term environmental outcomes?

Addressing the longer term outputs and outcomes of the program is important because ORD research has historically been focused on shorter term needs. The Plan explains clearly the linkages of the annual performance goals to the long-term goals and the long-term goals to the Strategy. However, it is not clear whether these long-term goals will significantly advance sustainable approaches to management and address specific sustainability challenges. The weakest part of the Plan is the integration between the long-term goals and long-term environmental outcomes. The outcomes, while measurable, are not scientifically compelling nor are they focused on achieving goals through the application of sustainability principles. A tenuous link between sustainability goals and outcomes leaves the Plan vulnerable to claims that ORD is retreating to the historical single-media “stove pipe” approach to environmental protection.

While the development of new, more sustainable technologies is usually best left to the private sector, the Agency has a critical role to play in certifying and evaluating data and making it available to the sustainability community. Furthermore, the Agency is encouraged to engage in research that is specifically focused on developing incentives for private companies to invest in and adopt new technologies.

The Plan alludes to but does not explicitly develop the Agency’s role in conducting “regular and continuous assessments of environmental trends”. If indeed the Agency assumes this role, and makes such assessments available to the public, then it will be performing a valuable service that can enable decision makers at all levels to respond to both emerging as well as legacy environmental issues.

- P5. Are the research products supportive of the strategic target as set forth in the Agency’s Strategic Plan under Objective 5.4?

Objective 5.4 of the Agency’s Plan focuses on enhancing society’s capacity for sustainability through science and research. The long-term goals support this strategic target by establishing sustainability metrics, creating decision-support tools, and developing and applying cutting-edge technologies to solve environmental problems. However, it is unclear who will be leading the proposed efforts, how funding will be prioritized, or how the research products will be defined. Given the lack of detail, it is difficult to assess the nature of the products or their significance. With the limited budget projections, it is unlikely that products will have a large impact on enhancing the science or decision-support of sustainability.

P6. Does the scope of work proposed within the Plan complement research being supported by other programs inside and outside EPA?

The Committee found that the scope of work appeared to complement research inside the Agency and perhaps outside the Agency. The Committee urges the Agency to conduct more extensive investigation and documentation of external research related to the Plan.

P7. Are there other potential emerging research areas that the Plan should consider?

The long-term goals are sufficiently broad to cover most emerging issues, however, it is unclear how the Agency will identify, prioritize, and respond to emerging issues on an on-going basis. The plan should explicitly address this concern since it has both resource and coordination implications.

P8. Is the level of resources specified by the Plan sufficient to address the research issues that it identifies, allowing ORD to achieve the intended outcomes of the research program? Is the Plan's relative allocation of those resources among the research tracks of the sustainability research program appropriate, based on a consideration of scientific and programmatic needs?

The level of support specified for the Plan is less than one one-thousandth of the Agency's overall budget and no more than 1% of the S&T budget. In the Committee's opinion, a substantially higher commitment is needed to have a serious impact on internal research priorities, managerial buy-in, and program visibility and growth. The level of support allocated will limit progress and suggests to the Committee that the Agency does not ascribe a high level of importance to sustainability-based research activities. In the Committee's opinion, the area of environmental sustainability should become a main thrust of ORD, with allocation and resources established at a level commensurate with its importance to current and future Agency decisions.

P9. Does the Plan appropriately address findings and recommendations in evaluations of the program and its components?

ORD is clearly interested in working with other parts of the Agency and organizations outside of the Agency. However, the descriptions of how such collaborations will be developed and implemented need to be strengthened in the Plan.

Overall, the Plan is too vague when it describes proposed results and outcomes that pertain to sustainability. Planned efforts to quantitatively describe those planned results and outcomes need to be expanded in light of future external assessments of the sustainability program.

This Committee's review and the upcoming BOSC review should address the concerns delineated in the PART evaluation. Regarding the integration of the elements of the P2NT (now sustainability) research program, the Plan provides evidence of substantial efforts at coordination and integration. The Committee's evaluation of those effects is described in the responses to other Plan charge questions.

## Responses to Charge Questions Relating to the Strategy

**S1 Does the SAB agree with the central premise of the Strategy that sustainability is all about decision making and that ORD research support should aim to inform and allow decision makers at all levels of government and in the private sector to choose courses of action that will lead to achieving sustainable outcomes?**

The Sustainability Strategy document is a careful and thoughtful effort to capture the opportunity to implement an important paradigm shift across much of the agency's jurisdiction and, along with other Federal partners and stakeholders, the national landscape. The Agency is to be commended for its work here.

The document will serve as an important companion document to the Plan as the sustainability paradigm is adopted internal to the Agency. It will also be important as the Agency works externally with other Federal agencies and stakeholders across the national landscape.

Many of the comments offered here reflect initial thoughts by the Committee that eventually resulted in the seven overarching comments being developed during the Committee meeting (presented in section 4 of this report). Consequently, these comments in response to S1 may be elaborative in nature.

The Committee does not agree with the central premise that sustainability is "all about decision making" and "aiming to inform." Rather, four additional, expansive views are offered:

First, Agency-sponsored core research focusing on sustainability science is needed. By defining sustainability as "all about decision making," the Strategy mixes together scientific questions with assumptions about likely policy directions. Overtly combining sustainability research activities with possible policy decisions weakens and limits the scientific aspects of the Strategy to only those environmental issues that can be addressed in the near term.

Development of decision support tools implies a foundation of knowledge about sustainability. In some areas, there is this foundation: for example, the benefits of energy efficiency are widely acknowledged. But, by not explicitly acknowledging the critical need for conducting research specifically focused on defining the fundamentals of sustainability science, the Strategy may not fully support sustainable outcomes. ORD research support should not just aim to inform decision makers, but should enable the Agency to establish a systematic and transparent process for identifying and prioritizing major environmental concerns that can be effectively addressed through application of sustainability principles. Sustainability research should provide the Agency with the scientific tools to deliver maximum value back to stakeholders in terms of a balance to economic, social and environmental improvements (the three pillars of sustainability).

It is of critical importance that the Strategy be able to distinguish between two related, yet distinct functions: clarifying sustainability principles, and implementing sustainability solutions. The strength of ORD research has traditionally been focused on clarifying and documenting environmental impacts. This role for ORD research is commendable and should be expanded to include clarifying the Agency's current understanding of sustainability principles. Implementing

sustainability solutions to a recognized environmental problem will be primarily a policy decision. After policy decisions are made, ORD research could then appropriately focus on applied research to implement the policies. For instance, ORD's efforts to "develop a set of appropriate metrics to gauge society's progress towards sustainability" (ES-page 14) should, in part, be based on metrics already available (e.g., energy efficiency) and allow greater focus on current and future policy and regulations. With such existing metrics, then society could proceed with the task of developing technologies and approaches to achieve these goals.

Second, the public and public stakeholders are clearly part of the cultural aspect of responding to and implementing sustainability at the local level.

Sustainable decision-making will take place at many levels and across both the public and private sectors, from individuals to neighborhoods, municipalities and regions, countries and continents, NGOs and private firms, and consumers and producers. Any plan to inform and support decision-making on such a scale is a large undertaking involving research on; material and energy flows, information dissemination, economic incentives and expectations for present and future payback. As such, integration of social factors into the science that ORD has traditionally employed is an essential element of the sustainability paradigm. Typically, major legislative actions and federal policy are needed that respond to public perception of need. The sustainability paradigm is of such a nature, a radical departure from past ways of perceiving humankind's relationship to the environment.

An important premise in the sustainability paradigm is informed decision making for change agents (e.g., government) and for the practitioners (e.g., the public). In general, the difficult component of decision-making is having the needed information. In this regard, it is important that the Strategy focus on decision-making and identify "information driven" processes. A sustainability-focused solution to environmental concerns is effective only if information is coupled with incentives (or disincentives) that can drive behavioral change (and prevent backsliding to traditional unsustainable solutions). The Strategy fails to explicitly acknowledge the role of the public and other stakeholders besides local, state and federal government and the regulated entities. The public should be apprised of and might well be interested in learning about what technological advances funded by ORD have been adopted by private industry. In addition, the metrics and indicators developed under the auspices of ORD research program would serve the interests of the public at large, not just those of government officials and decision makers.

Third, the definition of sustainability may benefit from additional interpretation. The research portfolio would be more compelling if the interdependence of the three pillars of sustainability (environment, social aspects and the economy) were clarified. Currently, economic growth and population change appear to be treated as exogenous variables that determine the pressure imposed on the environment.

Fourth, ORD needs to explicitly promote and integrate a life-cycle approach to environmental protection decision-making within the Strategy that goes beyond simply generating information and furnishing it to decision makers. The life-cycle approach would support the need for

behavioral change and outcome measurement over time, both internal to and external to the Agency.

**S2 Does the strategy make a compelling case for ORD and EPA that Sustainability Research is a priority for ORD?**

The Committee unanimously agreed a systems-based approach is needed in order to address environmental problems and that a sustainability framework supports a systems methodology. Other points of agreement included concern that the category of “decision maker” was construed rather narrowly. Committee members argued that the long-standing problem of “silos”—division of environmental problems into individual media and/or pollutants—was not sufficiently addressed as a core source of the problems facing environmental policy and the Agency.

Allocation of resources, on the other hand, does not indicate that Sustainability Research is a priority for ORD. The level of Agency resources currently allocated to support sustainability research is woefully inadequate for a meaningful scientific research program. Further, if the resources allocated to the Sustainability Research Strategy reflect Agency priority setting, then sustainability research does not currently appear to be a priority within ORD.

**S3 Does the strategy focus on priority national issues and identify the right research questions?**

The Strategy organizes its priority research questions according to the six critical research themes in Chapter 4 (Natural Resource Protection, Non-renewable Resource Conservation, Long Term Chemical and Biological Impacts, Human Built Systems and Land Use, Economics and Human Behavior, and Information and Decision Making). These themes, and the questions that are derived from them, have both a generic (i.e. nothing to distinguish EPA’s role), and EPA-specific focus which, in general, emphasizes issues related to human interactions with the environment. To its credit, the Agency has tried to derive a strategy that is cross-media. The areas and questions outlined are comprehensive, and expand upon the initial themes. The Committee encourages the Agency to apply the principles of sustainability in supporting research activities aimed at addressing high profile environmental concerns e.g., global climate change, energy production, etc. The Committee strongly endorses the efforts by the Interagency Sustainable Development Indicators group to develop a suite of scientifically defensible sustainability metrics.

The Committee acknowledges the inherent difficulty in establishing sustainability metrics that are acceptable to a broad range of public and private stakeholders. However, successful transition of the Agency from its single-media regulatory focus to a systems-based approach to environmental decision-making is dependent on the formulation of scientifically defensible sustainability metrics.

Owing to the early advances of the international community in conducting state-of-the-art research on sustainability, Committee recommends that the Agency critically examine the practices of the European Union (EU) countries, Japan, and others as a means of establishing reasonable sustainability benchmarks while developing a distinctive sustainability research

model that is patterned after the Agency’s sustainability paradigm, i.e. collaborative, forward-focused, inclusive, adaptive, and integrative.

**S4 Does the strategy identify the right implementing steps to address research questions and achieve sustainable outcomes (advance technology, develop tools and approaches, advance systems research, and disseminate and apply results)?**

The Strategy refers to four implementing steps:

Step 1: transition the current pollution prevention and new technology research program into a Science and Technology for Sustainability Research Program,

Step 2: coordinate with 16 other multi-year plans,

Step 3: collaborate and partner with EPA Program and Regional Offices and other government organizations, and

Step 4: identify and pursue future research opportunities.

As one proceeds from implementing steps one to three, a number of things occur:

1. There is less and less specificity of how this will work in the Strategy.
2. ORD has less and less direct control of the outcomes and this will lead to measurement problems.
3. There will be increasing resource demands tied to coordination with multiple entities (important given limited resources).

Step 4 (identify and pursue future research opportunities) appears in various forms throughout the strategy but neither the Strategy nor the Multi-year plan specify how this will be done, what resources will be used, or how success might be evaluated.

Finally, it is not clear what happens to pollution prevention (step 1). Though always under-resourced, prevention has been an important part of EPA message for over 15 years and one that resonates with the public, NGO community and private industry. The Plan should make clear how the S&T for Sustainability Research Program views the concept of “prevention.”

**S5 Does the Strategy adequately and correctly connect to policy and/or decision-makers inside and outside the EPA for achieving desired sustainability outcomes?**

Policy and decision-making are two different, but related, aspects of the problem. US environmental policy is, and will most likely remain, risk-based. Whether this is inconsistent with “sustainability-based” policy will only be known when the outcomes of research on sustainability become apparent.

Decision-making depends on policy, or more precisely the way policy is implemented, and requires that appropriate incentives (i.e. policy tools) be implemented. It can relate to long or short-term courses of action, the longer the term the greater the uncertainty in the outcome. This is why it is important to view sustainability metrics and standards as evolving, i.e., a moving target whose descriptions are continuously refined as research results are generated.

The Strategy focuses on activities, offices, and regions within EPA, and coordination among these entities. The Strategy does connect to EPA decision-makers by arguing that environmental sustainability research is important and appropriate for ORD, as well as by seeking to negotiate with other EPA program managers and decision-makers about the content and future of sustainability research at EPA.

The Strategy does not propose any significant connections to federal policy and/or decision-makers outside EPA. External collaborations and partnerships are discussed in a summary manner on pages 70-73. Ongoing programs and relationships are noted, with some specific examples given. There is more discussion of connections with other Federal agencies than with regulated bodies (industry), communities, and consumers. Although the Strategy refers on page 63 to the need for balance between research that supports decision making within EPA and by other government organizations and industry, it neglects to mention the role of consumers or non-governmental, non-regulated parties that may be involved in policy recommendations or decisions, be they individual life-style decisions or those that affect local or regional communities. There is little in the Strategy about partnering with academic research or even how EPA might better leverage information and research generated by the regulated parties themselves.

The general nature of the discussion of external connections is consistent with the tone of the rest of the Strategy, which examines six broad themes of environmental sustainability in a general manner. It is not clear, however, how much of an impact the collaborations and partnerships will actually have in advancing sustainable approaches to management and protection of the environment. There is no discussion of connections with specific kinds of decision-makers or policies linked with specific sustainability challenges. Certainly, specific connections within public and private sectors will evolve as the program develops, but the Strategy recognizes that this effort must be (and will be enhanced by) connections with other efforts in EPA and outside EPA.

ORD is clearly interested in connecting to policy and decision makers within and outside of Agency in the Strategy and Plan. However, as formulated, the Strategy does not require the identification of specific kinds of decision-makers and policies. Weakness in this respect probably reflects resource constraints rather than failure of intention and foresight. If the Strategy was built around specific sustainability challenges, which it is not, then the need for identifying decision-makers and policies would be more apparent.

The Strategy should do more to prepare to discuss research results with policy makers. After ORD clarifies and strengthens its research strategy, it should develop an active program to connect to policy makers and decision makers. In this regard, the strategy could be more explicit

in its goal of trying to change behavior through the development of metrics and tools that might move all parties towards decisions that create environmental sustainability – that recognize something beyond straight measures of economic productivity. It's almost too subtle in that regard. At the same time, it is critical that the Strategy acknowledge that decisions will always be made in the absence of complete information; development of approaches to decision making that address uncertainty are essential.

The Strategy could also do more to move us away from a waste-centered view of environmental protection toward a life cycle approach. The Strategy appears to view “sustainability” as following logically, temporally, and philosophically from the current emphasis on waste management as a means to healthy environments. It may be more useful to view things the other way around, regardless of how policy has historically been implemented. The problem with seeing sustainability as derived from a waste-centered view is that it then becomes very difficult to refocus our (EPA managers and scientists, the government in general, and the citizenry) environmental frame of reference. This inevitably leads to inadequate organizational structures, poor prioritization, and seeking answers to the wrong questions. Interestingly, this has been recognized in the Agency's Strategic Plan under Goal 3 (Land Preservation) in which it is stated “Our ultimate goal is to move the Nation from a waste-oriented to a life-cycle management way of thinking about materials”.

ORD has an opportunity to provide leadership both internal to the Agency and external among the federal agency family and other organizations. This can be accomplished by coordination and leadership in the definition of environmental sustainability and in the use of related research products which will influence how other federal agencies and organizations move forward with their sustainability programs.

The scope of environmental sustainability research efforts outside EPA is vast and the ORD has only skimmed the surface. To take one example, there is no mention of the scholarly literature on environmental sustainability. There are several key academic/scientific journals devoted to this topic and, of course, many more that touch on it. A more deliberate effort at ongoing literature review is warranted in this respect - to exploit what has been created by others, to stay abreast of developments in the field and to identify vehicles (e.g., journals) through which ORD research should be disseminated.

- S6 (a) Does the strategy enable ORD to prioritize its research investments?**  
**(b) Does the strategy define an appropriate role for EPA relative to other funding agencies? Does it sufficiently encourage other Federal agencies and organizations to relate their sustainability efforts to EPA's so as to promote co-funding and/or collaboration where appropriate?**

**S6(a): Does the strategy enable ORD to prioritize its research investments?**

The Strategy document identifies five objectives for ORD research (understanding of systems, development of decision-support tools, development of technologies, collaborative approaches to decision-making, development of metrics and indicators) and six broad research areas (“themes”—namely renewable resource systems, non-renewable resource systems, long-term

term chemical and biological impacts, human-built systems and land use, economics and human behavior, information and decision-making).

Examples of more specific, but still sufficiently broad, research questions are offered for each of the six research themes. In this document, ORD elected to present criteria that could be used to set priorities, rather than trying to identify research priorities directly. Specifically, these criteria are:

1. “high impact;”
2. “true to EPA’s research capabilities;”
3. “true to EPA’s role” and mission;
4. “leverage:” higher priorities on research that ultimately leads to sustainability on a large scale, with EPA partnering in initial research or through transfer and diffusion of knowledge, methodologies, and approaches; and
5. systems context.

The Strategy clearly states that it is up to the individual multi-year plans and to the National Program Directors to identify their priority sustainability research areas. (Indeed, the Plan document presents criteria for setting priorities—grouped into primary and secondary criteria—that are consistent with those in the sustainability strategy document.)

Moreover, the Strategy emphasizes that each individual multi-year plan should develop a balanced research portfolio with a good mix of short-term and long-term projects, known and emerging issues, projects that are traditionally central to EPA’s mission (e.g., water) and projects that are at the boundary of EPA’s responsibility but still important for sustainability (e.g., agriculture and energy), research that supports decision-making within EPA (programs and regional offices) and research that supports decision-making in the industry and in other local, state and federal organizations.

The Committee had mixed reactions regarding the efficacy of this agenda and the criteria employed for setting research priorities. The Committee determined that, on the whole, the research portfolio composition was appropriate for ORD. However, in practice, several Committee members expressed reservations over whether the compelling science questions and priorities that truly speak to sustainability and its cross-cutting issues would be addressed as part of ORD’s sustainability research program. When people have few resources and much work, there is a natural tendency to continue existing programs changing their description and little else. That temptation should be avoided here.

Recognizing that the Agency is poised to assume a global leadership role in sustainability research, the Committee strongly recommends that, in light of ORD’s limited budget, that the following parallel activities be conducted immediately:

1. conduct core research on sustainability focusing on the development of defensible sustainability metrics, and
2. implement a small number of Agency-sponsored technology demonstration projects that provide ORD with the opportunity to achieve significant visibility within the sustainability research arena.

It is important that these demonstration projects move away from waste/end-of-pipe approaches towards a broader, system-based perspective. Examples of such projects might include an assessment from a sustainability perspective of:

1. biofuels policies and options, which are topical and encompass a broad range of issues and potential impacts on emissions of greenhouse gases, agriculture, dependence on imports of fossil fuels, etc. and may imply a variety of economic incentives;
2. a study of the hypoxic environment in the Gulf of Mexico or the Chesapeake Bay, and
3. wastewater practices and infrastructure needs in regions and cities with accelerated population growth.

**S6(b): Does the strategy define an appropriate role for EPA relative to other funding agencies? Does it sufficiently encourage other Federal agencies and organizations to relate their sustainability efforts to EPA's so as to promote co-funding and/or collaboration where appropriate?**

The Strategy lists specific projects and programs with a sustainability emphasis or focus in other agencies. It also identifies other federal agencies with overlapping interests for each of the six broad research themes, as well as international partners. Despite these lists, however, and EPA's acute awareness of other nations' focus and recent advances on sustainability matters, the discussion and the information offered on page 71-73 is too cursory to allow the Committee to judge whether these other agencies will feel encouraged to establish partnerships with EPA and promote co-funding and collaborations.

**S7 Does the Strategy outline an adequate roadmap for ORD to implement this program (P2 transition to Sustainable Technology, coordination among NPD and across existing multi-year plans, leveraging interagency cooperation, and defining emerging research areas?)**

The roadmap for implementation of the program is described in Chapter 6, pp. 61-75, beginning on page 64 and includes the four implementing steps identified in the response to S4 on page 14 of this document.

The Committee supports ORD's roadmap for implementation of the Strategy. Coordination with other multi-year plans is essential to the success of the Strategy. The implementation of the Strategy through a number of multi-year plans will begin to provide the Agency with a distributed core of sustainability research in ORD. Coordination with EPA program and regional offices and other government organizations will provide additional needed capacity to carry out the research program.

Implementation of the Strategy is organizationally challenging because it relies on cooperation throughout ORD and EPA. The Strategy is an important step for ORD and for the Agency, and the Committee supports ORD's initiative. Explicit management support of the Sustainability Research Strategy would be important to ensuring successful implementation.

**S8 Does the SAB believe that sustainability research is a sufficiently strong concept for integrating and coordinating across ORD research programs?**

In the face of rapid economic and population growth, in addition to the threats of a possible oil crisis, global warming, and ozone depletion, it is clear that novel actions must be taken in order to ensure the continued prosperity and progress of our generation and those of the future. New methods must be developed to balance the needs of present and future populations with the real limits of our natural resources. Attempting to remedy ecological damage by "stovepipe" policies represents an incomplete understanding of pollution and the environment. Thus, environmental scientists and decision-makers are presented with a multitude of environmental challenges in developing new models, methods, and technologies to deal with pollution and environmental protection in a holistic, systems-based manner. The philosophy of sustainability has the capacity to provide the answers to these challenges when applied to relevant scientific, social, and economic fields.

Sustainability impacts and is impacted by variety of disciplines, and thus a multidisciplinary and multimedia approach to managing our environment is required. Building on the definition taken from the World Commission on Environment and Development issued its 1987 report, *Our Common Future*, better-known as the Brundtland Report, the ORD draft document defines sustainability as "meeting basic environmental, economic, and social needs now and in the future without undermining the natural systems upon which life depends." Thus sustainability is conceptualized as a dynamic process, an open-ended challenge, in which scientists, economists, and lawmakers work together to solve present problems and anticipate future issues.

More precisely, the Strategy identifies "Six Themes of Environmental Sustainability," that will underpin the Agency's approach to sustainability. They are: natural resource protection, non-renewable resource conservation, long-term chemical and biological impacts, human-built systems and land use, economics and human behavior, and information and decision-making. These themes reflect the concept upon which the Strategy is predicated – that "the nation is most capable of achieving sustainable environmental outcomes by investigating resources . . . in a systems-based context and incorporating the influences of economy and human behavior where appropriate."

The 2005 National Research Council report, *Thinking Strategically: the Appropriate Use of Metrics for the Climate Change Science Program* cited in the ORD draft document identified eight priority sustainability areas in need of government support, including green chemistry and engineering, energy intensity of clean processing, and separation sciences, among others. These fields all represent the frontier of environmentally conscious sciences, as well as representing specific research areas in which the ORD has a vested interest, and an accordingly strong presence.

In addition to intramural research programs, the Strategy proposes ORD involvement and collaboration with government programs at the federal and state level, and also with industrial programs. Thus, sustainability effectively helps to coordinate and integrate a broad range of ORD research programs. However, two main issues are not emphasized;

1. increasing food (both crop and animal) production and its consequences to the environment; and
2. multimedia nature of a sustainable strategy.

The EPA is the Federal agency most concerned with research designed to protect and utilize the natural resources of the environment. It is, therefore, appropriate for the Agency to fund research programs that will serve its mission, and, where possible, assist the missions of other agencies. The Strategy will create opportunities for co-funding/coordination between the EPA and other Federal agencies in science, engineering, economic and social fields, as sustainability comes to the forefront of research programs in many different disciplines.

While sustainability research can play an important role in integrating and coordinating across ORD research programs, the exigencies of Agency mandates and to a lesser extent resource constraints and the "ownership" of key topics by other agencies, means that the portfolio of ORD research programs is not likely to be completely conducive to integration in this manner. However, sustainable development must be taken seriously by the entirety of upper management at the Agency and a critical core of Agency scientists.

## Responses to Charge Questions Relating to the Plan

**P1 Does the organization of the new Sustainability Technology Plan provide a clear logical framework for implementing an element of the overall Sustainability Strategy? Does the Plan follow appropriately from the Sustainability Research Strategy? Are the research issues identified in the Plan consistent with the research questions identified within the Sustainability Research Strategy?**

Yes. The Committee agrees that the organization of the new Sustainability Technology Plan provides a clear logical framework for implementing an element of the overall Sustainability Strategy. The Committee recognizes that financial and personnel resources are limited for this program. Within this context, the Plan identifies a set of issues that are consistent with the Sustainability Research Strategy and current ORD capabilities. The criteria for project selection should be reviewed to ensure that they effectively focus research on projects that will contribute more effectively to the Sustainability Research Strategy.

The Committee is largely satisfied with the content of the Plan through Chapter 4. These parts of the Plan discuss the shift to sustainability, the foundation of a sustainability program, creation of a framework for the Plan, and prioritization of the Plan research. The Committee did engage in extensive discussion about Chapter 5, which presents the specifics of the planned research program. The Committee has a number of comments on the specifics of the planned research program. These comments are included later in this document, particularly in response to questions P4 and P5 and in chapter 4.

**P2 For each major research theme addressed within the Plan (e.g., Sustainability Metrics, Decision Support Tools, and Technologies), do the Annual Performance Goals (APGs) and Annual Performance Measures (APMs) represent a logical progression of activities and intended outcomes? Does the Plan identify the specific issues motivating the research program?**

On the one hand, within each major research goal related to metrics (LTG 1), tools (LTG 2) and technologies (LTG 3), the respective APGs and the APMs do represent a logical progression of activities and intended outcomes. While one could debate the choice of LTGs and related APGs and APMs, for those cited there is a logical progression of events for intended outcomes.

While on the other hand, if one looks at the progression of the three major LTGs, the Plan appears to be chronologically inconsistent. Technology development is identified as a major focus in the short term while development of sustainability metrics is not addressed until 2008-2011. A more logical progression within the context of a overall focused sustainability research project is described as follows:

1. Develop the appropriate metrics.
2. Develop any decision support tools required for analysis (if possible, the tools should be systems-based and linked to metrics).

3. Investigate technological options to reach the goal and try to get the technologies in place (SBIR grants, performance incentives...).

Again, the goal is to link metrics, with decision support, with technological innovation within one project that can be completed with available resources. Currently, there is no clear progression among the 3 LTGs described in the document.

### **Does the Plan identify the specific issues motivating the research program?**

While there does appear to be a logical progression of activities and intended outcomes presented within each LTG, it is difficult to determine the overarching objective and specific goals for the research program proposed. While the overall strategy is appropriate insofar as sustainable outcome measures related to energy, air, water, materials, land and ecosystems are concerned (see Table 1.1), there is no clear integration between the research program and how these outcomes will be achieved. Furthermore, the probability of achieving the intended outcomes is low due to resource (appropriate personnel and funding) constraints. Realizing such constraints and wanting to achieve maximum impact for the resources invested, one recommendation is to select one or two key demonstration projects, focused on a real and current sustainability issue where the approach can include all the aspects of metrics development, development and application of decision support tools, and technology development and demonstration. The actual projects identified should have a major impact for the municipality, region, or even industry that is the focus of the project, with the information gained easily transferred to other entities.

### **P3 Does the Plan lay out a balanced program addressing both short-term and longer-term research that meets current needs while positioning the Agency to respond to emerging issues?**

The Science and Technology for Sustainability Multi-Year Plan (Plan) builds upon the framework of the Pollution Prevention and New Technologies (P2NT) Research Program, created in 2000. Under the P2NT program, much progress has been made in a variety of fields pertaining to sustainability, such as the development of Environmental Impact Assessment Models, the Small Business Innovation Research Program, and the Technology for a Sustainable Environment programs.

The P2NT program was reviewed by the Federal Government's Office of Management and Budget, and several recommendations were made to improve the program, including "becoming more focused on the need of Agency client offices, fostering more collaboration with other researchers (academic, industrial, and government), and developing an ability to measure and track program results over time." Thus, the Plan benefits from being created with these recommendations in mind, focusing on coordinating interdisciplinary programs, setting long- and short-term goals, and measuring the program's performance in an effective way.

The Plan establishes three long-term goals (LTGs), with the overall vision of “providing support to regional and national sustainability polices and initiatives.” First, the Plan seeks to identify and create scientifically based sustainability metrics, which will allow scientists a clearer picture of what a healthy, sustainable ecological system looks like. Next, the Plan calls for the development of decision-support tools that promotes environmental stewardship and sustainable management practices. Thirdly, the Plan calls for the development, application, and demonstration of innovative technologies that solve environmental problems and provide sustainable outcomes.

The description of these three long-term goals is sufficiently broad to allow flexibility in their execution, but specific enough to establish criteria for their measurement. In addition, the related research program also has several performance measures which rely upon feedback from the Agency’s clients, e.g., individuals, communities, government and private companies.

Furthermore, the ORD has established criteria by which research activities may be prioritized. The primary criteria are: resource availability, relevance to the Agency’s Mission and Addressing Program Office Needs, and Staying True to ORD’s Research Capabilities. These criteria raise serious questions regarding implementation in that the draft document reports that the resources allocated to the existing P2NT research program are modest and, in fact, are expected to decline. With this in mind, are the long-term goals of the Plan attainable? Will new research programs fail to be funded, although there may be potential for a highly positive environmental impact? Is the Plan itself a sustainable program? This question is of the utmost importance as all goals and plans are predicated upon the availability of adequate resources.

The Plan calls for responding to emerging issues, but lays out no strategy for identifying these issues or organizing a coherent response. ORD needs to be specific about how it will track emerging issues, prioritize them, and decide how best to address them. This function will be important in terms of also identifying future partners within the government, industry and academia. The resource demands for issue tracking are not extensive, but ORD or other Agency program offices must be responsible for tracking not just relevant environmental issues but changes in industrial production technologies, social behavior and economic drivers that may result in new opportunities to achieve sustainable outcomes.

If this is a more helpful interpretation around the topic of balance, then it might be useful to weight the balance somewhat in favor of short term research projects that develop useful products in the next year or two; and slightly less towards long term (i.e. research projects that develop useful products within five years) so that early successes are ensured.

**P4 Do the long-term goals address the high-priority science, engineering, and technology needs of users that will help the Agency meet its strategic goals relating to sustainability? Do the long-term goals clearly relate to the research tracks within the multi-year plan framework? Do they provide a picture of what the program is trying to achieve? Will the proposed research activities lead to progress toward these goals? Are the goals appropriately linked to long-term environmental outcomes?**

**(a) Do the long-term goals address the high-priority science, engineering, and technology needs of users that will help the Agency meet its strategic goals relating to sustainability?**

This set of charge questions requests commentary from the SAB on the long term efficacy of the proposed sustainability research program. Addressing the longer term outputs and outcomes of the program is important because ORD research has historically been focused on shorter term needs, often driven by political imperatives rather than science-based prioritization.

Chapter 3 of the Plan explains clearly the linkage of the LTGs to the Sustainability Research Strategy, which examines six broad themes of environmental sustainability. It is not clear, however, how much of an impact the general LTGs will actually have in advancing sustainable approaches to management and addressing specific sustainability challenges. The LTGs address high-priority science, engineering, and technology needs mostly indirectly. Moreover, specific sustainability challenges involve more than just science, engineering, and technology research needs (i.e., the need to integrate economics, social sciences, architecture, and planning).

The Committee encourages the Agency to identify and document its role in facilitating the development of new, more sustainable technologies (APG 3.2). Although, in the majority of cases, such development is best left to the private sector, the Agency can play a unique and major role in highlighting the cross-cutting environmental problems for which sustainability technology is urgently needed. Moreover, the Agency can facilitate the interfacing between the federal government and private industry through the P2 program, certify and evaluate data and making it available to the sustainability community (consistent with proprietary requirements), verify sustainability technologies, ensuring that consistent metrics are used by all stakeholders (including various Agency offices and programs), and conduct research on ways to provide incentives for companies to invest in and adopt new technologies.

**(b) Do the long-term goals clearly relate to the research tracks within the multi-year plan framework? Do they provide a picture of what the program is trying to achieve?**

In Chapter 5 of the Plan, the planned research described via the APGs is consistent with the LTGs under which the APGs are listed. The inclusion of particular APGs can be debated, and other possible APGs could be suggested. The proposed research activities represented by the APGs will clearly lead to progress, but the likely impact of this progress in helping to address specific long term sustainability challenges is not clear.

One clear role that the Agency can play to which the Plan alludes but does not explicitly develop is that of conducting “regular and continuous assessments of environmental trends”. If indeed the Agency assumes this role, and makes such assessments available to the public, then it will be

performing a valuable service that can enable decision makers at all levels to respond to emerging issues as well as ongoing ones.

**(c) Will the proposed research activities lead to progress toward these goals?**

The document has specific deliverables but it is unclear where the research questions are developed and prioritized. There is little in the Plan about cooperative research with universities and industry. In the latter case, there needs to be a shift in Agency policy to move from one of regulation to one more focused on demonstrating the business case for sustainability. In this regard, having regulations in place to drive certain sustainability initiatives, once identified, can help but should be done judiciously.

The Committee notes that Plan LTG 1 focuses on the development of metrics for assessing environmental systems, but the Agency fails to follow this same approach for prioritizing its research. Without such an approach, the sustainability research portfolio may not reach its maximum long term value.

**(d) Are the goals appropriately linked to long-term environmental outcomes?**

This area is perhaps the weakest part of the Plan. The outcomes, while measurable, are not focused on achieving goals through the application of sustainability principles (such as dematerialization, material substitution, development of alternative energy sources, process modification, fostering of innovative technologies, organizational change, supply-chain management, and total cost accounting, to name a few). Without this aspect, the plan runs the risk of retreating to a focus on single-media, end-of-pipe treatment.

**P5 Are the research products supportive of the strategic target as set forth in the Agency's Strategic Plan under Objective 5.4?**

Objective 5.4 of the Agency's Plan focuses on enhancing society's capacity for sustainability through science and research. More specifically, it states that the Agency will "(Conduct leading edge, sound scientific research on pollution prevention, new technology development, socioeconomic, sustainable systems and decision tools. By 2011, the products of this research will be independently recognized as providing critical and key evidence in informing Agency policies and decisions and solving problems for the Agency and its partners and stakeholders."

The LTGs set forth in the Plan certainly support this strategic target, by establishing sustainability metrics, creating decision-support tools, and developing and applying cutting-edge technologies to solve environmental problems. However, it is not clear who will be leading the proposed efforts, how funding will be prioritized, or how the research products will be defined. In Section 4.2, a series of research questions is provided that are directed at the LTGs. Each of these questions are important and complex and in Chapter 5 the planned research program presents APGs that address these questions. Limited detail is provided in the Plan with regard to what the research products will be and therefore, it is difficult to assess the nature of the products or their significance. With the limited budget projections, it is unlikely that products will have a demonstrable impact on enhancing the science or decision-support of sustainability.

**P6 Does the scope of work proposed within the Plan complement research being supported by other programs inside and outside EPA?**

The Committee found that the scope of work appeared to complement research inside the Agency and perhaps outside the Agency. More extensive investigation and documentation of external research related to the Plan is urged.

**P7 Are there other potential emerging research areas that the Plan should consider?**

The LTGs are sufficiently broad to cover most emerging issues, however, it is unclear how the Agency will identify, prioritize, and respond to emerging issues on an on-going basis. The plan should reflect this since it has both resource and coordination implications (for instance, coordination with the 16 other MYPs). What criteria will be used to define “emerging” issues, how will they be prioritized, and what type of criteria could be used to evaluate “success” in terms of addressing an emerging sustainable development challenge (versus an existing one)?

What should the balance be between existing and emerging, which is related to the broader issue of how to allocate resources using a portfolio-of-initiatives approach?

**P8 Is the level of resources specified by the Plan sufficient to address the research issues that it identifies, allowing ORD to achieve the intended outcomes of the research program? Is the Plan’s relative allocation of those resources among the research tracks of the sustainability research program appropriate, based on a consideration of scientific and programmatic needs?**

The level of support specified for the Plan is \$2.7 million external and 36.5 internal full-time equivalents (FTEs). Assuming the 36.5 FTEs translate into something on the order of \$4 million, this suggests that the Agency is allocating about \$6.7 million to sustainability research (with the hope that it will increase by 10-20% in the near future). Even in times of declining budgets, EPA is still a \$7.3 billion agency, meaning that the sustainability initiative is less than one one-thousandth of the Agency’s budget. Even if the comparison is made only against the S&T budget, the fraction approaches to no more than 1%. No other multi-year plan is allocated such a miniscule resource base.

The Committee is perplexed by such modest levels of support for a program that promises to re-focus the way the Agency does research and re-evaluate the basis for the risk-based paradigm. Given the enthusiastic and expansive goals and metrics for this program, and assurances of “traction” of the sustainability theme within the Agency, the Committee is, frankly, disappointed that the Agency is unwilling to initiate this program at a more substantial level. The Plan correctly points out that as the value of the sustainability program becomes recognized, other program directors and offices will become more compliant with its attributes, goals, and metrics, and will presumably become active in seeking out collaborative projects. Even so, in the Committee’s opinion, this initial allocation, even if grown in the short term by 20%, falls far short of that needed to elevate the sustainability paradigm to a level where it is visible within the Agency, the federal government, and the nation. In the Committee’s opinion, a substantially

higher commitment is needed to have a serious impact on internal research priorities, managerial buy-in, and program visibility and growth.

The level of support allocated will limit progress and suggests that the Agency does not assign high significance to sustainability-based themes into its research programs. For example, the priorities for future research activities (Section 5.4 of the Plan) would result in further narrowing ORD sustainability research into the areas of its existing expertise. Instead, the Agency could seek to develop new and greater capacity in sustainability research through a combination of new personnel with training in sustainability research (directed hires), incentives for existing personnel to explore ways in which their expertise could be incorporated into the sustainability model (such as focused sabbaticals for Agency scientists), pioneering new models of cooperative research (such as partnering with industry and other agencies), and one or more small groups of experts in sustainability within the Agency who could undertake analysis and other related tasks. In the Committee's opinion, environmental sustainability should become a main thrust of ORD with allocation of resources assigned to a level commensurate with its importance for current and future decision-making.

**P9 Does the Plan appropriately address findings and recommendations in evaluations of the program and its components?**

Discussions between ORD officials and members of the SAB Committee revealed that this question pertains to the responsiveness of ORD to the feedback from the Program Assessment Rating Tool (PART) Review of USEPA's Pollution Prevention and New Technologies Research Program (P2NT).

In addressing the PART Review of the P2NT Program, the Plan briefly expresses concerns about:

1. becoming more focused on the need of Agency client offices,
2. fostering more collaboration with other research programs. and
3. developing an ability to measure and track program results over time.

Discussions with the Agency indicated that concerns had emerged during the PART review related to the lack of a timely review and failure to integrate all parts of the P2NT program.

ORD's responses in the Plan to P2NT's PART review was insufficient for the Committee to provide a comprehensive response as more detailed information about issues pertaining to the PART review should be included in the Plan.

The Plan and feedback from ORD during the June 13-15 meeting indicated ORD is interested in working with other Agency program offices as well as regional offices and state agencies. The Committee applauds ORD's commitment to enhancing inter and intra-Agency interactions on sustainability-related activities but suggests that ORD provide greater clarification within the Plan regarding the specific steps that will be followed to achieve meaningful collaboration. In

particular, ORD needs to explicitly describe how it will work with other governmental organizations and achieve measurable outcomes that will be helpful for future assessments of the sustainability program.

There is also information in the Plan that demonstrates ORD's intent on increasing collaborative efforts with research programs external to the Agency. More explicit descriptions of how such collaborations will be developed and implemented need to be strengthened within the Plan. The issue of developing methods to measure and track program results is briefly described as part of LTG1 in terms of identifying and creating scientifically based sustainability metrics. Such efforts aimed at developing techniques to measure and track sustainability program results should be described in greater detail. Overall, the Plan is commendable but in many instances is vague particularly when describing proposed results and outcomes that pertain to sustainability. Planned efforts to quantitatively describe those planned results and outcomes need to be expanded in light of future external assessments of the sustainability program.

This Committee review and the upcoming BOSC review should address the concerns delineated in the PART evaluation about timely review. Regarding the integration of the elements of the P2NT (now sustainability) research program, the Plan provides evidence of substantial efforts at coordination and integration. The Committee's evaluation of those effects is described in the responses to other Plan charge questions.

## Discussion of General Recommendations

### **1. The Committee recommends that the Agency better define those terms associated with the sustainability strategy and the measurement of sustainability outcomes.**

The Strategy and the Plan need to define sustainability more clearly and overtly. In this regard, the documents would benefit from explicit acknowledgement of competing definitions of sustainability—thereby providing both context for the Agency’s choice among the various definitions and recognition of alternative views of this contested and often vague topic. Similarly, the Agency should acknowledge the emphasis in its approach on environmental sustainability. (There should also be greater care taken to avoid conflating sustainability and sustainable development.) Clarity about these definitions will help readers better grasp choices made by the Agency and help them locate their own understanding of sustainability relative to the Agency’s deliberations.

In addition, some discussion of the attributes of sustainability (already implicit in the draft documents)—e.g., systems approach, integrative science—making clear where possible if the attributes are unique, necessary or sufficient markers of sustainability, will help the Agency avoid problems where the programs, Plan and other constituencies that it hopes to enlist in sustainability research, deem their existing activities as falling under this rubric without appropriate expansion, amendment or enhancement.

### **2. Picking Projects to Increase Internal and External Integration**

The Committee feels that the careful selection of multifaceted research projects within the Plan is helpful to the adoption of the sustainability paradigm both within and outside the Agency. EPA has a prominent leadership mandate in the sustainability arena and its research projects and their products are important for adoption of the paradigm. The projects should have visibility and be nationally compelling. The research products should strategically integrate into the other 16 multi-year plans across the Agency and allow the Agency to guide other Federal agency research on sustainability.

A portfolio of projects should be considered that has balance with respect to factors such as risk, early winners, and geography. The portfolio might include regional projects, projects conducted with CRADAs with industry, projects conducted jointly with other agencies, or projects conducted in cooperation with programs overseas. The Agency has conducted many prior compelling studies and efforts that may be amenable to analysis and produce excellent sustainability science, so some retrospective analysis may be helpful. A portion of the portfolio may be considered high risk with anticipated high rewards. One approach might be the development of a small, internal, creative and somewhat protected group that can be strategic and conduct certain higher risks projects, particularly in emerging areas, to advance important sustainability science products. The portfolio should become the basis for articulating projects and products for the APMs and APGs in the MYP.

Criteria for assembling the portfolio should be developed that include parameters such as balance, probability of success, and targeted product needs for internal and external adoption. These criteria should be more detailed than the primary and secondary criteria presently offered. Criteria for projects of high value but uncertain success may differ. The depiction of a clear linkage between criteria, project, product, and APMs and APGs in the Plan would be helpful.

Budgetary restrictions limit ORD's options in terms of sustainability technologies to explore, sustainability projects to fund and participate in, and aspects of sustainability to study within a project. Yet, to become a presence in the sustainability arena, ORD should be encouraged to think creatively and "outside the box."

For example, given the importance of water resources and water resource development, especially in the West, why not explore options for reuse/recycle of grey waters, or collection and reuse of rain water, even if they are not envisioned within the current regulatory framework and current practice?

Likewise, the portfolio of projects to fund or directly participate in might also include, along with obvious "winners", projects that examine unusual aspects of sustainability or innovative policy options and their relation to sustainability. The willingness to undertake such studies and to have a diversified portfolio would, in the Committee's opinion, enhance the Agency's scientific credibility within the sustainability research field.

The same might apply when selecting which aspects of sustainability to examine in depth within a given project. Consider, for example, biofuels and biofuels policy options. In addition to studying the implications of biofuels use on greenhouse gas emissions, the impacts of biofuel crops on agriculture and the environmental consequences of biofuel crop practices, it might be valuable to examine how such environmental consequences are linked to social aspects of biofuel use and production. Similar considerations might apply to a sustainability-based project that expands the Agency's current hypoxia research efforts in the Gulf of Mexico. This new activity could include evaluating the implications for upstream agricultural practice and wastewater treatment, impacts on communities, economic activities and ecosystems at risk. ORD could serve as a coordinator for such a project. Another type of project where ORD would be an excellent leader and coordinator might be one focused on wastewater treatment, a real problem in communities with undersized capacity and high projected growth in population.

The Committee believes that ORD's long-term success in establishing itself as a major stakeholder in sustainability research activities will depend on its research portfolio, which should include a mix of projects that are central to EPA's mission (e.g., watershed protection), projects that reside at the boundaries (e.g., agriculture and the health of aquatic ecosystems), and projects that specifically address emerging issues. To pursue them, ORD might consider partnerships with other agencies and/or international organizations as well as hiring personnel with the appropriate background, as discussed in overarching theme #3.

**3. The Committee encourages the Agency to become more creative and strategic in developing its human resources programs with the goal of establishing a critical number of champions of the sustainability approach to environmental protection.**

In an era of constrained resources, it is essential that the Agency be strategic in the development and deployment of its human capital. It needs to address more explicitly the human resource implications of working on sustainability research. This involves combining the appropriate personnel skill set with the most effective management structure as well as addressing where certain skill sets are employed within the Agency hierarchy. Simply establishing sustainability outcomes within the context of the existing ORD management structure and research program goals may not yield the best results.

If it were to achieve the goals of the Strategy and the Plan, there is a need to fill talent gaps. The Agency needs to acquire the requisite expertise through new hires, or through redirection of the workforce through transformation of existing skill sets or efforts of current staff, and through partnering and leveraging other programs in ORD or the agency as a whole. A sabbatical program to enable current staff to retool would allow the agency to better employ talented individuals whose current work is no longer supported. EPA should consider the use of internal transfers for EPA employees, the Intergovernmental Personnel Act (IPAs) to bring in academics, details for people from other agencies and fellowships for post-docs such as AAAS Science Fellows. It might be worth bringing in someone from another country that has worked on developing and implementing a national sustainability plan. This approach could allow another 6-10 individuals with needed skills and talents to be added to the existing 35 FTEs as well as better positioning the current 35 FTEs.

There are several areas identified for development. There are no in-house experts with a background in decision theory. If the Agency is to pursue the critical social dimensions of sustainability, even if its focus were limited to environmental sustainability, it needs to hire individuals with backgrounds beyond the physical sciences, engineering and economics. Stronger social science components that go beyond economics are needed. Such fields and tools include anthropology for ethnographic assessments (how individuals, households and communities think, behave and interact with products, technologies and natural systems) and psychology (behavioral economics) among others.

If EPA were to be a knowledge agency as well as a regulatory one, it would need to devote some resources to analyses and syntheses of the outcomes of both intra-mural and extra-mural research as well as of the efforts world wide in this area. There is still more thinking that is needed around sustainable development and EPA's role as well as the need to catalyze additional people and resources. A small, internal, creative, and somewhat protected team of five to eight individuals, for example, could do out of the box strategic thinking on this topic for at least a year without being saddled with management responsibilities.

**4. The Committee encourages the Agency to enhance the diffusion of sustainability concepts and practices within and outside the Agency (related to strategic human resource development, careful project selection and linkage with other multi-year plans, consideration of sustainability components for internal and external research projects, and securing and exploiting senior management buy-in).**

There is a need for, and EPA should provide, leadership both internal to the Agency and external among the federal agency family and other organizations. The EPA has an opportunity to coordinate and lead in the definition of environmental sustainability and in the use of related research products that will influence how other federal agencies and organizations move forward with their sustainability programs. The Plan correctly points out that as the value of the EPA ORD sustainability program becomes recognized, other program directors and offices will become more compliant with its attributes, goals, and metrics, and will become active in seeking out collaborative projects.

To achieve leadership by EPA in promotion of environmental sustainability, there needs to be a paradigm shift at EPA. The shift needs to be away from the current silos related to air, water, solid waste, etc and more towards a true systems approach involving personnel from many different areas, including different offices within EPA, the EPA regions, other government agencies such as DOD and DOE, community stakeholders (i.e., general public), and industry.

There are many opportunities for EPA ORD to step up to a leadership role, even in the context of limited resources. ORD could seek to develop new and greater capacity in sustainability research through a combination of new personnel with training in sustainability research, incentives for existing personnel to explore ways in which their expertise could be incorporated into the sustainability model, pioneering new models of cooperative research within the Agency and with industry, and development of sustainability “think tank” within the Agency.

The development and diffusion of sustainability metrics, tools, and technologies can be accelerated via the creation of in-house think-tank to consider how to infuse environmental sustainability approaches and thinking. The think-tank, a group of perhaps 5-8 people, could develop the messages that can catalyze additional people and resources. Such a program could become attractive since there are not many places in government now where out-of-the-box thinking on this topic can take place. These people should be kept out of the “weeds” to be able to think strategically about the topic for at least one year. Members of the think-tank group need to be systems thinkers with diverse backgrounds to focus and be agents of change within EPA.

Careful project selection and demonstrated integration with other multi-year plans do matter. Internal and external interest in ORD sustainability research will be driven at least partially by successes (or failures) of early projects. The Science and Technology for Sustainability Plan should have some definitely achievable APGs and APMs for prioritized themes that will quickly deliver research product “winners.”

The research products should clearly tie into the other 16 multi-year plans. This way, results of the EPA ORD program in sustainability will be immediately relevant to the larger EPA, and will encourage more EPA groups to adopt the sustainability paradigm.

The ORD should require the applicants for both extramural and internal research support to state how their proposed research impacts, affects, or enhances environmental sustainability. Similar to the “broader impacts” component required in all NSF proposals, a statement about “sustainability relevance” could be a required section in all proposals received by the Agency.

To encourage a systems approach in EPA research, care should be taken to encourage systems thinking in proposals and to have an extramural review process that rewards not only good reductionist science but broad systems science that investigates many variables in one or a few systems.

**5. The Committee strongly supports a greater and more explicit endorsement of the sustainability approach by the Agency Administrator as well as other senior Agency management personnel**

EPA needs to demonstrate leadership both internal to itself and external among the federal agency family with respect to sustainability and environmental stewardship. To that end, within ORD, the position of National Program Manager for Sustainability needs to be created. Such a position should be expected to lead not only in ORD but in the Agency as a whole. Management of the overall team if developed as outlined in Section 3 above will require skill and care. The National Program Manager, as well as leadership of the various programs directed at sustainability should be chosen carefully. Explicit support from the Administrator of this effort, and of this position is critical. It is also important that the Agency recognize that the opportunity for leadership across the federal agencies is now, and that a commitment from the highest levels will be transformative.

**6. The Committee recommends that the Agency establish more effective and substantive collaborations with other federal agencies as well as the private sector.**

The Agency and the ORD should be applauded for their recognizing the need to establish partnerships with sustainability related programs and activities being carried out by others as summarized in Section 5.2 of the Plan. However, the Committee feels that this is such an important item that more specific plans and goals in this regard should be clearly identified related to the specific environmental sustainability projects to be performed.

As environmental sustainability relates to achieving a balance among the three areas of economic growth and viability, social responsibility and environmental protection, organizations associated with all three aspects need to be engaged. With much effort and focus being given to the issue of environmental sustainability by numerous groups ranging from governmental organizations, the private sector and academia, EPA could move into the key role of providing overall leadership and coordination among these different organizations by providing structure and focus as none presently exists.

The Committee recommends that the Agency immediately initiate a thorough bench-marking exercise of different organizations dealing with environmental sustainability, both within the US and internationally as well as covering all the different stakeholder groups. This will serve to

help bring the Agency personnel quickly up the learning curve as well as even help to identify some key focus areas that EPA could begin participating in directly. As a first step, ORD could just determine what is happening within other Agency program offices and determine what opportunities exist for greater coordination and resource leveraging. The lessons learned internally by the Agency could be expanded to other governmental organizations, academia and the private sector.

In conclusion, actively engaging many of the other organizations focused on environmental sustainability can be the first step in EPA becoming the body that first brings the different groups to the table, and then provides the coordinating structure that holds them together to achieve true sustainability. This could also be the first step for all the other programs within EPA to be focused and coordinated under an overall environmental sustainability paradigm.