



# **AN SAB REPORT: REVIEW OF ORD'S POLLUTION PREVENTION RESEARCH STRATEGY**

**REVIEW OF THE OFFICE OF  
RESEARCH AND DEVELOPMENT'S  
DRAFT POLLUTION PREVENTION  
RESEARCH STRATEGY BY THE  
ENVIRONMENTAL ENGINEERING  
COMMITTEE**

July 14, 1998

EPA-SAB-EEC-98-008

Honorable Carol M. Browner  
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U.S. Environmental Protection Agency  
401 M Street, SW  
Washington, DC 20460

Subject: An SAB Report: Review of ORD's Pollution Prevention  
Research Strategy

Dear Ms. Browner:

At the request of the Office of Research and Development (ORD), the Pollution Prevention Subcommittee of the Science Advisory Board's (SAB) Environmental Engineering Committee's (EEC) conducted a review of the ORD's Pollution Prevention Research Strategy. This research strategy was developed by ORD research coordination teams in consultation with EPA's regulatory program offices. In brief, the Pollution Prevention Subcommittee (PPS) was charged to comment on the strategy's assessment of the current state-of-the-art and trends; the relationship of the ORD's Strategic Plan to the strategy, vision, mission, and long-term goals; the scope and priorities of the regulatory program; and the appropriateness of the project areas under the goals (the detailed Charge is located in section 2.3 of the enclosed report).

The Subcommittee met on June 30-July 3, 1997 at the National Risk Management Research Laboratory (NRMRL) in Cincinnati, Ohio. The results of that review are summarized in this letter, and provided in detail in the enclosed report.

The EEC notes with pleasure ORD's progress in strategic planning. The 1996 ORD document *Strategic Plan for the Office of Research and Development* (EPA, 1996), was critical to this transition. The 1997 draft *Pollution Prevention Research Strategy* (EPA, 1997a) is one of the first documents the EEC has reviewed that takes this process further.

The existence of a pollution prevention research strategy is, in itself, commendable progress. In 1994, the EEC's strategic research planning commentary (SAB, 1994) recommended development of a vision statement; a definition of a mission; an assessment of strengths, weaknesses, external opportunities, and threats; and identification of strategic initiatives and metrics of success. The EEC now recommends

two advancements to the process of research strategy development -- the involvement of external organizations in the process and the transparent documentation of decisions in the resulting research strategy.

The Subcommittee finds that the vision and mission statements for the research strategy effectively capture the appropriate role of the ORD in pollution prevention and also recognize the importance of making pollution prevention precepts and tools useful to society. The strategic rationale for the ORD's program provides a clear basis for delineating research priorities. The ORD considered pollution prevention needs in national and internal strategies and in advice provided by advisory boards (e.g., SAB). The end result of the research strategy development process appears reasonable. The long-term goals developed for the research strategy are consistent with the mission statement. Thus, if the long-term goals are thoroughly executed, significant advances toward the stated vision will occur.

Goals I and II address the successful development and deployment of technologies, products, tools, and methodologies targeted at high-priority health and environmental problems. Goal III emphasizes ORD's role of supporting verification; verification can potentially accelerate the use of pollution prevention products and technologies. Goal IV recognizes that targeted social science research could foster more rapid adoption of pollution prevention.

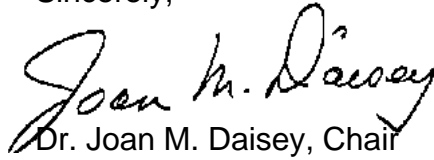
Implementation of the strategy is likely to produce results that will improve the Agency's capacity in pollution prevention and reduce risks to human health and the environment. Within the universe of research opportunities considered in the strategy, the programs and projects highlighted are reasonable and largely justifiable. Strategic planning for pollution prevention, however, is a dynamic process, and the strategy may need revision as new information becomes available.

The strategy could be strengthened by documenting the decision process as well as the product of those decisions. The EEC also has some concerns about how the long-term goals translated into specific projects. Some of the research projects and products walk a thin line between providing a useful product or service, one that would not otherwise be available, and infringing on the domain of commercially viable products and services. This is especially true in the area of software development. Inclusion of a clear, written disclosure identifying the nature and types of technology products that the ORD should or should not pursue would be invaluable as a guide.

Based on the Subcommittee's expertise and ORD briefings, the Subcommittee concludes that the strategy is being successfully implemented. The projects being undertaken in the pollution prevention field by the ORD address high-risk issues and also build upon the core competencies and experiences of the ORD. However, there is a concern that the level of resources provided to ORD seems inadequate for the diversity and depth of the pollution prevention research activities planned.

The Committee appreciates the opportunity to review the draft *Pollution Prevention Research Strategy* and looks forward to a written response from the Assistant Administrator of ORD.

Sincerely,



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## ABSTRACT

At the request of the Office of Research and Development (ORD), the Environmental Engineering Committee (EEC) of the Science Advisory Board (SAB) reviewed the draft *Pollution Prevention Research Strategy*.

In general, implementation of the strategy is likely to produce results that will improve the Agency's capacity in pollution prevention and reduce risks to human health and the environment. The vision and mission statements for the research strategy effectively capture the appropriate role of the ORD in pollution prevention and also recognize the importance of making pollution prevention precepts and tools useful to society. The strategic rationale for the ORD's program provides a clear basis for delineating research priorities.

The programs and projects highlighted in the draft strategy are reasonable and largely justifiable. The long-term goals developed for the research strategy are consistent with the mission statement. Thus, if the long-term goals are thoroughly executed, significant advances toward the stated vision will occur.

The strategy could be strengthened by documenting the decision process as well as the product of those decisions, including the translation of long-term goals into specific projects. Such documentation could improve the transparency of the process, especially to stakeholders whose support the Agency needs to ensure the implementation of effective pollution prevention programs which we expect will result from the developed research strategy.

**Keywords:** pollution prevention, research strategy,

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# 1 EXECUTIVE SUMMARY

The EEC has commented on the substance of the draft Pollution Prevention Research Strategy and recommended generic improvements on its development.

## 1.1 Generic Comments on Research Strategy Development

A research strategy should document the process by which it was developed. Ideally, if all of the people involved with creating the strategy left and a new team was formed, the research strategy document would allow the new team to see not only what decisions were made, but also how and why they were made. Secondly, a research strategy should identify who is working in which areas, both inside and outside EPA. Mapping needs against what is currently being researched will identify gaps (and potential areas for collaboration). The gaps are opportunities for the EPA. Such analysis also adds credence to ORD's need for expertise in the research areas. Thirdly, the strategy should address EPA's role in the research area(s)--not just ORD's.

## 1.2 Specific Comments on the Draft Pollution Prevention Research Strategy

In response to the Charge, the EEC finds that, overall, the draft research strategy correctly describes the *current* state of pollution prevention. The EEC suggests that EPA consider additional time frames. The activities that are selected to satisfy short-term needs should continue to be picked within a framework that is structured to address issues that could emerge in the long term. Such a framework should be flexible enough to accommodate changes in program directions.

The vision and mission statements for the research strategy are excellent. The vision statement is:

*Scientifically based pollution prevention research and development products will be used routinely by communities, industries, governments, and other stakeholders for improved environmental decision making on high-risk human health and environmental problems and as part of a move toward sustainable development in the 21st century.*

The mission statement is:

*To advance scientific research and develop cost-effective tools, methods, technologies, and approaches which expand the availability and use of pollution prevention by both the public and private sectors.*

The vision and mission statements clearly present the appropriate role of the ORD in pollution prevention. Because the four long-term goals developed for the research

strategy are consistent with the mission statement, if the long-term goals are thoroughly executed, significant advances toward the stated vision will occur.

The draft strategy recognizes the importance of making pollution prevention precepts and tools useful to society. Research in this field requires more than just the development of technologies to achieve progress. Relevant social, economic, and behavioral factors are also important components in this process. In places, however, the draft strategy emphasizes technology without fully embracing the need to integrate economics, technology, social science, etc., with environmental performance.

The strategic rationale presented in the draft research provides a clear basis for delineating research priorities. The ORD considered pollution prevention needs in national and internal strategies, and in advice provided by advisory boards (including the SAB). The end result appears reasonable, and until recently, this was sufficient for a successful strategy. However, professional expectations for research strategy development now include documentation and transparency of process. The process through which the current research strategy was developed is not documented and transparent; by current standards, this is a serious weakness in the strategy.

To improve the strategy, the EEC specifically recommends that the next attempt explicitly apply relevant and mutually independent criteria in a more formal and quantitative process to set priorities among potential areas of pollution prevention research. Of the six criteria identified in the strategy (p.11-13), the EEC finds three to be appropriate. These three criteria are:

- a) Address high-risk human health or environmental problems;
- b) Respond to needs of stakeholders; and
- c) Fill important research and development gaps not being addressed by others.

The EEC expects that more than three criteria will be needed to distinguish the priority of potential research areas. Other possible criteria include:

- a) The probability of success;
- b) Reversibility of negative impacts;
- c) Impact of waiting;
- d) Effectiveness of research in addressing the need; and
- e) Availability of human, facility, and funding resources to meet user needs.



## 2 INTRODUCTION

### 2.1 Background of the Review

In 1996, the U.S. Environmental Protection Agency (EPA) Office of Research and Development (ORD) published its *Strategic Plan for the Office of Research and Development*. That plan, and the more recent *1997 Update to ORD's Strategic Plan* (EPA, 1997b), include two priority long-term goals addressing pollution prevention:

- a) *To provide common sense and cost-effective approaches for preventing and managing risks; and*
- b) *To provide leadership and encourage others to participate in identifying emerging environmental issues, characterizing the risks associated with these issues, and developing ways of preventing or reducing these risks.*

The SAB's Research Strategies Advisory Committee (RSAC) reviewed a draft of ORD's strategic plan (SAB, 1996) and commented that:

*The general sense of RSAC was that the Plan represents a monumental undertaking and an important step forward. We congratulate ORD and EPA for producing a well-written document that responds to advice given to the Agency by other external review groups, such as the SAB and the National Academy of Sciences. The Plan clearly states the vision and mission of ORD, articulates the principles underlying EPA research, delineates long and short-term research goals, and presents criteria for priority setting. The existence of the Plan, coupled with the desire of the Agency, and specifically ORD management, to implement it, will provide ORD with much needed guidance for setting its immediate and future research agenda.*

Based on these goals noted above, the ORD formed Research Coordination Teams (RCTs) to coordinate the research program across the ORD and with ORD's clients. The RCTs are organized by media (i.e., air, waste, water, toxics/pesticides, multi-media). The RCTs developed a series of research strategies in different areas, which are being reviewed by the SAB as they become available. The research strategies elaborate on the directions in the strategic plan and provide a framework to guide investments in research and development over the next five years.

### 2.2 Description of the Document Reviewed

The ORD's *External Review Draft: Pollution Prevention Research Strategy*, May 30, 1997, characterizes the state-of-the art of pollution prevention and considers where

the EPA can play a meaningful role. Based on internal and external discussions, the ORD has identified the following pollution prevention themes:

- a) *Life-cycle assessment (LCA) and costing research to provide the scientific basis for comparing alternative risk management approaches;*
- b) *Techniques to measure pollution prevention effectiveness and verify the performance of pollution prevention strategies;*
- c) *Pollution prevention approaches for the agricultural sector;*
- d) *Pollution prevention approaches to reduce greenhouse gases, including alternative energy (renewable) sources; and*
- e) *Pollution prevention approaches for targeted industries.*

In addition to these themes, the ORD developed the following six priority-setting criteria to drive choices in research:

- a) *Address high-risk human health or environmental problems;*
- b) *Respond to the needs of stakeholders;*
- c) *Fill important research and development gaps not being addressed by others;*
- d) *Produce multimedia solutions that have wide applicability;*
- e) *Apply knowledge, experience, and capabilities that reside within the ORD; and*
- f) *Leverage resources with other organizations.*

### **2.3 Charge for the Review**

The ORD asked the EEC to comment upon the following eight questions:

- a) *Is the research strategy on target in describing the current state of pollution prevention, where it should be focused in the near term, and where it needs to be directed in the future (i.e., sustainable development)?*
- b) *Does the strategic review and program scoping provide a clear sense of priorities and identify the role for ORD's pollution prevention research effort? Does it support the opportunities for pollution prevention research*

*and development described in Chapter 3.0? Have any opportunities for ORD research in pollution prevention been missed, and, if so, what are they?*

- c) Are the four long-term goals consistent with the mission of the research strategy, and, if thoroughly executed, will they effectively achieve the stated vision? If not, what improvements or changes are recommended?*
- d) Are the prioritization criteria listed in Chapter 2.0 of the research strategy thorough and will they permit rational and reasoned decision making on which projects should be pursued as part of a more detailed research and development implementation plan? If not, what needs to be done?*
- e) Are the research and development activities and project areas presented under each of the four long-term goals generally understandable and achievable? If not, what suggestions do you have for improvements?*
- f) Are the project areas described under Long-Term Goal II (Technologies and Approaches) appropriate for the broad scope of the research strategy? If not, what changes do you recommend?*
- g) Is the breadth and extent of Long-Term Goal IV (Social Science) sufficient to advance economic, social, and behavioral issues that enhance or limit the acceptance of pollution prevention?*
- f) Overall, does the research strategy support the position stated in the ORD strategic plan that pollution prevention (along with new technology) is one of six high-priority research areas that should be pursued? Is it supportive of a risk-based approach or is a stronger argument needed?*



### 3 RESPONSE TO THE CHARGE

Separate from its comments on the specific contents of *Pollution Prevention Research Strategy*, the EEC recommends that the considerations below be included in developing a research strategy.

Firstly, the strategy should document what decisions were made and how. Ideally, if all of the people involved with creating the strategy left and a new team was formed, the research strategy document should allow the new team to see not only what decisions were made, but how and why they were made.

Although the direct and indirect benefits associated with some of the research areas (e.g., agriculture, global warming) may be difficult to quantify, these research areas are extremely important and should be addressed. Research issues that seem to be characterized by elevated risks should be identified and possible measures determined for addressing each type of risk.

Secondly, the strategy should identify who is (or should be) working in which areas, both inside and outside EPA. Mapping what needs to be done against what is currently being researched will identify gaps (and potential areas for collaboration). The gaps analysis will identify opportunities for the EPA and also contributes credence to ORD's need for expertise in the research area.

Thirdly, the strategy should address EPA's role in the various pollution prevention research areas, be it leadership or otherwise. A clarification of the EPA's role will help set the course of the overall strategy.

Fourthly, the strategy may be linked with the efforts that EPA has expended in the area of environmental management system development (such as, ISO 14000). These management principles would help improve the implementation of the strategy and make the research results more useful.

#### 3.1 Question 1

*Is the research strategy on target in describing the current state of pollution prevention, where it should be focused in the near term, and where it needs to be directed in the future (i.e., sustainable development)?*

Overall, the research strategy is on target in describing the current state of pollution prevention. However, the EEC suggests both redirecting the strategy to better meet future research needs responsive to a sustainable development paradigm, and modifying the strategy to better meet short-term needs.

### **3.1.1 Future direction**

The EPA is correct in recognizing that the future of pollution prevention is at a crossroads. Considering this situation, a more aggressive and accelerated research effort would be indicated in order to extend pollution prevention into the 21st century. From the Subcommittee's assessment, a longer-term research program that addresses sustainability development aspects has the potential of being fruitful. The EEC recommends that the EPA take an aggressive stance regarding the importance of pollution prevention in sustainable development and demonstrate how pollution prevention tools now under development can provide a path toward sustainability.

### **3.1.2 Short-term focus**

The strategy states that "all of the low-hanging fruits have been picked." The EEC disagrees.. There are still many small and medium-sized firms and government agencies that have under-emphasized pollution prevention. The justifiable effort on long-term pollution prevention programs should not necessarily mean neglect of technical support programs for small and medium sized firms and agencies. The Office of Pollution Prevention and Toxics (OPPT) in EPA's Office of Prevention, Pesticides, and Toxic Substances has funded many technical assistance programs educating firms about pollution prevention. However, OPPT's programs have generally served larger firms, leaving the smallest firms in need of pollution prevention guidance. Clearly, more can be done to encourage pollution prevention in smaller industrial and governmental organizations.

Seemingly overlooked in the strategy is the recycling of mixed solid waste. Although the technology currently exists to implement technologies like recycling and composting, their full potential has not been realized.

### **3.1.3 Tools and initiatives**

Companies taking a systems approach to pollution prevention find a variety of tools to be useful, including those for process characterization, problem solving, and decision making. These tools are common to quality management programs in these same companies. EPA should encourage the use of problem solving and decision making tools for both their internal work and in publications that are developed to help targeted industries and smaller firms seek continual improvements in their pollution prevention programs and as a path for achieving sustainability in their operations. A series of articles on these tools appeared in the journal, *Pollution Prevention Review*.

Identification of appropriate initiatives will be easier when EPA has improved its understanding of the research needs. The following activities may advance that understanding:

- a) **Stakeholder definition and polling:** To determine whether the research strategy is on target, a larger set of stakeholders should be contacted to assess the needs that cannot be met with current tools. The National Pollution Prevention Roundtable and the American Institute for Pollution Prevention can help EPA identify potential stakeholders. The National Institute of Standards and Technology (NIST) has 90 centers which also provide technical assistance to small and mid-sized firms and small business development centers.

Other stakeholders are citizen groups and nongovernmental organizations involved in the EPA Common Sense Initiative (EPA, 1997c). Moreover, the American Institute for Pollution Prevention tracks a large number of trade and professional associations that have shown interest in pollution prevention. Finally, the Department of Defense and the Department of Energy have active pollution prevention programs and could be potential collaborators or clients.

- b) **Needs analysis:** One approach to strategic planning is to conduct a needs analysis by targeting a point in the future (e.g., 5 or 10 years) and determining what is required to get there. The gap between current circumstances and the point envisioned in the planning process can reveal research needs. A focus group of knowledgeable pollution prevention experts could be convened to brainstorm about the gaps and needs. Such a group should include EPA and external representatives and could be facilitated by use of the Internet.
- c) **Relationship between manufacturing and pollution prevention:** Much research has been conducted on just-in-time source reduction (i.e., the elimination of all wastes from all business practices), agile manufacturing, manufacturing resources planning, preventive maintenance, and a variety of related topics. What was learned about source reduction and waste reduction? With some research, could some of these lessons be embraced within the pollution prevention context? What other research needs existing in these fields would improve the effectiveness of EPA's research program on pollution prevention? The EEC recommends that the EPA attempt to answer these questions during the next year while preparing the first annual update of its plan.

### 3.2 Question 2

*Does the strategic review and program scoping (Chapter 2.0) provide a clear sense of priorities and identify the role for the ORD's pollution prevention research effort? Does it support the opportunities for pollution prevention research and development described in the Chapter 3.0 program description?*

*Have opportunities for ORD research in pollution prevention been missed, and, if so, what are they?*

### **3.2.1 Priorities and Role**

The strategic review and program scoping presented in the draft research strategy provides a clear basis for delineating research priorities. The ORD considered pollution prevention needs in national and internal strategies, and in advice provided by advisory boards (including the SAB). The end result appears reasonable. Professional expectations for research strategy development now include documentation and transparency of process. The process through which the current research strategy was developed is not adequately documented and transparent. This is a weakness in the strategy development process, not the resulting strategy.

Section 3.4 presents and addresses criteria used to rank areas of potential research. Both sections 3.2.1 and 3.4 recommend a more formal and quantitative process for priority setting. Here, the EEC recommends that individual *projects* be ranked using a balance of three criteria, called "project review criteria". These are:

- a) **Effectiveness of research** to reduce pollution, protect human health, and protect the environment, i.e., sufficiency of the research with respect to meeting the needs of the users seeking to achieve source reduction and protect human health and the environment;
- b) **Implementation capacity** of the staff at the NRMRL, i.e., ability to meet user needs; and
- c) **Resource constraints** at NRMRL, i.e., adequacy of available resources to meet user needs

### **3.2.2 Clarification and assumptions**

Sustainability is not an overall guiding principle for the strategy, but rather a goal to be achieved eventually. As a result, the strategy focuses almost exclusively on environmental performance and does not embrace the necessity of integrating economics, technology, social science, etc., with environmental performance.

The introductory paragraph to the strategy defines pollution prevention not only as a broad area, but one whose "...breadth...pose[s] a significant challenge." This is true only if pollution prevention is considered to be something special or separate. However, if pollution prevention is defined as those activities that achieve environmental protection by looking at causes rather than at symptoms and effects, then pollution prevention is simply a technology, and EPA has a long history of addressing technology issues.

Strategies commonly define the problem fairly early in the process. However, there is an implied problem definition toward the end of this research strategy. Leaving the definition to the interpretation of the reader is risky, and suggests that the Agency should be more precise. Hence EPA could define the problem as, "more pollution prevention technologies, and more information about pollution prevention technologies, are needed." This definition also suggests a need to address the resistance to change that may currently be a factor in the slow pace at which industry is adopting pollution prevention technologies. A more convincing case needs to be made (possibly in business terms) that a move to pollution prevention is good for business.

Therefore, the strategy may be overemphasizing development of more technology and supporting tools and underemphasizing the significance of making pollution prevention a normal part of doing business. If barriers to implementation need to be overcome, social science research may be helpful in identifying and evaluating applicable approaches.

### 3.2.3 Connection to priorities

In the research strategy development process, EPA will want to demonstrate how the research activities selected relate to the problem definition. A good, transparent evaluative methodology is likely to yield results that are defensible within the constraints of the program. To illustrate such an evaluative process, the Subcommittee has developed an easily understandable summary table. Because different organizations

**Illustrative Table 1: Relationship of Problem Definition to Project Review Criteria**

| Activities **  | "Project review criteria " **   |  |            |
|--|---|--|------------|
|  | Effectiveness in Leading to Source Reduction  | Implementing Capacity                              | Cost       |
| Linking risk assessment and pollution prevention tools             | Indirectly effective by providing persuasion and setting priorities.                | Difficult linkage to make; many partners required. | High       |
| Improving environmental engineering economics and cost tools       | High, once in place and verified.   | Good, on both sides.                               | Medium     |
| Improving the utility of LCAs                                      | Low because of limitations of the analysis.   | Good for NRMRL; poor for most users.               | High       |
| Developing process simulation tools                                | Excellent, especially when fully integrated with other, more familiar applications. | Good on both sides.                                | High       |
| Developing pollution prevention progress measurement methodologies | Marginal; mostly useful to agencies.  | Low; very difficult proposition.                   | High       |
| Developing impact assessment tools                                 | Supports persuasion only.   | OK for NRMRL; not for user.                        | Very high* |
| Providing decision support tools for MSW management                | Minimal; heavy recycling focus.   | OK   | Medium     |
| Developing improved selection tools for surface treatment          | Good, although can also lead to other treatment reductions.                         | Excellent because of experience.                   | Medium     |

\* Activities for illustrative table were selected from EPA's Strategy, pages 18-21.

\*\* Project Review Criteria were selected from section 3.2.1 of this report.

may evaluate the same activities somewhat differently, the specific details of the evaluation are less important than the transparency and documentation.

The above table *illustrates* how EPA could relate a problem definition to the "project review criteria." To generate this table, the EEC used:

- a) The problem definition suggested in Section 3.2.2, "more pollution prevention technologies, and more information about pollution prevention technologies, are needed."
- b) The "project review criteria" suggested in Section 3.2.1.

### **3.2.4 Use of Analytical Techniques and Product Design Tools**

The EEC recommends that the Agency increase the use of decision-making tools in the pollution prevention program. The draft strategy introduces decision-making tools throughout, but leaves out some important analytical techniques that have gained widespread usage. Two examples of these tools are Pareto analysis (rank ordering) and cause-and-effect diagrams (root cause analysis). The use of these tools (including those listed in the Strategy) is likely to enhance the acceptability of the decisions made. Such acceptance is generally easier when the evaluation factors and criteria are clear from the start. As a result, decision-making tools help both the researcher and the user.

Because there is an apparent plateau in the acceptance of pollution prevention technologies by the regulated community, EPA may need to consider research in marketing and on the diffusion of technological innovations to improve the transfer of their information to the "middle innovators" -- those companies that lag the early innovators in the adoption of new technologies because they require more proof that the change will be favorable to them. EPA may need to identify firms of this type and target some for technology information and demonstration. Similar firms may then be convinced to follow. Consideration should be given to the selection of industry segments and the regional structure of the industry. For this approach to be successful, EPA must consider altering both the means by which it transmits information and its content. The focus can no longer be solely on the environmental manager, and the emphasis cannot be on environmental damages and "pollution prevention". There must be a decided business tone to the information. A rationale for determining the costs and benefits of improving the company's operations should be made using activity-based costing principles. Means for integrating clean technology practices into core business functions need to be investigated. Advances in social science research areas, such as organizational behavior and behavioral decision-making should be adapted for in-house use. Also, knowledge gaps identified should be targeted for research focus.

In addition to analytical tools for decision-making, the Research Strategy should

seek to enhance the use of product design tools. Currently, there is a generation of product design tools that allow designers to consider environmental externalities and various life cycle considerations in materials selection. Another approach within this context is designed for dis-assembly and recycling.

The EEC recommends that EPA consider P2 technology as "technology that achieves environmental protection by altering causes rather than managing symptoms". These technologies may be divided into two subsets as follows:

- a) Technology that improves the efficiency and effectiveness of materials use enough to be considered to be commercially viable due to the potential for significant cost savings; and
- b) New technology that is needed to provide an answer to an unacceptable release to the environment and that existing technologies provide insufficient cost savings to make it commercially viable.

In the former case, EPA may work with technology developers as translators between the regulatory and business worlds and support these technology developers by providing technology verification. In the latter case, EPA may wish to take a more active role in the technology development process.

### **3.2.5 Summary Comments**

Some industries and organizations are both pioneers and proud practitioners of pollution prevention. However, many more industries and organizations would benefit from learning that pollution prevention makes good business sense. The draft pollution prevention research strategy does not address this need.

Here is an opportunity for the NRMRL and ORD to design a persuasive educational program to promote use of pollution prevention. Such an effort may usefully combine several risk reduction options: pollution prevention technologies, economic incentives, communication, education, and environmental management systems. One approach would be to collect and describe successful pollution prevention case histories illustrating the links between product life cycle assessment (LCA), full-cost accounting, and specific pollution prevention technologies that reduce chemical emissions. Such a program could assist companies in analyzing true environmental cost across the product life cycle, with the result that commitments to pollution prevention and sustainability might take on greater significance. Examples can be found in successful sustainability programs in European countries and associated industries.

### **3.3 Question 3**

*Are the four long-term goals consistent with the mission of the research strategy,*

*and, if thoroughly executed, will they effectively achieve the stated vision? If not, what improvements or changes are recommended?*

The vision and mission statements for the research strategy clearly articulate and emphasize sufficiently the appropriate role of the ORD in pollution prevention. The mission statement is:

*To advance scientific research and develop cost-effective tools, methods, technologies, and approaches which expand the availability and use of pollution prevention by both the public and private sectors.*

The vision statement is:

*Scientifically based pollution prevention research and development products will be used routinely by communities, industries, governments, and other stakeholders for improved environmental decision making on high-risk human health and environmental problems and as part of a move toward sustainable development in the 21st century.*

These statements recognize the importance of making pollution prevention precepts and tools useful to society. They also recognize that research in this field requires more than just the development of technologies to achieve progress. The development of tools and methods, as well as the resolution of relevant social, economic, and behavioral factors are important components of this process.

The four long-term goals developed for the research strategy are

- a) *ORD will develop, test, and provide tools and methodologies which improve individual and organizational decision making related so as to reduce or eliminate emissions, effluents, and wastes from products, processes, and activities.*
- b) *ORD will develop and test pollution prevention technologies and approaches which are applicable across economic sectors, and evaluate products, technologies and approaches which are targetedd at preventing high-priority human health and environmental problems in support of the Agency's regulatory and compliance programs.*
- c) *As part of its Environmental Technology Verification (ETV) Program, ORD will serve as a catalyzing organization to propel into the marketplace the most promising commercial-ready pollution prevention products and technologies from both the public and private sectors.*
- d) *Through its extramural grants program, ORD will sponsor economic,*



*social, and behavioral research to improve decision making and foster the adoption of pollution prevention by the public and private sectors at all levels.*

These four long-term goals are consistent with the mission statement. They address the successful development and deployment of technologies, products, tools, and methodologies targeted at high-priority health and environmental problems (Goals a) and b). Additionally, the goals place the ORD in a key role of supporting verification that can potentially accelerate the use of pollution prevention products and technologies (Goal c)). Finally, the need to conduct targeted research on social area to foster more rapid adoption of pollution prevention is recognized (Goal d)).

Thus, if the long-term goals are thoroughly executed, significant advances toward the stated vision will occur. This will depend in part, on the activities and products that ORD targets within multi-year programs with the resources that are limited. Considering that factors such as commercialization potential, costs, and needs could be used as criteria for selecting projects, the EEC recommends that ORD prepare a clear, written statement identifying the nature and types of technology products that the ORD plans to pursue. This may be a useful guide to ORD with respect to determining which of the products and activities are better suited to industry considering the Agency's limited resources.

On the whole, the definition and on-going execution of Goals I and II appear to be proceeding well. However, the absence of a clear budget statement showing where money is being spent to support the strategy hinders the EEC's evaluation of whether resources are being appropriately applied and/or sought. Similarly, a clear delineation of how each element of the strategy is addressing the identified needs would be useful in understanding whether omissions in the strategy exist.

The EEC finds that the projects being undertaken in the pollution prevention field by the ORD address high-risk issues. Additionally, the projects build upon the core competencies and experiences of the ORD. With respect to the general objectives, the EEC finds that there is a desirable overlap between the Environmental Technology Verification Program (ETV) and the evolving pollution prevention activities of the Agency. The specifics of the programs may differ, but both address the issue of technology performance effectiveness. The Committee suggests that as pollution prevention activities are developed, aspects that lend themselves to coverage within the ETV program should be identified for possible action.

The EEC's greatest concern is the lack of implementation of Goal d). Activities undertaken to date are not linked with the overall strategy, and there appears to be no accountable plan underway to rectify this situation. The field of social and behavioral research is not one of ORD's historic strengths, and specialized expertise in this area will be required to appropriately define its dimensions. A number of investigators in academe

are already working on various social science aspects of pollution prevention. For resource conservation purposes, it may be wise for the Agency to adapt the results of external investigations (refine and/or improve them if necessary) to its use. For this strategy to succeed, efforts on Goal d) must be linked with the rest of the strategy. The EEC suggests that ORD develop in-house expertise on this topic, and in the meantime seek outside assistance in the social and behavioral areas to define a reasonable and useful program. Failing that, the EEC concludes that this particular goal is being given short shrift, in spite of its potential importance.

### 3.4 Question 4

*Are the prioritization criteria listed in Chapter 2.0 of the research strategy thorough and will they permit rational and reasoned decision making on which projects should be pursued as part of a more detailed research and development plan? If not, what needs to be done?*

The six prioritization criteria listed in Chapter 2.0 of the research strategy are:

- a) Addresses high-risk human health or environmental problems;
- b) Responds to needs of stakeholders;
- c) Fills important research and development gaps not being addressed by others;
- d) Produces multimedia solutions that have wide applicability;
- e) Applies knowledge, experience, and capabilities that reside within the ORD;
- f) Leverages resources with other organizations.

It does appear that some of the criteria are not distinct enough. While this may not be a problem with respect to general analysis, it will make it difficult to employ analytical techniques that require mutual exclusivity among evaluation factors for addressing options within the EPA research strategy. Such analytical techniques usually require that both the options and criteria be refined to make it more possible to rate and rank them. The criteria are discussed below.

- a) **Addresses high-risk human health or environmental problems** - This criterion is proper because it is consistent with EPA's mission, the ORD strategy, and NRMRL's mission. To be fully defensible, the implementation of this criterion must be transparent and documented.
- b) **Responds to needs of stakeholders** - This criterion is proper and can be

implemented by identifying and engaging the stakeholder community to catalogue their needs.

- c) **Fills important research and development gaps not being addressed by others** - This criterion is proper because of EPA's mission. Currently, the strategy does not document the selection of gaps to be filled. To be fully defensible, the implementation of this criterion must be transparent and documented. Amongst other things, a survey of the research being performed by others is needed to identify gaps.
- d) **Produces multimedia solutions that have wide applicability** - The validity of this criterion is not clear because it is not independent of and could conflict with the first criterion. Reducing a large risk, even in a single medium, is more beneficial than reducing a smaller multi-media risk. While impacting more than one medium is revealing, but not critical; this criterion should not be used without caution.
- e) **Applies knowledge, experience, and capabilities that reside within the ORD** - This criterion should not be used because whether or not the ORD has expertise is a management decision, not a scientific criterion.
- f) **Leverages resources with other organizations** - This criterion should not be used because it relates to implementation, not to evaluation .

Other criteria that could be applied are:

- a) The probability of success, because it is important to maximize risk reduction;
- b) The probability of promoting prevention and reducing the need for "reactive" research at a later date; and
- c) The probability that the problem will get worse if unattended for the present.

### 3.5 Question 5

*Are the research and development activities and project areas presented under each of the four long-term goals generally understandable and achievable? If not, what suggestions do you have for improvements?*

The four long-term goals in the Pollution Prevention Research Strategy are:

- a)(I) Developing testing tools and methodologies
- b)(I) Developing and evaluating technologies and approaches
- c)(III) Verifying the performance of cleaner products, technologies, and approaches
- d)(IV) Conducting research which addresses the economic, social, and behavioral aspects of pollution prevention

In general, all four long-term goals address relevant areas in which the ORD could potentially make a significant research contribution in pollution prevention and risk management. Although each long-term goal is understandable within the general context of the strategy, it is difficult to assess whether or not the ORD can achieve these goals. Unfortunately, the resources provided for implementing the planned activities appear inadequate. Understanding the process and the criteria used by the ORD to identify the long-term goals would help determine whether or not a) the four long-term goals are indeed the most important goals for ORD to be pursuing, and b) the ORD has identified the expertise necessary for achieving each of the long-term goals. In this context, ORD should review EPA's internal resources for group decision-making because use of a guided process would improve transparency and documentation.

- a) **Long-Term Goal I** - The draft strategy identified life cycle assessment (LCA), process simulation and cost/benefit analysis as the primary tools for improved individual and organizational pollution prevention decision making. Moreover, the ORD has recognized the need to integrate these pollution prevention decision-making tools with risk assessment methodologies to develop decision-making approaches that include meaningful estimates of the costs and benefits associated with pollution prevention options.

It is clear from the description of Long-Term Goal I that the ORD has done a commendable job in identifying the technical needs required for improving the pollution prevention decision-making tools. However, given the uncertainty associated with the ORD's capability to identify and evaluate many of the nontechnical issues impacting pollution prevention decisions (e.g., social and behavioral factors, training, education), achieving this goal is unlikely. We recommend that the ORD develop a rational framework, employing expertise outside of the agency, if necessary, to define the nontechnical data needs that will allow a more comprehensive approach to pollution prevention decision tool and methodology development.

- b) **Long-Term Goal II** - ORD plans to develop and test pollution prevention technologies across various economic sectors. It is unclear whether or not

this is the most cost-effective approach to develop, test, and disseminate pollution prevention technologies that can reduce human health and environmental risks. Major concerns are whether the ORD has the necessary in-house capabilities or has developed the mechanism to acquire the necessary expertise to define the process and product testing criteria and how the results of such testing might be evaluated and prioritized. The EEC recommends that the ORD develop a framework to identify the technical and nontechnical expertise that are appropriate for pollution prevention technology development and testing. In addition, some of the principles associated with pollution prevention also appear in environmental management systems. The ISO 14000 is one such example. The Subcommittee recommends that EPA review and, perhaps, adopt those elements of ISO 14000 (or similar systems) that may enhance implementation of EPA's program. The brevity of this report precludes an in depth discussion of all the elements of environmental management systems.

Based on those results, the EEC suggests that the ORD either re-define the scope of Long-Term Goal II to include only those pollution prevention economic sectors in which the ORD has experience or capability, or develop a mechanism to acquire the needed expertise to address the pollution prevention needs of a broader array of stakeholders.

- c) **Long-Term Goal III** - The ORD plans to focus on facilitating the transfer of the most promising pollution prevention products and technologies into the marketplace. The strategy did not identify the criteria the ORD will use to define a promising pollution prevention technology or the metrics to be employed to gauge whether a technology/product is commercially ready. Moreover, it is unclear how the pollution prevention decision-making tool development (Long-Term Goal I) will be integrated into the ORD's decision of what constitutes a commercially ready pollution prevention alternative.

The EEC recommends that the ORD develop specific criteria to evaluate the commercial readiness of pollution prevention products. The mechanism used to develop the criteria should be well documented so that the criteria can be objectively applied to a wide range of pollution prevention technologies and products. Finally, the EEC suggests that the ORD develop a framework to evaluate whether the Environment Technology Verification Program can serve as a potential marketing tool for industrial/commercial partners who choose to invest resources in this program.

- d) **Long-Term Goal IV** - This goal represents perhaps the most difficult

challenge for the ORD with regard to pollution prevention program implementation. The ORD's internal expertise (engineers and scientists) may be incapable of formulating the correct questions that must be addressed regarding the nontechnical issues critical to implementing the pollution prevention program. These nontechnical issues would include, but not be limited to, the social, behavioral, and cultural impediments to pollution prevention. The EEC suggests that the ORD evaluate the administrative/contractual options to acquire the required expertise in these nontechnical areas. There is a sense of urgency since acquiring pertinent proposals in pollution prevention from external organizations will require development of unambiguous research criteria in the nontechnical issues impacting pollution prevention.

### **3.6 Question 6**

*Are the project areas described under Long-Term Goal II (Technologies and Approaches) appropriate for the broad scope of the research strategy? If not, what changes do you recommend?*

The EEC finds it difficult to map the objectives described under this goal to projects. The charge question requests commentary on the appropriateness of projects currently funded through pollution prevention, but this seems to be more of an implementation question than a strategic question. For the EEC to properly address the question, it would need to know the rationale behind the decisions, the allocation of EPA research dollars, and the process EPA uses to determine when to use the EPA or contract personnel. Absent that information, the EEC has made some assumptions and responded as follows.

#### **3.6.1 Assumed Mapping of Projects to Goal II**

The EEC's best understanding of mapping projects to this Goal follows:

- a) **Air Pollution Prevention and Control Division**
  - 1) Ambient Air Pollutants; coating and cleaning operations, medium- and small-sized industries with high-risk problems
  - 2) Global Climate Change; intelligent process controls, TEWI alternatives
  - 3) Indoor Air Pollutants; products used indoors (consumer products and building materials)
- b) **University Grants Program and SBIR Program**

- 1) Fundamental science research
- 2) Pre-competitive engineering research
- c) **Separations Technologies** (projects involve sorption and membrane methods for metals and VOCs)
  - 1) Pervaporation for VOC recovery and predictive software
  - 2) VOC recovery from paint spray booths using Temperature Swing Adsorption (with SERDP funding)
  - 3) Adsorption for metals recovery
    - (i) Low cost materials (lignins, derivitized lignins) for lead, copper, nickel, and other adsorbents for metal finishing metals
    - (ii) Electrochemically enhanced adsorption
    - (iii) Ion exchange membrane development, and hybrid processes for the removal of lead
- d) **Green engineering for chemical synthesis oxidation with photocatalysis**
  - 1) Small-scale chemical synthesis; hydrogen from water; amino acids from methane and ammonia
  - 2) Detoxification of water, air; bacteria destruction

### 3.6.2 Tables Illustrating a Ranking Process

As an illustration only, a member of the Subcommittee prepared the table presented in Appendix A, which could be used to rank projects for their applicability to a goal. The first three columns of the table summarize the pollution prevention research activities presented at the meeting. The fourth column is provided for ranking and a final column for additional comments.

Just to illustrate the difficulty of reproducing the results produced by the Agency, the EEC conducted a limited re-evaluation and ranking of the projects targeting the stated goals and objectives finding. The finding that very few of the projects ranked highly in the Agency's program ranked as high during the evaluation.

Nonetheless, criteria should be better clarified and the language tightened so that others can completely understand the prioritization decisions made by the Agency

Also, the distinction between Objectives A and B seemed unclear, and which projects are applicable to Objective C is vague. In revising the strategy, EPA may wish to distinguish more clearly between (a) projects and strategies that satisfy long-term research goals and (b) projects that satisfy short-term program office needs. The concept of core competencies may be valuable when addressing this issue.

### **3.7 Question 7**

*Is the breadth and extent of the Long-Term Goal IV (Social Science) sufficient to advance economic, social, and behavioral issues that enhance or limit the acceptance of pollution prevention?*

Long-Term Goal IV reads: "Through its extramural grants program, ORD will sponsor economic, social, and behavioral research to improve decision making and foster the adoption of pollution prevention by the public and private sectors at all levels."

In both its written documents and in oral discussion, ORD staff have made it clear that they understand that technology development (i.e., the primary outcomes of Long-Term Goals I, II, and III) is not enough to achieve actual implementation of pollution prevention. Readily available and cost-effective pollution prevention technology enables implementation of pollution prevention. However, the vast majority of pollution prevention gain in industry and in society at large does not require improved technology but the conscious decision on the part of the participants to change their behavior and engage in certain activities, coupled with the will and resources to follow through.

With that in mind, it is hard to understand why all of the ORD's efforts oriented toward fostering pollution prevention implementation are funded through extramural grants. Extramural grants for basic science may lead to advances in knowledge but may not be adequate for tackling identified practical problems, especially in a direct fashion. This is especially true of grants funded in concert with the National Science Foundation, with its institutional bias against applications research. It is unlikely that such an approach will accomplish Long-Term Goal IV, and, indeed, ORD staff have indicated that proposals oriented

To better understand the factors that control pollution prevention decisions, ORD should develop in-house social science capability, either through professional development of current staff or through hiring staff that already has the necessary social science credentials. An effort should also be made to interact with other agencies and institutions that fund and/or conduct research on issues that relate to pollution prevention. Having in-house talent will ensure that the critical role that the EPA can play



in pollution prevention implementation is guided by current best understanding of the factors that affect decision-making behavior.

Although the Committee recognizes that research advances that push the frontiers of social science, management, economics, etc., can generate techniques that may be adapted to use in the long-term, some resources within the modified extramural grant program should focus on developing an understanding of the social, behavioral, and economic factors that control pollution prevention decision making. The language in the requests for proposal should clearly indicate an increase in orientation towards real-world implementation of pollution prevention strategies. Options include managing the grants program in-house or working with the NIST. These modifications to the grants program would better ensure that the funded research evaluates practical obstacles to pollution prevention implementation.

### **3.8 Question 8**

*Overall, does the research strategy support the position stated in the ORD strategic plan that pollution prevention (along with new technology) is one of six high-priority research areas that should be pursued? Is it supportive of a risk-based approach or is a stronger argument needed?*

Some of the primary features of the ORD's plan are that it:

- a) Is founded in risk assessment principles, focusing its research and development in the areas of greatest risks to people and the environment;
- b) Has strong commitments to using extramural grants and utilization of the peer-review process; and
- c) Is designed to meet today's technical needs while positioning itself to aid in resolving the environmental problems of tomorrow.

Of the six high-priority research needs present to support the ORD's vision, mission, and long-term goals, pollution prevention and new technologies for environmental protection are of paramount importance. In general, the linkages between the strategy and the challenge of the sixth ORD high-priority research topic on pollution prevention is clear. Furthermore, the vision statement enhances the importance of the pollution prevention program, putting it in the context of the larger, more long-term needs of sustainable development into the 21st century.

The strategy has a strong component consistent with and supportive of the risk-based approach. Risks to human health and the environment can result when exposure or stressors reach known toxicological or effects levels. The pollution prevention

program is aimed at technologies and approaches that can prevent and reduce the formation and release of toxic pollutants that are of high risks to both human health and the environment. In addition to developing specific exposure reducing technologies (e.g., separations of metals and organic compounds in process streams, alternatives to ozone-depleting chemicals, alternatives in the coatings and cleaning industries to reduce VOCs and HAPs, chemicals to improve indoor air quality), tools are being developed in LCA and economic analysis to better evaluate the effectiveness of technology programs in reducing releases and exposure.

## 4 CONCLUSIONS

At the request of the Office of Research and Development (ORD), the Environmental Engineering Committee (EEC) of the Science Advisory Board (SAB) conducted a review of the Pollution Prevention Research Strategy. The EEC's Pollution Prevention Subcommittee prepared this report of the EEC's findings and recommendations. In brief, the EEC was charged to comment on the strategy's assessment of the current state-of-the-art and trends; the relationship of the ORD's Strategic Plan to the strategy, vision, mission, and long-term goals; the scope and priorities of the program; and the appropriateness of the project areas under the goals. The EEC also offered some generic advice about research strategy development.

The Office of Research and Development (ORD) requested that the Science Advisory Board (SAB) review research strategies developed by ORD research coordination teams in consultation with the regulatory program offices. The Environmental Engineering Committee (EEC) and a specially established multi-disciplinary Subcommittee reviewed the Pollution Prevention Research Strategy at a public meeting held June 30-July 3, 1997 at the National Risk Management Research Laboratory in Cincinnati, Ohio.

The EEC notes with pleasure ORD's progress in strategic planning. The 1996 ORD document, *Strategic Plan for the Office of Research and Development* (EPA, 1996), was critical to this transition. The 1997 draft *Pollution Prevention Research Strategy* (EPA, 1997a) is one of the first documents the EEC has reviewed that takes this process further.

The existence of a pollution prevention research strategy is, in itself, commendable progress. In 1994, the EEC's strategic research planning commentary (SAB, 1994) recommended development of a vision statement; a definition of a mission; an assessment of strengths, weaknesses, external opportunities, and threats; and identification of strategic initiatives and metrics of success. The EEC now recommends two advancements to the process of research strategy development--the involvement of external organizations in the process and the transparent documentation of decisions in the resulting research strategy.

The Subcommittee finds that the vision and mission statements for the research strategy effectively capture the appropriate role of the ORD in pollution prevention and also recognize the importance of making pollution prevention precepts and tools useful to society. The strategic rationale for the ORD's program provides a clear basis for delineating research priorities. The ORD considered pollution prevention needs in national and internal strategies and in advice provided by advisory boards (e.g., SAB). The end result of the research strategy development process appears reasonable. The long-term goals developed for the research strategy are consistent with the mission

statement. Thus, if the long-term goals are thoroughly executed, significant advances toward the stated vision will occur.

Goals I and II address the successful development and deployment of technologies, products, tools, and methodologies targeted at high-priority health and environmental problems. Goal III emphasizes ORD's role of supporting verification; verification can potentially accelerate the use of pollution prevention products and technologies. Goal IV recognizes that targeted social science research could foster more rapid adoption of pollution prevention.

Implementation of the strategy is likely to produce results that will improve the Agency's capacity in pollution prevention and reduce risks to human health and the environment. Within the universe of research opportunities considered in the strategy, the programs and projects highlighted are reasonable and largely justifiable. Strategic planning for pollution prevention, however, is a dynamic process, and the strategy may need revision as new information becomes available.

The strategy could be strengthened by documenting the decision process as well as the product of those decisions. The EEC also has some concerns about how the long-term goals translated into specific projects. Some of the research projects and products walk a thin line between providing a useful product or service, one that would not otherwise be available, and infringing on the domain of commercially viable products and services. This is especially true in the area of software development. Inclusion of a clear, written disclosure identifying the nature and types of technology products that the ORD should or should not pursue would be invaluable as a guide.

Based on the Subcommittee's expertise and ORD briefings, the Subcommittee concludes that the strategy is being successfully implemented. The projects being undertaken in the pollution prevention field by the ORD address high-risk issues and also build upon the core competencies and experiences of the ORD. However, there is a concern that the level of resources provided to ORD seems inadequate for the diversity and depth of the pollution prevention research activities planned.

## APPENDIX A -- RANKED RESEARCH AREAS

**Table A: Retrospective Ranking of Research Areas  
for Applicability to Goal II/ Objective A**

| Research Activity Area   | Project Area/<br>Research Activity   | Program Area  | Applicability to Goal II/Objective A*  | Other Comments  |
|--|--|---|--|---|
| Science for pollution prevention.  | Supporting fundamental research on science   | Green chemistry Program / University Grants Program | High. Good program to help meet objectives   | See general comment about University Grants Program   |
|  | Developing and testing improved oxidation pathways/<br>photocatalysis-based oxidation for chemical synthesis | Separation Technologies                             | Medium-Applications suggested are small-scale synthesis of H <sub>2</sub> from water, and detoxification of bacteria in water. Does this really have broad enough applicability?       | Not sure that applicability is broad enough to make this a pollution prevention technology. What is the relative priority of this project?  |
| Engineering for pollution prevention.                                      | Supporting pre-competitive engineering research  | University Grants Program                           | High, but not sure this is best done exclusively in University Grants Program. In-house research could significantly contribute.   | Be careful not to trade health and safety for pollution prevention. What is the relative priority of this task in relation to other pollution prevention tasks? How is this sub-objective different from Objective B? |
| Measurement, assessment, and feedback techniques for pollution prevention. | Supporting prevention-related evaluation research/LCA Systems Analysis                                       | Systems Analysis Branch                             | Not obvious how it fits into this goal. But high applicability to overall goals.   | Doesn't it belong under Long-Term Goal III?   |
|  | Developing intelligent controls for process operations / fuzzy logic, etc.                                   | Global climate change                               | Medium. Strategic plan says this is to predict performance of intelligent controls in pollution prevention applications, thereby preventing releases and increasing energy efficiency. | Weak relation to pollution prevention. Stated objective (developing) is different from project description (predicting performance). Is this project limited to combustion applications?                              |

\* Objective A = Research, design, and assess environmentally benign industrial process and manufacturing methods.

## APPENDIX B -- MATERIALS REVIEWED

The following materials were available to the Environmental Engineering Committee for use in the review of the Pollution Prevention Research Strategy. They can be found in the FACA file for the June 30-July 3, 1997 Environmental Engineering Committee meeting.

1. Material for the SAB Conference Call on June 13, 1997
  - a) Agenda (1 page)
  - b) Visuals for ORD Strategy Plan (4 pages)
  - c) Visuals for Pollution Prevention Research Strategy (16 pages)
  - d) Visuals for Waste Research Strategy (13 pages)
2. Memorandum dated May 30, 1997 from the Assistant Laboratory Director of the National Risk Management Research Laboratory to Kathleen Conway
  - a) Attachment 1, Questions for the SAB on the Pollution Prevention Research Strategy
  - b) Attachment 2, Tentative Agenda for the Pollution Prevention Research Strategy Science Advisory Board Review
  - c) External Review Draft Pollution Prevention Research Strategy
  - d) Note to Kathleen Conway from Jon Herrmann
3. 1997 Update to ORD's Strategic Plan
4. Pollution Prevention Research Strategy, SAB Briefing for the External Review Draft, June 30, 1997  
Pollution Prevention Research, Sustainable Technology Division
  - a) Development and Demonstration of Cost-Effective Decision-Making Tools
  - b) Environmental Improvement Toolbox
  - c) P2P: A Measurement Methodology for Pollution Prevention Progress
  - d) A "Mark I" Measurement Methodology for Pollution Prevention Progress Occurring as a Result of Product Design Decisions
5. P2 Research Strategy Science Advisory Board Review, Preventive Technologies and Approaches
6. Progress Tools for P2: Separations Technologies Green Chemistry and Engineering
7. The 1997 Joint STAR Program RFAs

8. Pollution Prevention Technologies and Approaches
9. EPA's Environmental Technology Verification Program
10. 1995 U.S. EPA Science to Achieve Results (STAR) Research Grant Awards by Selected Topics
11. EPA Small Business Innovation Research Phase I FY/97 Program Solicitation No. D700001M1, 1995 ETI-SBIR Phase III
12. Pollution Prevention Status Report, Pollution Prevention Technologies for Emissions Assessment and Management, April 1997

## GLOSSARY

|                           |  |
|---------------------------|--|
| <b>CAGE</b>               | Coatings Alternative Guide. This computerized guide was developed on an EPA contract to provide information on low emitting alternative coating technology to coatings users and technical assistance providers. It is available through the EPA Internet site - <a href="http://earth2.epa.gov/search">http://earth2.epa.gov/search</a> |
| <b>CSI</b>                | EPA's Common Sense Initiative. Regularly updated information on CSI can be obtained through the EPA home page in the Internet <a href="http://www.EPA.gov">http://www.EPA.gov</a>  |
| <b>EPA</b>                | U.S. Environmental Protection Agency   |
| <b>EEC</b>                | Environmental Engineering Committee of the EPA Science Advisory Board  |
| <b>ETV</b>                | EPA's Environmental Technology Verification Program  |
| <b>FACA</b>               | Federal Advisory Committee Act   |
| <b>FUZZY LOGIC</b>        | Fuzzy Logic This mathematical theory was invented in 1964 by Professor Lotfi Zadeh at UC Berkeley. Conventional logic divides the world into black and white, yes and no. Fuzzy Logic deals in shades of gray. The use of Fuzzy Logic helps computers handle artificial intelligence tasks and complex subjects.                         |
| <b>HAPs</b>               | Hazardous Air Pollutants under the Clean Air Act   |
| <b>LCA</b>                | Life Cycle Assessment  |
| <b>LONG TERM GOAL I</b>   | Developing testing tools and methodologies   |
| <b>LONG TERM GOAL II</b>  | Developing and evaluating technologies and approaches  |
| <b>LONG TERM GOAL III</b> | Verifying the performance of cleaner products, technologies, and approaches  |



**LONG TERM  
GOAL IV**

Conducting research which addresses the economic, social, and behavioral aspects of pollution prevention

**MISSION**

To advance scientific research and develop cost-effective tools, methods, technologies, and approaches which expand the availability and use of pollution prevention by both the public and private sectors. (ORD May 1997)

**NIST**

National Institute of Standards and Technology (Dept. Of Commerce)

**NRMRL**

ORD's National Risk Management Research Laboratory

**OBJECTIVES**

(as defined in the May 30, 1997 strategy) For Long-Term Goal I, Objective A is, " Develop and test user-friendly tools and methodologies for improved decision making." For Long-Term Goal II, Objective A is, "Research, design, and assess novel and advanced environmentally benign approaches for industrial processing and manufacturing." Objective B is, "Develop and test technologies and approaches targeted as specific environmental problems." Objective C is, "Demonstrate and evaluate pollution prevention in support of Agency and Program Office priorities." For Long-Term Goal III, Objective A is, "Build a high-quality and efficient program to verify the performance characteristics of pollution prevention products and technologies." For Long-Term Goal IV, Objective A is, "Develop and integrated social science and socioeconomic information and research products into environmental decision making."

**OPPT**

Office of Pollution Prevention and Toxics at the EPA

**ORD**

Office of Research and Development at the EPA

**P2**

Pollution Prevention

**POLLUTION  
PREVENTION**

"source reduction" (EPA) environmental sustainability including pollution prevention (National Commission on the Environment)

**PRIORITY  
SETTING  
CRITERIA**

(In the draft strategy)

- a) Addresses high-risk human health or environmental problems
- b) Responds to needs of stakeholders
- c) Fills important research and development gaps not being addressed by others
- d) Produces multimedia solutions that have wide applicability
- e) Applies knowledge, experience, and capabilities that reside within the ORD
- f) Leverages resources with other organizations. (ORD May 1997)

**PROGRAM  
OFFICES**

EPA regulatory offices including: the Office of Air and Radiation, the Office of Pesticides, and Toxic Substances, and the Office of Solid Waste and Emergency Response, and the Office of Water.

**SAB**

Science Advisory Board, a FACA Committee at EPA

**SAGE**

Solvent Alternatives Guide. This computer search tool helps solvent users and their assistance providers find alternatives to solvents that have regulated emissions. Available through the EPA Internet site - <http://earth2.epa.gov/search>

**SBIR**

EPA Small Business Innovation Research Program

**SERDP**

Strategic Environmental research and Development Program. This multi agency program is funded through the Department of Defense. Besides having the full cooperation of the U.S. EPA other agencies are also actively involved including: the Department of Interior, National Institute of Health, U.S. Geological Survey and NASA

**STAR**

U.S. EPA Science to Achieve Results (STAR) Research Grant Program

**TEWI**

Total Equivalent Warming Impact

**VISION**

To advance scientific research and develop cost-effective tools, methods, technologies and approaches which expand the availability and use of pollution prevention by both public and private sectors. (ORD May 1997)

**VOCs**

Volatile Organic Chemicals

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