A large, green-tinted map of the United States is positioned on the right side of the cover, set against a blue background that resembles a globe.

EPA Technology Programs: Engaging the Marketplace

May 2007

**SUBCOMMITTEE ON
ENVIRONMENTAL
TECHNOLOGY**

**National Advisory
Council for Environmental
Policy and Technology (NACEPT)**

The National Advisory Council for Environmental Policy and Technology (NACEPT) is an independent federal advisory committee that provides recommendations to the Administrator of the U.S. Environmental Protection Agency on a broad range of environmental issues. The Subcommittee on Environmental Technology is an *ad hoc* subcommittee of the Council and was formed to examine EPA's role in the development, commercialization, and use of innovative technology in fulfilling its mission to protect human health and the environment. The findings and recommendations of the Subcommittee do not necessarily represent the views of the U.S. Environmental Protection Agency.

EPA 130-R-07-004
U.S. Environmental Protection Agency
Office of Cooperative Environmental Management
<http://www.epa.gov/ocem>
May 2007

EPA Technology Programs: Engaging the Marketplace

May 2007

National Advisory Council for Environmental Policy and Technology (NACEPT)

SUBCOMMITTEE ON ENVIRONMENTAL TECHNOLOGY

Subcommittee Members

Phillip Helgerson (Chair) – CSC Advanced Marine Center
Dan Watts (Liaison to the NACEPT Council) – New Jersey Institute of Technology
Linda Benevides – Massachusetts Department of Environmental Protection
David Dzombak – Carnegie Mellon University
Kenneth Geiser – University of Massachusetts at Lowell
John Hornback – Metro 4/Southeastern States Air Resource Managers, Inc. (SESARM)
Kristine Krause – Wisconsin Energy Corporation
JoAnn Slama Lighty – University of Utah
Raymond Lizotte – American Power Conversion Corporation
Oliver Murphy – Lynntech, Inc.
Robin Newmark – Lawrence Livermore National Laboratory
Patrick O’Hara – Cummings/Riter Consultants
Christine Owen – Tampa Bay Water
Katherine Reed – 3M Environmental, Health and Safety Operations
Norman Richards – Mohegan Environmental Protection Department, The Mohegan Tribe
Karen Riggs – Battelle Memorial Institute
James Robbins – Environmental Business Cluster
Howard Roitman – Association of State and Territorial Solid Waste Management Officials
Kent Udell – University of Utah (Professor and Chair), University of California, Berkeley
(Professor Emeritus)

Chairman's Prologue

This is the second report by the Environmental Technology Subcommittee of the National Advisory Council on Environmental Policy and Technology (NACEPT). The Subcommittee was created in November 2004, at the request of the U.S. Environmental Protection Agency's (EPA) Administrator to provide insight and guidance regarding EPA's current technology programs. The Subcommittee has brought together representatives from the environmental, industrial, public policy, scientific, and academic communities in dialogue with senior managers and EPA subject matter experts. Together with our first report, which was issued in May 2006, this report completes the Findings and Recommendations of the Subcommittee.

In our first report, we focused on internal EPA programs and practices. In this report, we offer additional recommendations for the Agency's Environmental Technology Programs, and then turn our attention outward, looking at how the Agency engages with others. The recommendations cover four critical areas:

- *Partnerships*—We recommend specific ways that EPA can increase its partnerships with states, tribes, and private-sector organizations to further the discovery, development, and deployment of new technologies.
- *Encouraging Market Demand*—We highlight opportunities for EPA to use its regulatory authority and respected science and technology expertise to stimulate market demand for promising new technologies.
- *International Issues*—Our recommendations encourage EPA to engage more in international activities, increase awareness of and response to changing international standards and markets, expand cooperative technology verification programs across the world, and identify emerging markets for new technologies.
- *Global Climate Change Roles and Responsibilities*—We propose increased activity in technology development and regulatory analysis and policy in areas where the Agency's mission will require it to be involved in addressing causes, projected environmental impacts, and potential adaptation actions related to global climate change.

In December 2006, EPA Administrator Johnson advised NACEPT that he had directed implementation of key recommendations from our first report, establishing a Senior Environmental Technology Officer to lead and coordinate Agency environmental strategy and policy and creating positions for Environmental Technology Advocates in each EPA region. In addition, the Administrator acted to strengthen the Environmental Technology Council and to create an Environmental Technology Verification and Assessment Staff coordinated by the National Risk Management Research Laboratory.

Building on these positive initiatives, I am confident that the Agency will be able to adopt further recommendations of this Subcommittee, and more visibly and effectively improve its engagement with the environmental technology market.

Philip Helgerson, *Chairman*
Subcommittee on Environmental Technology
National Advisory Council for Environmental
Policy and Technology

Table of Contents

I. Executive Summary	1
A. Background and Process	1
B. Summary of the Recommendations in the First Report of the NACEPT Subcommittee	2
C. Findings and Recommendations in the Second Report of the NACEPT Subcommittee	3
II. EPA Technology Programs: Engaging the Marketplace	11
A. Introduction/Background	11
B. NACEPT Subcommittee First Report, <i>EPA Technology Programs and Intra-Agency Coordination</i>	12
C. Report Overview	13
D. Findings and Recommendations	13
1. EPA Technology Program Management (Additional Recommendations)	13
2. Partnership Issues	18
3. Encouraging Market Demand for Innovative Environmental Technology	25
4. International Issues	37
5. Environmental Technology and Climate Change	41
III. Appendices	49
Appendix A: Charge to the Subcommittee on Environmental Technology	49
Appendix B: List of Subcommittee Members	55
Appendix C: List of Recommendations in the First Report of the NACEPT Subcommittee	56
Appendix D: EPA Administrator's December 19, 2006 Letter to NACEPT Chair	59
Appendix E: Suggested Functions and Duties of the SETO, Regional Technology Coordinators, and Technology Communication Coordinator	61

List of Acronyms

DfE	Design for the Environment
DOC	Department of Commerce
DoD	Department of Defense
DOE	Department of Energy
ECOS	Environmental Council of the States
ELV	End of Life Vehicles
EMS	Environmental Management System
EP	Environmental Project
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ERIS	Environmental Research Institute of the States
ESTCP	Environmental Security Technology Certification Program
ETC	Environmental Technology Council
ETOP	Environmental Technology Opportunities Portal
ETV	Environmental Technology Verification
EU	European Union
FRTR	Federal Remediation Technologies Roundtable
GHG	Greenhouse Gas
ITRC	Interstate Technology and Regulatory Council
LEED	Leadership in Energy and Environmental Design
MOA	Memorandum of Agreement
NACEPT	National Advisory Council for Environmental Policy and Technology
NPS	Nonpoint Source
ORD	Office of Research and Development
POC	Point of Contact
R&D	Research and Development
RoHS	Restriction on Hazardous Substances in Electronics
SEP	Supplemental Environmental Project
SERDP	Strategic Environmental Research and Development Program
SETO	Senior Environmental Technology Officer
SWAQ	Subcommittee on Water Availability and Quality
TARP	Technology Acceptance and Reciprocity Partnership
UNEP	United Nations Environment Programme
USAID	U.S. Agency for International Development
USGBC	U.S. Green Building Council
WEEE	Waste Electrical and Electronic Product
WHO	World Health Organization



I. Executive Summary

This report, *EPA Technology Programs: Engaging the Marketplace*, is the second of two reports issued by the National Advisory Council for Environmental Policy and Technology (NACEPT) on the role of the U.S. Environmental Protection Agency (EPA) in fostering the development and deployment of innovative environmental technologies. Produced by the NACEPT Subcommittee on Environmental Technology, the first report was published in May 2006 and focused on the internal structure, efficacy, and communication aspects of EPA's many and diverse technology programs. The Subcommittee now issues its second and final report on EPA's relationships, interactions, and communication with the vast universe of entities that constitute the complex marketplace for new environmental technologies.

A. Background and Process

EPA's mission is to protect human health and the natural environment. Its strategic goals are Clean Air and Global Climate Change, Clean and Safe Water, Land Preservation and Restoration, Healthy Communities and Ecosystems, and Compliance and Environmental Stewardship. The EPA Administrator and other senior managers have stated that technology is critical in achieving these goals, and that it will be the central driver in moving from the command and control policies of the past to a new, more sustainable environmental protection paradigm for the future.

The EPA Administrator established the NACEPT Subcommittee on Environmental Technology to evaluate and make recommendations on EPA's stimulation, facilitation, and use of innovative technology in carrying out its mission. The Agency's charge to this Subcommittee is presented in Appendix A, and a list of the Subcommittee members is provided in Appendix B. The Subcommittee convened its first meeting in November 2004, and has held quarterly sessions for the past 2 years. Numerous presenters from EPA, other government agencies, states, nongovernmental organizations, and the private sector have briefed the Subcommittee on a broad spectrum of technology issues. Eight specific subject areas have been addressed further by working groups comprised of Subcommittee members. Each working group has developed findings and recommendations with which the full Subcommittee concurs.

The Subcommittee has reviewed the Agency's technology programs in the context of the unique role that EPA plays in the broad spectrum of public and private activities that must occur to bring increasingly cost-effective technologies

into use. Specifically, the Subcommittee has sought to answer the questions posed in the Agency's charge:

How can EPA better optimize its environmental technology programs to make them as effective as possible in promoting the research, development, commercialization, and implementation of sustainable private-sector technologies?

What other environmental programs and activities should EPA initiate to take advantage of opportunities that it may be missing to further the effectiveness of its technology facilitation objectives? (Although EPA is not likely to receive significant additional funding for any new technology activities, the Subcommittee should not feel constrained in its thinking.)

In general, the Subcommittee has been most impressed with the broad spectrum of technology-related programs presented to it by Agency managers and others. The overall pace of environmental progress in recent decades attests to EPA's effectiveness in supporting the legal and technological changes that have brought it about. EPA is involved in all of the components of technology research, development, and diffusion, and some of the Agency's programs have been pivotal in bringing important new technologies into use.

B. Summary of the Recommendations in the First Report of the NACEPT Subcommittee

The NACEPT Subcommittee on Environmental Technology issued its first report, *EPA Technology Programs and Intra-Agency Coordination*, in May 2006. This report focused on the evaluation of EPA's internal technology programs, the organization of their presentation to the public, and recent efforts to cross organizational lines to more effectively solve problems that are impeded by the lack of commercially available technology. In particular, the report contained the EPA Technology Development Continuum, a newly developed tool for organizing and analyzing the Agency's diverse technology facilitation programs, which reside in EPA's media program offices (i.e., Air and Radiation; Water; Solid Waste and Emergency Response; and Pollution Prevention, Pesticides and Toxic Substances), Office of Research and Development (ORD), and Region 1. Twenty-four programs are defined and appropriately arrayed across the entire spectrum of activities needed to move technology ideas from earliest conceptualization through research and development and on to full commercialization and use. The first report contained Subcommittee findings and the following recommendations in three areas:¹

1. **Environmental Technology Development Continuum:** EPA should broadly publish the Continuum and should use it as a tool to evaluate the outcomes of EPA programs across a wide spectrum of metrics and criteria.
2. **EPA Programs, Priorities, and Policy:** EPA should target its technology support efforts to publicly stated environmental goals; improve its metrics of success; expand its support programs at the demonstration, verification,

¹ Figure 1, on page 14 of this report, contains a summary of the major recommendations from the Subcommittee's first report and Appendix C contains the complete list of recommendations. The entire report can be found on the Web at <http://www.epa.gov/etop/nacept>.

and commercialization end of the Continuum; improve communication from one technology program to another; designate technology coordinators in the regional offices; increase public awareness of its programs to create demand for new environmental technologies; and encourage sustainability as one of the criteria for technology development assistance.

3. **Environmental Technology Action Teams:** EPA should employ an ongoing public process to identify the country's most pressing environmental problems needing technological solutions and utilize its newly developed Environmental Technology Council (ETC) Action Team initiative to address them.

C. Findings and Recommendations in the Second Report of the NACEPT Subcommittee



The Subcommittee's second report, *EPA Technology Programs: Engaging the Marketplace*, focuses on management issues that affect the Agency's ability to coordinate its programs and interface with the diverse governmental and private-sector organizations that constitute the environmental marketplace; on the critical area of the Agency's ability to build, join, coordinate, sustain, and leverage partnerships with key government and private-sector organizations; on the complex issues of EPA's role in impacting market demand forces to empower technology deployment both within the United States and abroad; and finally, on the looming technological challenges associated with mitigation of and adaptation to climate change.

Findings and Recommendations

Finding 1: EPA Technology Program Management (Additional Recommendations)

From its earliest deliberations, the Subcommittee has discussed the need for EPA to create a more coordinated and interconnected internal technology management structure to attain a higher degree of coordination and visibility across the broad and diverse spectrum of programs now operating within the Agency. The Continuum was the first product of this focus on increased coordination and this report follows with its focus on EPA's engagement with those outside entities whose actions will fundamentally influence the rate of new technology implementation.

Between the issuance of its first report in May 2006 and this one, the Subcommittee is pleased to note that EPA management has responded to its recommendations through the establishment or enhancement of four organizational entities. These changes are described in a letter dated December 19,

2006, from EPA Administrator, Stephen L. Johnson, to the Chair of NACEPT, John L. Howard, Jr. (see Appendix D). The Subcommittee believes the implementation of these changes will have a positive impact on the Agency's ability to manage its internal technology programs and to interact with a diverse external universe of environmental actors. The four new functions identified in the December 19 letter are to:

- "Establish a Senior Environmental Technology Officer (SETO) who will be the focal point for key activities recommended in the report like establishing priorities, chairing the ETC, facilitating cross-agency coordination and information sharing, working with the business community and other stakeholders, and developing metrics for measuring effectiveness."
- "Establish the Environmental Technology Council as a core Agency activity with more senior-level membership accountable for results."
- "Establish a Regional Environmental Technology Advocacy Network comprised of a technology advocate in each region to identify opportunities to use technology to achieve better results, share information within the Agency and with stakeholders, serve as a liaison with technology programs across the Agency, and serve as a member of the ETC."
- "Create an Environmental Technology Verification and Assessment Staff coordinated by the National Risk Management Research Laboratory to provide enhanced technology support to the SETO and the rest of the Agency on issues like technology verifications, state-of-the-art assessments, technology development collaborations, and encouraging sustainability."

4

Recommendation 1.1: SETO. EPA's newly created SETO should report directly to the Administrator and be afforded the appropriate staff and monetary resources necessary to support this important function. The primary roles of this position should be to: (1) have knowledge of Agency technology programs and needs; (2) coordinate program and regional office activities to ensure that redundancies are avoided and resources are appropriately allocated to address the most serious problems requiring technological fixes; (3) provide the Administrator with knowledgeable advice on domestic and international technology issues and policies; (4) open communication channels and partnership opportunities to all outside entities whose assistance can further Agency technology development and deployment goals; and (5) ensure that outstanding communication functions operate across the entire Agency to facilitate robust information flow to the marketplace on effective technologies of all types.

Recommendation 1.2: Additional Important SETO Functions. Three additional functions to be carried out by the SETO are recommended to: (1) assure EPA leadership in environmental technology communications and the provision of substantial resources for this critical function; (2) create and nurture EPA partnerships with both public- and private-sector organizations to maximize effective interface with other government agencies that have major technology development and deployment responsibilities, as well as the multiple actors in the commercial marketplace; and (3) convene a broadly based External Technology Advisory Board to advise the Agency on priority environmental problems needing technology breakthroughs, marketplace realities, communication issues, partnership

opportunities, and emerging technological challenges and opportunities such as those to be found in the field of nanotechnology.

Recommendation 1.3: Expansion of Environmental Technology Council Functions. EPA will expand the present functions of the ETC to encompass the broader role of an ongoing, cross-Agency technology council for coordination of technology programs, sharing of information, and development of general EPA technology policy.

Recommendation 1.4: Regional Technology Coordinator Function. The Subcommittee reconfirms its previously stated recommendation to “establish a policy that each regional office will designate a specific technology information coordinator” and applauds EPA’s decision to do so. It further recommends specific functions to be provided by the regions through this mechanism and overall coordination by the SETO.

Recommendation 1.5: Environmental Technology Verification and Assessment. A primary barrier to new private-sector technology has been the lack of independent and quality assured data on its environmental performance, operational reliability, and cost. EPA-supported verification allows this gap to be filled by providing technology developers with data that they can use to convince buyers to buy, while ensuring that the Agency’s primary function, environmental protection, is safe-guarded by technologies that work. The permanent placement of verification and assessment staff within ORD’s National Risk Management Research Laboratory will ensure that this critical function is continued.

Finding 2: Partnership Goals and Opportunities

The concept of partnership is integral to the success of EPA’s environmental technology efforts. Partnerships with other federal, tribal, state, and local government agencies; academia; public- and private-sector research organizations; trade and professional associations; technology developers and vendors; and purchasers and users of new technologies are necessary for technologies to move from early research to actual deployment. EPA cannot and should not develop or promote the development of technology in a vacuum. This is true not only because of EPA’s finite resources, but also, more importantly, because a host of other partners bring needed expertise, creativity, and market knowledge, as well as resources, to the table. EPA is particularly in need of input from the private sector.

Recommendation 2.1: Strategic Partnership Planning. EPA should use the Environmental Technology Development Continuum, described in the Subcommittee’s first report, for strategic thinking about the need for partners at different stages along the Continuum. By identifying partnerships that may be needed and available at particular stages, the Agency can better target its resources towards either supporting those partnerships or filling gaps by establishing new partnerships where there currently are no partners.

Recommendation 2.2: Partnerships With Other Agencies. EPA should join successful initiatives that already exist in other government agencies at all levels to further commercialization of environmental technology and expand the successful partnerships in which the Agency now participates.

Recommendation 2.3: State Partnership Challenges. Because states, tribes, and local government regulators play a major role in implementation of all technology, EPA should establish effective mechanisms for them to provide significant ongoing input into EPA environmental technology strategies and receive information and training on new technologies.

Recommendation 2.4: Partnership With the Private Sector. EPA should expand the use of its broad stakeholder process used in the Agency’s Environmental Technology Verification (ETV) program to other appropriate programs across the Continuum and use that process in the ETC Action Teams. The process brings to the table all segments of the marketplace—scientists and engineers, small business incubators, testing organizations, buyer and seller associations, developers and vendors, purchasers and users, other appropriate federal agencies, and regulators/permit writers at all appropriate levels of government—to discuss the opportunities and impediments as well as the data necessary to bring specific classes of needed technology to commercialization.

Finding 3: Encouraging Market Demand for Innovative Environmental Technology

Historically, EPA has conducted numerous programs to develop and promote marketplace demand for innovative environmental technology with strong emphasis on particular areas such as municipal wastewater treatment systems, soil and groundwater remediation technologies, and others. In the past 15 years, the universe of primarily voluntary approaches for stimulating and increasing demand for innovative technology deployment has expanded, and EPA has been involved to varying degrees with development and/or implementation of many of these approaches. In general, so-called “demand pull” activities fall into three categories: (1) creative regulatory and enforcement approaches that provide incentives for technology innovation, such as emission trading (e.g., the acid rain program), flexible permitting, and enforcement incentives; (2) efforts to assist skeptical purchasers in their selection of new technologies with high-quality, independent information on performance (e.g., ETV, Design for the Environment (DfE)) and voluntary certification programs (e.g., ENERGY STAR); and (3) direct government support in selected areas through preferential procurement standards and purchasing (e.g., recycled paper, fly ash in concrete) or direct project funding (e.g., wastewater facilities, arsenic removal systems).



Recommendation 3.1: Emission Credit Trading. Emission credit trading should be a component of environmental programs wherever possible. Under “cap and trade” programs, industry is given the incentive to achieve pollution reduction and maximize efficiency by the ability to sell emission credits to other companies that it has gained through reductions in emissions. The weak market for many new technologies can be stimulated

through partnership with market forces found in emission credit trading programs established or endorsed by EPA.

Recommendation 3.2: Flexible Permitting. EPA should commit to partnering with states independently and regionally to develop specific opportunities for greater flexibility in permitting to promote progressive technology development, particularly in areas in which innovative technology is needed to address serious unsolved problems or existing technology is too expensive for widespread implementation.

Recommendation 3.3: Flexible Enforcement Actions. Environmental Projects (EPs) and Supplemental Environmental Projects (SEPs) are important tools that EPA can employ to promote technology development and should be used more extensively for this purpose. Enforcement actions should authorize the development, piloting, or enhancement of environmental technology where appropriate. EPA should specifically include innovative technologies in project ideas for potential SEPs, with appropriate protections for the performance risks of the new technologies.

Recommendation 3.4: ETC Action Teams and SEPs. SEPs should be expanded specifically to include support for ETC Action Team projects. Action Team problem areas that have sufficient nexus to the environmental conditions impacted by alleged violations could be directly supported by SEPs.

Recommendation 3.5: Independent and Quality Assured Performance Data. EPA can and should continue to stimulate demand by providing the environmental marketplace with independent information and quality assured data on the performance of innovative, commercial-ready technologies through expansion of the DfE and ETV programs.

Recommendation 3.6: Expanded “Green” Certification Programs. EPA should continue to expand on the success of its voluntary ENERGY STAR program, creating additional “green” programs in the same mold for a wide variety of industries and activities. In addition, the Agency should welcome the opportunity to work with any not-for-profit or private-sector organization interested in creating a robust certification program aimed at reducing pollution, energy usage, water usage, and waste, and increasing the overall sustainability of commercial, residential, and industrial activity.

Recommendation 3.7: Preferential Purchasing. EPA should identify and act on opportunities to stimulate innovative environmental technology development and adoption through direct Agency preferential purchasing and through preferential purchasing requirements included in procurement specifications. EPA should be a leader among federal agencies in environmentally preferential purchasing, and offer guidance to other agencies in implementing adaptations of its model program.

Finding 4: International Trends and Issues

The Subcommittee has focused its work in the international area on evaluating the role and function of EPA technology assistance activities in the rapidly evolving international marketplace. The international technology sector is important to EPA and to the United States for many reasons, including the direct environmental impact of cross-border pollution, the expanded use in this country of technology developed and manufactured abroad, and the economic stimulus

potential of the global marketplace for the development of innovative technologies across the board. In addition, emerging product, operational, and waste regulations in Europe that target the environmental characteristics of products are causing entire industries to redesign their products to optimize for environmental performance. Individual U.S. states, most notably California, are producing similar regulations that are resulting in the demand for new environmental technologies in the areas of manufacturing, measurement and verification, risk assessment, software, and other tools needed to achieve and ensure desired product performance.

Recommendation 4.1: New International Manufacturing and Recycling Standards. U.S. manufacturers are responding to product environmental performance standards and regulations developed in Europe, and to state regulations that are emulating those developments at home. Emergence of differing and possibly conflicting standards will create confusion and impede the marketplace for these new technologies. Therefore, in partnership with appropriate state and business organizations, EPA should promptly conduct a major study or series of studies in affected sectors to determine the extent to which these new standards will affect U.S. environmental and technology requirements and determine what EPA's role should be in harmonizing regulatory approaches and guiding states, manufacturers, and citizens in this rapidly evolving situation.

Recommendation 4.2: International Technology Verification. EPA's technology verification programs should be strengthened and promoted internationally as a process that offers technically reliable assessment of new domestic and international environmental technologies. In particular, the Agency should promote the use of ETV testing protocols by other nations to allow for the more rapid understanding and diffusion of commonly based performance information.

Recommendation 4.3: International "Targets of Opportunity." EPA should continue to pursue, and if possible, expand its policy of addressing international "targets of opportunity," particularly in areas of cross-boundary pollution prevention/control and on other topics of high priority to the Agency, such as mercury control. Such targets also may arise from priorities developed by other departments and agencies charged with U.S. foreign policy missions.

Recommendation 4.4: U.S. Department of Commerce (DOC) and U.S. Agency for International Development (USAID) Partnerships. EPA should strengthen its interaction and cooperation with the domestic agencies that are the primary players in the international realm. DOC and USAID, in particular, have the lead in areas such as foreign aid and capacity building and support international opportunities for U.S. environmental technology industries.

Finding 5: Global Climate Change Technology Challenges

Climate change, a large-scale environmental issue with the potential to impact the entire globe, is one of the most important challenges that EPA will face in the 21st Century. The EPA Administrator stated in his climate change memorandum of July 6, 2006, that "Our planning must truly be strategic and include consideration of emerging challenges and opportunities. Rather than react or confront problems out of necessity, we should try to anticipate them and

adapt our programs accordingly.” The Subcommittee agrees with this forward-looking strategy and believes that problem anticipation must be accompanied by a corollary activity in technological solution evaluation.

EPA’s massive commitment to and success in improving air and water quality over the last three decades are at risk. Many problems, which the nation has viewed as “solved,” will require new technology development to address newly defined issues as the dimensions of climate change impacts emerge.

Strategic planning in this area will be multimedia of necessity, and therefore, will require the active participation of the new SETO to ensure that cross-media impacts are addressed and that the climate change aspects of technologies developed for other needs are evaluated.

EPA should, as a result of its core environmental protection function, continue on its present course of assessing the potential degradation of air and water quality that will be caused by global warming. The Subcommittee also thinks, however, that EPA should expand its role in facilitating the development and deployment of the new technologies that will be needed to address climate change, assess its role in facilitating emissions trading, and prepare to use its regulatory authority to work with partners on the state and federal level on this serious emerging environmental challenge.

Recommendation 5.1: Climate Change Technology Planning and R&D.

Current federal climate change policy gives primary responsibility to other agencies, principally the U.S. Department of Energy, for technology related to reducing greenhouse gas emissions. The Subcommittee recommends that EPA identify and fund climate change technology in areas of importance within its purview that need special development assistance. Assistance along the entire Continuum for these required technologies needs attention and active, cross-Agency strategic planning for technology development. This planning process should be addressed by the SETO as a priority matter.

Recommendation 5.2: Public/Private and State Partnerships. EPA should establish and cultivate meaningful public/private partnerships for technology development on climate change challenges. The importance of private-sector and public-sector partnerships becomes markedly more significant when dealing with large-scale environmental issues because of cost and scale, as well as practical implementation issues. In addition, EPA should increase its participation in partnerships with state, tribal, and regional groups that already are actively addressing the environmental effects of climate change.

Recommendation 5.3: Technology Verification and Demonstration Support.

EPA should establish and actively promote its leadership role in evaluating climate change technologies as new technologies approach the commercialization stage, so that purchasers can be assured that they are selecting the best technology for their particular situation. Governments, businesses, and individual consumers are beginning to voluntarily seek climate-friendly technologies in large numbers. Performance claims by vendors in a rapidly expanding marketplace need to be verified to ensure that technologies produce the types of results desired and that purchasers are not dissuaded from further voluntary actions by poor performance of new technology.

Recommendation 5.4: EPA's Potential Role in Carbon Dioxide (CO₂)

Emissions Trading. EPA should utilize its existing inventory of CO₂ power plant emissions to establish a baseline for use by electric utilities in instituting an emissions trading program in the United States as soon as possible. As a result of the emission monitoring and reporting provisions of the Clean Air Act Amendments of 1990, EPA's Office of Atmospheric Programs is a world leader in operating both emissions inventory activities and emissions trading programs. The CO₂ database that it has maintained for 10 years is the most available and logical source of plant-by-plant emissions data in the country and it should be utilized to rapidly establish year-specific baselines for all medium- to large-sized power plants.

Recommendation 5.5: EPA's Regulatory Role in Innovative Technology

Development. Consistent with its charge to explore "encouraging demand for innovative technologies," the Subcommittee recommends that EPA drive and enable innovative technology in all media by using not only existing but also new and creative regulatory and policy approaches to help solve the difficult issues facing the nation with respect to both prevention of and adaptation to climate change. EPA should actively seek and consider suggestions for innovative regulatory approaches that would encourage technology development within the regulated community as well as state, tribal, and local organizations.



II. EPA Technology Programs: Engaging the Marketplace

A. Introduction/Background

In October 2004, the U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD) requested that the National Advisory Council for Environmental Policy and Technology (NACEPT) form a broad-based subcommittee of technology experts to address issues and advise the Administrator on the present focus and status of environmental technology programs within the Agency (see Appendix A for the full text of the Subcommittee Charge document). On November 3, 2004, the Environmental Technology Subcommittee was formed (see Appendix B for the Subcommittee membership list) and shortly thereafter, held its first meeting.

The Charge to the Subcommittee posited the following core questions:

How can EPA better optimize its environmental technology programs to make them as effective as possible in promoting the research, development, commercialization, and implementation of sustainable private-sector technologies?

What other environmental programs and activities should EPA initiate to take advantage of opportunities that it may be missing to further the effectiveness of its technology facilitation objectives? (Although EPA is not likely to receive significant additional funding for any new technology activities, the Subcommittee should not feel constrained in its thinking.)

In particular, EPA requested the Subcommittee to review its effectiveness in the following five areas:

- **Evaluating the existing suite of technology support programs**, both individually and collectively, with a particular focus on redundancies or gaps and the extent to which they are appropriately designed to address technology development barriers.
- **Encouraging demand for innovative technologies** through the use of such tools as direct financial incentives, creative regulatory and policy approaches, preferential governmental purchasing, the evaluation and elimination of governmental permitting barriers, or other demand-pull actions.
- **Reaching critical audiences with innovative technology information** by organizing (or reorganizing) the massive amount of information that the Agency possesses on technology advances and performance, and by making this mate-

rial more accessible to the multiple public- and private-sector customers who need it through the use of 21st Century communication tools.

- ***Collaborating with states, tribes, and local governments*** to increase coordination and cooperation within and across all levels of government in assisting technologies to move from research to the actual implementation stage of development and commercialization.
- ***Collaborating with other federal agencies and the private sector*** to ensure that all major stakeholders in the complex process of bringing innovative technologies to market are represented in the consideration and implementation of EPA's technology programs.

The full Subcommittee has held eight meetings to date. Meeting agendas have included presentations by both government and nongovernment experts on overview issues and extensive briefings on the many and varied environmental technology research, development, and proliferation programs conducted by EPA. Working groups comprised of Subcommittee members have been formed to address specific issues and make preliminary recommendations to the full Subcommittee. After 2 years of deliberation, the Subcommittee now issues its second and final report containing findings and recommendations on which all members concur. The Subcommittee recommends that EPA and NACEPT monitor and periodically review the results of actions taken in response to recommendations contained in both reports.

B. NACEPT Subcommittee First Report, *EPA Technology Programs and Intra-Agency Coordination*

The Subcommittee's first report, *EPA Technology Programs and Intra-Agency Coordination*, was issued in May 2006, and focused on findings and recommendations pursuant to EPA's broad spectrum of technology programs and coordination among them. As such, it addressed primarily the first and third of the Charge topics listed above. In particular, the report contained the newly developed EPA Technology Development Continuum, the entire text of which can be found in Appendix D of the Subcommittee's first report (the full Subcommittee report is available on the Web at <http://www.epa.gov/etop/nacept>). The Continuum displays, for the first time, the full range of EPA's many and diverse technology facilitation programs. The Subcommittee reviewed a substantial subset of these programs, 24 of which have been identified to date, and have used this information to inform the findings and recommendations for both of its reports. These programs reside in all of the Agency's media program offices (Air; Water; Solid Waste and Emergency Response; and Pollution Prevention, Pesticides and Toxic Substances), ORD, and Region 1. They cover all of the three major



functions necessary to develop, evaluate, and promote commercial-ready technologies to improve the environment:

- **Basic research and development assistance** for new ideas and innovations by academics, independent inventors, and researchers working both within the Agency and in large and small companies;
- **Demonstration and verification of near or fully commercial-ready technologies** to assist consultants and purchasers in making good choices among competing technologies based on independent and quality assured performance data; and
- **Technology information diffusion to targeted audiences** such as states, local governments, associations, and private-sector organizations to facilitate the spread of information on technologies that are available, effective, and affordable.

A brief summary of the major recommendations in the Subcommittee's first report is presented in Figure 1. A full list of these recommendations is provided in Appendix C and will be referenced extensively in this report. The entire first report can be found on the Web at <http://www.epa.gov/etop/naccept>.

C. Report Overview

This second report, *EPA Technology Programs: Engaging the Marketplace*, focuses on findings and recommendations pursuant to the remaining elements of the Subcommittee's Charge. These include: management recommendations, which the Subcommittee believes will make the operation of the Agency's programs more holistic, coordinated, and transparent to the public; the critical area of the Agency's ability to build, join, coordinate, sustain, and leverage partnerships both internally and with key organizations outside of EPA, including the private sector; the use of various instruments, both regulatory and nonregulatory, to create a market demand for new technologies; the increasingly important role of international activity in the development and proliferation of improved technology; and the looming technological challenge of global climate change.

D. Findings and Recommendations

1. EPA Technology Program Management (Additional Recommendations)

As the Subcommittee emphasized in its first report, innovative and cost-effective environmental technologies are the keys to meeting our environmental goals and to achieving maximized environmental protection in the 21st Century. Ensuring that innovative technologies, capable of attaining improved environmental results at lower cost to the economy, move through the research and development continuum to full implementation in the marketplace requires focused attention at the highest levels of EPA and throughout the organization. This focus is particularly important in light of the need to interact extensively with the private sector on technology commercialization and deployment. With declining resources, however, the focus on getting technologies developed and used is rarely a priority activity in the Agency's media programs and regional offices.

1. EPA Technology Development Continuum

The U.S. Environmental Protection Agency (EPA) should broadly publish the Continuum, in both Web and document form, to assist information seekers both within the Agency and outside. The Agency should use the Continuum as an effectiveness and evaluation tool to determine the metrics and outcomes of EPA programs; a prioritization and resource evaluation tool to make cross-Agency resource decisions; and an evaluation tool to determine EPA's effectiveness in working with the other critical stakeholders in technology development and diffusion, most particularly state and local government and the private sector.

2. EPA Programs, Priorities, and Policy

- EPA should target its technology support efforts to areas clearly linked to environmental regulations and other publicly stated environmental goals.
- Improved and coordinated metrics need to be developed, used across the entire spectrum of EPA technology programs, and publicized.
- Although a research focus is consistent with the government's traditional role in funding basic research, it is important that other efforts, further along the research and development continuum, continue to be supported.
- Demonstration/verification programs need to be expanded.
- Each EPA technology program should know where to direct technologies to the next step in the development process both inside and outside EPA to ensure that promising innovations move through the Continuum toward commercialization.
- The Agency should address critical diffusion and utilization gaps that impede new technology from reaching the appropriate markets.
- The Agency should establish a policy that asks each regional office to designate a specific technology information coordinator.
- EPA should place more emphasis on and increase public awareness of its programs to create a demand for new environmental technologies.
- EPA should devote more attention and resources to those Agency programs that incorporate and encourage sustainability as one of the goals or criteria for technology development or implementation assistance.

3. Environmental Technology Council Action Teams

EPA should develop a formal and ongoing public process to identify the country's most pressing environmental problems needing technological solutions. EPA should make the Action Team initiative a core program with high-level Agency support, while streamlining the management structure for both the Environmental Technology Council (ETC) and its Action Teams. The ETC should develop and institute Standard Operating Procedures for Action Teams and ensure that they immediately begin to include appropriate outside stakeholders.

The Subcommittee believes that implementation of the recommendations made in its first report (see Figure 1), as well as those contained in this report, will move EPA toward more robust and coordinated technology programs across the Agency. The recommendations in this report, in particular, will facilitate activities through the many outside entities that must be involved for improved technology to be deployed through the marketplace.

From its earliest deliberations, the Subcommittee has discussed the need for EPA to create a more coordinated and communicative internal technology management structure to attain a higher degree of coordination and visibility across the broad and diverse spectrum of programs now operating within the Agency. The Continuum was the first product of this focus on increased coordination, and this report follows with its focus on EPA's engagement with those outside entities whose actions will fundamentally influence the rate of new technology implementation.

Between the issuance of the Subcommittee's first report in May 2006, and this one, EPA management has responded to the Subcommittee's recommendations through the creation of four new organizational entities. These changes are described in a letter dated December 19, 2006, from EPA Administrator, Stephen L. Johnson, to the NACEPT Chair, John L. Howard, Jr. (see Appendix D). The Subcommittee believes that the implementation of these changes will have a positive impact on the Agency's ability to manage its internal technology programs and to interact with a diverse external universe of environmental actors. The four new organizational functions are referenced in the findings below, along with the Subcommittee's comments and recommendations on their implementation.

Findings

Finding 1.1: EPA will, "Establish a Senior Environmental Technology Officer (SETO) who will be the focal point for key activities recommended in the report like establishing priorities, chairing the Environmental Technology Council (ETC), facilitating cross-agency coordination and information sharing, working with the business community and other stakeholders, and developing metrics for measuring effectiveness."

Finding 1.2: EPA will, "Establish the Environmental Technology Council as a core Agency activity with more senior-level membership accountable for results."

Finding 1.3: EPA will, "Establish a Regional Environmental Technology Advocacy Network comprised of a technology advocate in each region to identify opportunities to use technology to achieve better results, share information within the Agency and with stakeholders, serve as liaison with technology programs across the Agency, and serve as a member of the ETC."

Finding 1.4: EPA will, "Create an Environmental Technology Verification and Assessment Staff coordinated by the National Risk Management Research Laboratory to provide enhanced technology support to the SETO and the rest of the Agency on issues like technology verifications, state-of-the-art assessments, technology development collaborations, and encouraging sustainability."

Finding 1.5: Communication of technology information on the broadest possible scale is necessary for the actual adoption, implementation, and use of better technology. At every point in the Continuum, but especially at the end of the process when an innovation has been fully developed, its performance independently verified, and its commercial potential ensured, EPA must facilitate the transmission of information and data to the wide diversity of people outside the Agency who need it for decision-making purposes. Today, Web sites and Web-based communication activities are the most universal means of information diffusion and critical to every aspect of implementation of innovative technology. The existence of a Web site, however, does not ensure that it will or should be used. EPA, through the focused management structure that it now has created, must ensure that those sites incorporated into its Environmental Technology Opportunities Portal (ETOP) Web Site are up to date, accurate, and user friendly. This Web site quality control function is essential for the Agency's ongoing reputation as a repository of current and high-quality data and information.

Recommendations

Recommendation 1.1: SETO. EPA's newly created SETO, should report directly to the Administrator and be afforded the appropriate staff and monetary resources necessary to support this important function. The primary roles of this position should be to: (1) have knowledge of Agency technology programs and needs; (2) coordinate program and regional office activities to ensure that redundancies are avoided and resources are appropriately allocated to address the most serious problems requiring technological fixes; (3) provide the Administrator with knowledgeable advice on domestic and international technology issues and policies; (4) open communication channels and partnership opportunities to all outside entities whose assistance can further Agency technology development and deployment goals; and (5) ensure that outstanding communication functions operate across the entire Agency to facilitate robust information flow on effective technology opportunities of all types. Appendix E contains further Subcommittee ideas on the internal and external roles of the SETO.

Recommendation 1.2: Additional Important SETO Functions. The Subcommittee believes that there are several specific functions requiring special skills and experience that should reside within the office of the SETO. These are:

- **Communications Leadership.** The responsibility for the critical communication function should reside with the SETO and receive the substantial resources that a really effective communication effort will require to ensure actual implementation of new technologies. Subcommittee suggestions for this function are found in Appendix E.
- **Partnership Coordination.** EPA should create and nurture a technology support coordination function with the mission and responsibility of linking promising technologies with partners. This support function should have a working knowledge of incubators, markets, financial resources like venture capital organizations, regulatory agency needs, leadership companies, regulatory tools, interests of nonprofits, states

taking leadership roles in specific areas, and other partners that could contribute to successful technology development and marketing.

- **External Technology Advisory Board.** An external Technology Advisory Board, comprised of major stakeholders, including a range of public and private representatives, should be formed to provide ongoing advice to the SETO and the Agency on priority environmental problems needing technology breakthroughs, marketplace realities, communication issues, and partnership opportunities. The Technology Advisory Board also could be charged with recommending or reviewing appropriate metrics for the Agency to use in measuring real-world results, both environmental and economic, from the introduction of innovations and could follow and advise on issues germane to the emergence of wholly new environmental approaches such as those involving nanotechnology.

Recommendation 1.3: Expansion of Environmental Technology Council

Functions. The Subcommittee approves of the Administrator's decision to place the ETC under the direction of the SETO as EPA's cross-Agency council on technology issues. The now permanent ETC should expand its functions to the broader role of an ongoing technology forum for coordination of technology programs, information diffusion, and development of general EPA technology policy. The ETC currently consists of representatives from each program office, ORD, and all 10 regions. Its present functions are to periodically identify the most pressing environmental problems requiring new technology and establish cross-Agency Action Teams to address them. The Subcommittee examined the ETC and its Action Teams and developed several recommendations concerning the Council in the May 2006 report, among which was, "EPA should make the Action Team initiative a core program with high-level Agency support..." ETC's expanded functions will vary over time as Agency goals, issues, and initiatives evolve, but its existence as an intra-EPA forum for technology discussion is critical.

Recommendation 1.4: Regional Technology Coordinator Functions. The Subcommittee's May 2006 report recommended that the Agency "...establish a policy that each regional office will designate a specific technology information coordinator." The Subcommittee reconfirms this recommendation and applauds the Administrator's decision to implement it. The Subcommittee's recommendations on the functions of these Coordinators are found in Appendix E.

Recommendation 1.5: Environmental Technology Verification and Assessment. In almost every section of both its first and second reports, the Subcommittee has recommended the expansion and support of the Agency's programs for technology verification as a core function within EPA. The Agency's charge to this Subcommittee stated, "The Agency must support the role of the private sector in technology development, leveraging its programs and activities to facilitate the deployment of such technologies and eliminating barriers that discourage or hold back their adoption." A primary barrier to new private-sector technology has always been the lack of independent and quality assured data on its environmental performance, operational reliability, and cost. EPA-supported verification allows this gap to be filled by providing technology developers with data that they can use to convince buyers to buy, while ensuring that the

Agency's primary function, environmental protection, is safe-guarded by technologies that work. The permanent placement of a verification and assessment staff within ORD's National Risk Management Research Laboratory will ensure that this critical function is continued.

2. Partnership Issues

The recommendations of the Subcommittee on partnerships are intended to address strategic use of various partnership opportunities to further EPA's environmental goals and solve priority problems. EPA has adopted a partnership culture and has established successful partnerships with many organizations. Some examples of these effective partnership-based programs include the Design for the Environment (DfE), WasteWise, Environmental Technology Verification (ETV), Nonpoint Source Partnership, and ENERGY STAR programs (see Successful EPA Partnership Programs on page 19 as well as the descriptions of DfE and ETV in the May 2006 report), but there are many others across the Agency.

The concept of partnering with other federal, tribal, state, and local government agencies; academia; trade and professional associations; public- and private-sector research organizations; technology developers and vendors; and purchasers and users of new technologies is integral to the success of EPA's environmental technology efforts. EPA cannot and should not develop or promote the development of technology in a vacuum. This is true not only because of EPA's finite resources, but also more importantly, because a host of other partners bring needed expertise, creativity, and market knowledge, as well as resources, to the table.

It should be emphasized that "partnership" is not a euphemism for "deep pockets," nor are partnerships entered into primarily to leverage resources from other organizations, although this may sometimes occur. Partnership means many different things, and different kinds of partnerships may be more or less important at various points along the Continuum of technology development described in the NACEPT Subcommittee's first report. Further, EPA's role is different in relation to different partners. EPA can form partnerships and lead them, but it also can join existing partnerships led by others and effectively further its mission through these activities.

Findings

Findings 2.1: Partnerships are important to the advancement of environmental technology. EPA's ability to advance technology is greatly enhanced by effective collaboration with a multiplicity of research, development, and marketplace actors. In particular, its relationships with state organizations such as the Environmental Council of the States (ECOS) is critical to implementing its environmental goals in general and its technology goals in particular (see the description of ECOS on page 20). EPA needs to identify the gaps in developing needed technologies and support their closure through strategic use of partnerships.

Finding 2.2: Current EPA partnerships that support development and marketing of environmental technologies are category specific (i.e., by industry, media, or technology) and tend to focus on the early and late stages of the Continuum. Partnerships appear to be less prevalent in the middle of the Continuum, the stage at which good ideas either succeed or fail in moving to commercialization. Partnerships needed at this stage may

Successful EPA Partnership Programs

Design for the Environment (DfE) is one of EPA's premier partnership programs, working with individual industry sectors to compare and improve the performance and reduce human health and environmental risks and costs of existing and alternative products, processes, and practices. DfE partnership projects promote integrating cleaner, cheaper, and smarter solutions into everyday business practices.

WasteWise is a free, voluntary EPA program through which organizations eliminate costly municipal solid waste and select industrial wastes, benefiting their bottom line and the environment. WasteWise is a flexible program that allows partners to design their own waste reduction programs tailored to their needs. All organizations within the United States may join the program. Large and small businesses from any industry sector are welcome to participate. Institutions, such as hospitals and universities, non-profits, and other organizations, as well as state, local, and tribal governments, also are eligible to participate in WasteWise.

The Environmental Technology Verification (ETV) program develops testing protocols and verifies the performance of innovative technologies that have the potential to improve protection of human health and the environment. The program partners with private-sector testing organizations, federal agencies such as the U.S. Department of Defense, Department of Energy (DOE), National Oceanic and Atmospheric Administration, and Coast Guard, and numerous states to accelerate the entrance of new environmental technologies of all types into the domestic and international marketplace. ETV utilizes the largest stakeholder process in the Agency—more than 800 public- and private-sector individuals representing federal, state, and local government agencies; academics and technology experts; not-for-profits; associations; and a broad group of technology purchasers, users, developers, and vendors—to direct program activities.

The State-EPA Nonpoint Source (NPS) Partnership provides an excellent framework for states and EPA to work together cooperatively to identify, prioritize, and solve NPS water problems. Work groups were established through this partnership to focus on NPS topic-specific needs, including: watershed planning and implementation; rural nonpoint sources; urban nonpoint sources; nonpoint source grants management; nonpoint source capacity building and funding; information transfer and outreach; nonpoint source results; and nonpoint source monitoring. The information and products emerging from these work groups help states to more effectively implement their NPS management programs.

ENERGY STAR is a joint program of EPA and DOE that is helping Americans save money and protect the environment through energy-efficient products and practices. The program was introduced by EPA in 1992 as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. Today, more than 40 percent of the American public recognizes the ENERGY STAR label, which is on major appliances, office equipment, lighting, home electronics, and more. EPA also has extended the label to cover new homes and commercial and industrial buildings. Through its partnerships with more than 8,000 private- and public-sector organizations, ENERGY STAR delivers the technical information and tools that organizations and consumers need to choose energy-efficient solutions and best management practices.

Environmental Council of the States

The Environmental Council of the States (ECOS) is the national nonprofit, nonpartisan association of state and territorial environmental agency leaders. The purpose of ECOS is to improve the capability of state environmental agencies and their leaders to protect and improve human health and the environment of the United States. ECOS believes that state government agencies are the keys to delivering environmental protection afforded by both federal and state law, and that the Council plays a critical role in facilitating a quality relationship between federal and state agencies in the fulfillment of that mission. The role of ECOS is to:

- ◆ Articulate, advocate, preserve, and champion the role of the states in environmental management.
- ◆ Provide for the exchange of ideas, views, and experiences among states and with others.
- ◆ Foster cooperation and coordination in environmental management.
- ◆ Articulate state positions to Congress, federal agencies, and the public on environmental issues.

ECOS is actively working on several environmental policy research efforts both independently and through cooperative agreements with EPA, including the National Childhood Asthma Prevention Campaign, the Forum on State and Tribal Toxics Action, and Small Community Compliance Assistance. ECOS currently has several key partnerships with EPA, including:

20

- ◆ **State-EPA Information Management Workgroup.** This workgroup formed the Environmental Data Standards Council in November 1999. The Council has 10 members—four state, four EPA, and two tribal representatives. The Council develops environmental data standards to promote the exchange of information among states, tribes, and EPA. The workgroup also sponsors WISER, a secure, electronic workplace for use by employees of state environmental agencies and the EPA. Its purpose is to share ideas and information about information management and other topics of mutual interest.
- ◆ **National Environmental Information Exchange Network.** The Exchange Network is a partnership among states, tribes, and EPA that is revolutionizing the exchange of environmental information. Partners on the Exchange Network share data efficiently and securely over the Internet. This new approach is providing real-time access to higher quality data while saving time, resources, and money for partner states, tribes, and territories.
- ◆ **The Interstate Technology and Regulatory Council (ITRC).** The ITRC is a state-led coalition of regulators, industry experts, academia, citizen stakeholders, and federal partners working together to increase regulatory acceptance of state-of-the-art environmental technologies and approaches.

provide funding for verification, regulatory or market advice, a venue for demonstration, and/or an opportunity for scale up. All are important to technology development and marketing success.

Finding 2.3: A successful technology project partnership contains several key components, including: a serious environmental problem focus, a free exchange of existing knowledge and information as it develops, an adequate funding base, a willingness to explore the technology opportunity and pursue development, and an acceptance that risks and rewards should be shared. Different partners provide these components.

Finding 2.4: Creative collaboration with the private sector, as well as input and interaction with government entities, are pivotal to the success of EPA's environmental technology programs. Critical elements of development and commercialization can be achieved and sustained only by the private sector. A major factor in the success of EPA's verification programs is the active inclusion of diverse public and private stakeholder groups used to: set priorities on categories to be tested, identify data needs, set testing parameters/protocols, and locate commercial technologies ready for testing. Stakeholder groups typically include appropriate federal, state, and sometimes local and tribal representatives, business and industry associations, scientists and engineers working in the field, large and small companies that need to procure technology in the area, and technology developers and vendors.

Finding 2.5: Commercialization by the private sector may be the least understood aspect of technology development by government regulators. As a project approaches the commercialization phase, the importance of private-sector partnerships becomes markedly more significant. Factors that affect commercialization include:

- Limited growth potential, recognizing that, unlike many other businesses, there is a natural ceiling for many environmental technologies (i.e., only those who are required to or, for business or altruistic reasons, voluntarily decide to purchase pollution prevention/control/monitoring technology do so).
- Technical risk of noncompliance or nonperformance; operational and management difficulties; and high or unknown lifecycle costs.
- Intellectual property rights issues.
- Unfavorable odds, including lack of capital, opportunity, and time necessary to adequately demonstrate performance capabilities of the technology.
- Uncertain, evolving, and multiple regulatory requirements and performance standards at the local, state, and federal levels.

Finding 2.6: Small business incubators, which accelerate development of successful entrepreneurial efforts by providing practical assistance and a variety of business and technical support services, represent a target of opportunity for EPA. A relatively small investment per company or project may be critical to the development of a technology needed to address a key EPA priority.

Finding 2.7: Partners who can supply much-needed financial resources are particularly difficult for regulatory agencies to identify. Fundamentally, to invest in technology development, an entity must perceive a reasonable likelihood of a return on investment through the creation of new markets, increased efficiency, and/or lower costs. Thus, broad-based and multipurpose technologies will have greater likelihood of attracting venture capital than technologies with limited applications, even though some of these “limited market” technologies could be important for environmental protection needs (e.g., real-time bacterial monitoring).

Finding 2.8: EPA’s longstanding policy of collaboration with other federal agencies, states, tribes, and local governments needs to focus more effectively on technology issues. Lack of regulatory acceptance at state and local government levels continues to be cited as an impediment to effective adoption of new environmental technologies. Early involvement of EPA in the process will help to facilitate the acceptance of state, tribe, and local regulators and the effective implementation of innovative technologies.

Finding 2.9: EPA participates in a number of partnerships in which the Agency plays an important role in influencing the policies and actions of the other partners. EPA representatives serve on committees and other groups that are shaping federal policy, identifying research needs, and forging strategies for addressing important environmental issues. EPA’s role in these activities is important for overcoming barriers to the adoption of innovative technologies and for identifying opportunities to work with partners to address specific high-priority problems.

Recommendations

Recommendation 2.1: Strategic Partnership Planning. EPA should use the Technology Development Continuum, described in the Subcommittee’s first report, for strategic thinking about the need for partners at different stages of technology development along the Continuum. By identifying partnerships that may be needed and available at particular stages, the Agency can better target its resources towards either supporting those partnerships or filling gaps where there currently are no partners by actively seeking new partners. The likelihood of financing should be evaluated, and synergies can be identified and promoted. This should be done as early as possible in the development process and include an assessment of motivations or drivers for needed partners, including such factors as potential financial gain, rule development facilitation, good will, regulations, and enforcement. EPA should have an explicit goal in entering into each partnership and evaluate the need for its continuation, modification, and termination with that goal in mind as a technology moves through the Continuum. As indicated in Recommendation 1.1, the SETO should have overall responsibility for coordinating the Agency’s technology partnership strategy and implementation.

Recommendation 2.2: Partnerships With Federal and State Organizations. EPA should develop new partnerships and expand existing ones that address technology needs across the entire Continuum and in all environmental media. EPA should join successful initiatives and multiparty consortia that already exist in other government agencies both at the federal and

state levels to further commercialization of environmental technologies that address the Agency's priority problems. For example, EPA could partner with the California Energy Commission and the U.S. Department of Energy (DOE) National Renewable Energy Laboratory's Industry Growth Forums, and follow technologies all the way across the development Continuum with these partners.

EPA also should expand the successful partnerships in which it now participates, such as the Department of Defense's (DoD) Strategic Environmental Research and Development Program (SERDP), which focuses on the early stages of the Continuum (see the description of SERDP on page 24), and the Environmental Security Technology Certification Program (ESTCP), which focuses on the middle and later stages of the Continuum (see the description of ESTCP on page 24). Furthermore, EPA should expand many of its current partnerships and support more partnerships that include all environmental media.

The Agency should seize opportunities to participate in committees and other groups that are shaping federal policy, identifying research needs, and forging strategies as a means of overcoming barriers to the adoption of innovative technologies and for identifying opportunities to work with partners to address specific high-priority problems. Some examples of these types of partnerships include the Federal Remediation Technologies Roundtable (FRTR) and the Subcommittee on Water Availability and Quality (SWAQ). The FRTR leads the Federal Government's efforts to promote inter-agency cooperation to advance the use of innovative technologies for the remediation of hazardous waste sites and transfer the benefits of these cooperative efforts to the site remediation community. SWAQ was formed to advise and assist the Committee on Environment and Natural Resources and the National Science and Technology Council on policies, procedures, plans, issues, scientific developments, and research needs related to the availability and quality of water resources of the United States.

Recommendation 2.3: Regulator Challenges and Opportunities. Because states, tribes, and local government regulators play a major role in implementation of all technology, EPA should establish or maintain strategic partnerships that allow these regulators to provide significant input to Agency environmental technology strategies early in the process so that their concerns can be addressed. EPA also should form partnerships to provide information and training on new technologies to these regulators. Lack of acceptance by state regulators may be tied to unfamiliarity with the technology and/or lack of comfort with the risk it poses, as well as resource limitations that require focus on core activities (permitting, developing regulations, providing technical assistance, and enforcing regulations). It is important that the Agency understands and honors the legitimate role and concerns of state and local regulators that may be contributing to their reluctance to foster utilization of new technologies.

There are many state-, tribal-, and local-level environmental initiatives that are consistent with EPA policy or regulations, but that may not be required by EPA. The Agency should consider technology partnerships that are mutually supportive of those efforts and EPA's mission. The Interstate Technology and Regulatory Council (ITRC) (see the description of the ITRC

Strategic Environmental Research and Development Program

The Strategic Environmental Research and Development Program (SERDP) is the U.S. Department of Defense's (DoD) environmental science and technology program, planned and executed in full partnership with EPA and the U.S. Department of Energy (DOE), with participation by numerous other federal and nonfederal organizations. Representatives from DoD, EPA, DOE, and the U.S. Coast Guard sit on the 12-member council that manages SERDP.

To address the highest priority issues confronting the Army, Navy, Air Force, and Marines, SERDP focuses on cross-service requirements and pursues high-risk/high-payoff solutions to DoD's most intractable environmental problems. The four focus areas of the program are: Environmental Restoration, Munitions Management, Sustainable Infrastructure, and Weapons Systems and Platforms. Within its broad areas of interest, SERDP focuses on cleanup, compliance, conservation, and pollution prevention technologies. The program partners provide locations, facilities, and mechanisms for applied research, comparative demonstrations, and comprehensive evaluations. Its goal is to transfer technology from research to full-scale use and from government agencies to the private sector.

Environmental Security Technology Certification Program

The Environmental Security Technology Certification Program (ESTCP) is DoD's environmental technology demonstration and validation program. ESTCP's goal is to identify, demonstrate, validate, and transfer promising, innovative technologies that address DoD's highest priority environmental requirements. The program promotes innovative, cost-effective environmental technologies through demonstrations at DoD facilities and sites. These technologies provide a return on investment through improved efficiency, reduced liability, and direct cost savings. ESTCP selects laboratory-proven technologies with broad DoD application for rigorous field trials documenting their cost, performance, and market potential. ESTCP technology demonstrations address DoD environmental needs in the Environmental Restoration, Munitions Management, Sustainable Infrastructure, and Weapons Systems and Platforms focus areas.

In July 1999, DoD and EPA signed a Memorandum of Agreement (MOA) to facilitate closer cooperation and coordination on joint technology verification efforts. The MOA built a partnership between DoD's ESTCP and EPA's Environmental Technology Verification program. This agreement was designed to help companies that develop innovative technologies penetrate markets of interest to both EPA and DoD at a faster rate.

on page 26) and the Technology Acceptance and Reciprocity Partnership (TARP) (see the description of TARP on page 28) are good examples of partnerships that involve states early in the process, address the challenges faced by these regulators, and expedite the acceptance and use of innovative technologies. The Subcommittee believes that EPA’s focused, efficient, and highly leveraged support of ITRC represents a “best practice” in real-world fostering of technical innovation that should serve as a model for consideration by EPA offices and programs. EPA should use the ITRC and TARP as models in other areas and expand them to include additional media, states, and programs.

Recommendation 2.4: Partnership With the Private Sector. EPA should expand the use of its broad stakeholder process used in the ETV program to other appropriate programs across the Continuum and use it in the ETC Action Teams. This process brings to the table all segments of the marketplace—scientists and engineers, small business incubators, testing organizations, buyer and seller associations, developers and vendors, purchasers and users, other appropriate federal agencies, and regulators/permit writers at all appropriate levels of government—to discuss the opportunities and impediments as well as the data necessary to bring specific classes of needed technology to commercialization. The broadest possible range of public/private collaboration should be encouraged through this process.

3. Encouraging Market Demand for Innovative Environmental Technology

In its first report, the Subcommittee recommended that, “the Agency place more emphasis on and increase public awareness of its programs to create a demand for new environmental technologies,” and commit itself to “seek further information on EPA’s past experiences, both positive and negative, with these types of policies.” EPA has conducted a number of programs to develop and promote approaches to stimulate marketplace demand for innovative environmental technology with emphasis on particular areas such as municipal wastewater treatment systems, soil and groundwater remediation, and others. In recent years, the universe of possible approaches for stimulating and increasing demand for innovative environmental technology has expanded, and EPA has been involved to varying degrees with development and/or implementation of many of these approaches.

Approaches for Stimulating Market Demand

General categories of approaches for stimulating market demand for innovative technology are listed in Table 1, along with examples of specific programs or activities under each category. The motivating factors that drive the interest of individuals or organizations in the various approaches also are listed, and include regulatory/legal, financial, and public benefit. A subjective assessment of the important motivators for each of the approaches also is provided in Table 1. The demand-pull approaches identified in the table have been selected from the perspective of the desirability of moving commercial-ready technologies into the marketplace. Although some of the approaches listed could certainly be applied to promote initial research and development of new technologies, these approaches were selected for their actual or potential ability to enhance market demand and facilitate market penetration at the commercialization and diffusion/utilization stages of the Technology Development Continuum.

State Leadership in Permit Facilitation: The Interstate Technology and Regulatory Council

The Interstate Technology and Regulatory Council (ITRC) is a state-led organization devoted to increasing the efficiency of state permitting on innovative technologies. ITRC originated in 1995 from a previous initiative by the Western Governors' Association. In January 1999, it affiliated with the Environmental Research Institute of the States (ERIS), which is a nonprofit educational subsidiary of the Environmental Council of the States (ECOS).

For most of its 10-year history, the primary goal of the ITRC has been to expedite the acceptance of innovative technologies utilized in the remediation of contaminated hazardous waste sites. In the last 2 years, the ITRC has broadened its focus to address other environmental issues. With the funding ITRC receives from EPA, Department of Energy (DOE), and Department of Defense (DoD), it has been able to break down barriers to innovative technologies, reduce compliance costs, make it easier to use new technologies, and help states maximize their resources.

ITRC accomplishes its mission in two ways: it develops guidance documents and training courses to meet the needs of both regulators and environmental consultants, and it works with state representatives to ensure that ITRC products and services have maximum impact among state environmental agencies and technology users. EPA has supported the development and operation of ITRC through modest direct funding, but additionally through broad and effective outreach communicating ITRC information, events, and programs to vital stakeholders. For example, all free ITRC Web workshops (typically 10 per month) are directly advertised by EPA's Office of Superfund Remediation Technology Innovation to more than 26,000 subscribing stakeholders. Just this one example of outreach enables 150 stakeholders (on average) to actively participate in each ITRC Web seminar at no cost. The benefits to ITRC on having such broad and deep stakeholder involvement in its activities are substantial, and include the support and consensus on ITRC guidance documents enjoyed by state regulators and the engineering community.

ITRC has made significant strides in reducing the barriers to and increasing the acceptance of innovative technologies by forming technical teams devoted to providing information that decision makers use to address issues of concern. ITRC brings together a diverse mix of environmental experts and stakeholders from both the public and private sectors to broaden and deepen technical knowledge and streamline the regulation of new environmental technologies. Technical Teams are comprised of a diverse group of stakeholders: state and federal regulators, federal site owners such as DoD and DOE, consultants, vendors, academics, and public stakeholders. These organizations bring a healthy diversity of views and interests to ITRC. The Technical Team gets the "shovel in the ground" and provides critical information that is used in the Team's final product, the *Technical and Regulatory Review Guidance Document* (Tech/Reg). This document is a comprehensive review that examines all aspects of the technology. The Team may produce other documents as well—most commonly Overviews of the Technology, State Surveys, or Case Studies. Although sometimes challenging, consensus is facilitated by the fact that ITRC concentrates on technical issues, providing the best information available, and does not directly address policy issues. Upon completion of the Tech/Reg document, the Team provides related training on the Internet or possibly through classroom training. ITRC documents and training have proved immediately beneficial to the user, and the documents do not "sit on the shelf."

A critical component of ITRC is its network of state Point of Contact (POC). Each state that is a member of ITRC (currently 46) assigns one staff person to serve as a liaison between ITRC and the organization. The POCs provide information on training opportunities and documents that may be relevant to state technology problems to state staff and others that may benefit from ITRC products. They respond to surveys prepared by Technical Teams and seek state concurrence on documents. POCs also are expected to convey the needs of their states to ITRC and to attend ITRC meetings.

ITRC is housed in ECOS, giving members a direct line of communication to state environmental commissioners, who are the most important environmental decision makers in the state and pivotal in getting new technologies introduced and accepted.

Table 1. Demand-Pull Approaches, Motivating Factors, and EPA Involvement

Market Demand Stimulation Approach ¹	Motivating Factors			
	EPA Role ²	Regulatory/ Legal	Financial	Public Benefit
Creative Regulatory Approaches				
<i>Emissions Trading</i>	L	X		
<i>Flexible, Efficient Permitting</i>	L	X		
<i>Supplemental Environmental Projects</i>	L	X	X	X
<i>Environmental Projects</i>	L	X	X	X
Green Product/Process Design (e.g., Hg-free batteries)				
Technology Verification <i>EPA ETV Program</i>	L		X	X
Certifications/Labeling				
<i>Product Labeling (e.g., cleaning supplies, carpets)</i>	S		X	X
<i>EPA ENERGY STAR Standards</i>	L		X	X
<i>EPA Green Lights</i>	L		X	X
<i>Voluntary Greenhouse Gas (GHG) Reduction</i>	L		X	X
<i>Mobile Diesel Emission Reduction</i>	L			X
<i>LEED Green Building Certification</i>	S		X	X
Product Take-Back Requirements (e.g., PCs, Pb-acid batteries)				
	S	X		
Preferential Purchasing (e.g., recycled paper, green buildings, hybrids for fleet vehicles)				
	S		X	X
Direct Financial Incentives (subsidies for innovative technology implementation)				
	L		X	

¹Example programs or activities are shown in italics.

²EPA Role: L = lead; S = supporting role to states, tribes, or other organizations.

- Creative regulatory and enforcement approaches can provide incentives for technology innovation.** Examples of regulatory approaches that encourage innovation are emissions trading, where an investment in control technology can yield a valuable asset in the form of emission credits, and flexible permitting that allows for uncertainty in technology performance during a startup period or under varying operational conditions. Flexible enforcement programs also can create the opportunity for new solutions and the chance to demonstrate them, increasing the market for innovative technologies.
- Market demand also can be stimulated for new technologies through efforts to assist skeptical purchasers in their selection of technologies with high-quality performance and cost information.** When it comes to making technological choices and acquisition decisions, buyers and users frequently will move to those technologies that are known to work, rather than take a chance on new and unproven approaches even if these are advertised to save them money either immediately or over time. Demonstration, verification, publicly available information on operation and maintenance parameters and costs, and/or certification with respect to publicly stated standards by trusted institutions are all approaches that assist high-performing, commercial-ready technologies to penetrate the market. Readily available information, particularly verified or certified information, on new approaches is critical to acceptance and widespread implementation.

Technology Acceptance and Reciprocity Partnership Consensus Testing Protocols at the State Level

Scientifically valid information on the performance of new technologies is critical to making state permit decisions, and it often does not exist for new technologies. Uncertain testing requirements and duplicative reviews under traditional “state by state” permit review systems drive up the cost of commercialization for new technologies.

The Commissioners and Secretaries of the eight Technology Acceptance and Reciprocity Partnership (TARP) states (California, Illinois, Massachusetts, Maryland, New Jersey, New York, Pennsylvania, and Virginia) have set up a mechanism for states to develop common testing protocols for vendors to use to demonstrate the effectiveness of their technologies, thereby providing a pathway for technology developers to develop credible data; reduce costly, duplicative field-testing; and gain regulatory acceptance.

In the area of stormwater treatment technologies, for example, regulators in each participating state oversee the field-testing of stormwater technologies across the country. The host state performs a critical evaluation of the performance data collected and required in the common protocol and then shares its analysis with collaborating states. Results are posted in a searchable database (<http://www.mastep.net>) to provide the public and regulators with a “one-stop shop” for reports, data, and evaluations of stormwater technologies. By sharing the workload for review across state lines, TARP estimates that up to 80 percent of the state’s traditional application review time is reduced. TARP is housed in the Environmental Council of the States along with the Interstate Technology and Regulatory Council.

- *The government can stimulate markets in selected areas through preferential purchases or direct funding.* The capacity for government to stimulate market demand for environmental technologies and products through preferential purchasing and direct financial incentives has been demonstrated and such efforts can be expanded.

Findings

Finding 3.1: Emissions trading programs have been in place for sulfur dioxide (SO₂) air emissions control since the early 1990s, and currently are under development for water effluent control. Under such “cap and trade” programs, industry is given the incentive to achieve emission reduction and maximize efficiency through the ability to sell its unused emission credits to other companies. Trading schemes encourage the adoption of innovative technology as opportunities for process revision arise because of the potential to create more emission credits than can be achieved with conventional technology. The credits can be used for process expansion internally or sold. By providing industry with maximal opportunity for technology innovation, trading programs can be a cost-effective way to achieve regional or national emissions reduction at relatively low cost through voluntary implementation of new emission control technology. The success of the acid rain air emission credit trading program, which was established under the authority of the Clean Air Act to reduce acid rain and its impacts, has demonstrated the clear potential of the approach. It is now being developed by EPA and the states for use in water programs and is used extensively in other countries. Partnerships with industry and regional state organizations may provide opportunities for EPA to identify emissions impacting a variety of media that may potentially respond to emission trading programs. In any media, however, pollutant-specific emissions trading must start with a limited number of pollutants and grow to include other pollutants as successes are demonstrated.

Finding 3.2: Flexible permitting approaches are sometimes important for the trial and adoption of innovative environmental control technology. There is little incentive for trying a new emissions technology, for example, if penalties for excess emissions during the trial or startup period loom. Pilot-scale studies or other controlled technology testing with engineering uncertainty but minimal public health consequences need to be pursued. The decision of an organization concerning the trial of a new control technology can be influenced by the willingness of a regulatory agency to work with the organization to develop monitoring and performance requirements appropriate for the new technology. Colorado, for example, has piloted a holistic permit that combines all media permits for a given facility under the umbrella of an environmental management system (EMS) permit as a way of encouraging innovation for better environmental results.

Finding 3.3: Creative enforcement approaches can help stimulate technology innovation. The development of Supplemental Environmental Projects (SEPs) in lieu of legal penalties is an important example of such an enforcement approach. A SEP is a tool that the Agency can use in achieving settlements of enforcement actions with the regulated community. EPA has a policy that permits fines and penalties to be mitigated in part by settlements that provide for voluntary performance of SEPs by the accused violator of an environmental statute. There are clear policy limitations on the

scope and use of SEPs in settlements. Some important aspects of the EPA SEP policy are:

- A SEP cannot be inconsistent with any provision of the underlying statute.
- The SEP must advance at least one of the objectives of the environmental statute(s) that is(are) the basis of the enforcement action.
- The SEP must have nexus (i.e., it must be reasonably directed towards improving conditions or adverse effects of the alleged violation).
- The SEP must be a tangible project that otherwise would not be required to be performed. It cannot simply be a monetary contribution to an existing charitable or civic organization.
- EPA cannot directly manage the SEP or the funds used to finance the SEP.

EPA has published ideas for potential SEPs such as: lead-based paint abatement, purchase/installation of fuel cells, diesel retrofits of municipal/transportation fleets, alternative fuel/hybrid vehicles, coolant recycling systems, installing wind turbines for buildings, and so on. Innovative technologies in these and other areas that could be explored for SEP applications are developed in the EPA Small Business Innovation Research Program, and investigated by the EPA ETC Action Teams and the Technology Innovation Program. In general, SEPs cannot be pure research activities; however, projects to overcome funding gaps to produce/encourage demand for innovative technologies and that produce environmental benefits are excellent candidates for SEPs and should be routinely considered by EPA in settling enforcement actions. Another tool that has been utilized by the EPA is an "Environmental Project" (EP). An EP can be part of a settlement process where injunctive relief and assessment of civil penalties is sought by EPA. The Wisconsin Electric Environmental Project (described on page 31) is a notable example.

Finding 3.4: The Pollution Prevention Act of 1990 recognized that "pollution should be prevented or reduced at the source whenever feasible." The legislation directed EPA to provide industry with technical assistance and information on source reduction opportunities and financial assistance to states to establish source reduction programs. EPA's Office of Prevention, Pesticides and Toxic Substances has created several information and technical assistance activities that include the DfE, Green Chemistry, and Environmentally Preferable Products (EPP) programs. EPA also initiated a national design competition entitled, "P3: People, Prosperity, and the Planet Student Design Competition for Sustainability," and has co-sponsored initiatives with the Green Chemistry Institute of the American Chemical Society, the International Center for Sustainable and Appropriate Technology, and other organizations. DfE works collaboratively with industry groups to share information and improve the environmental performance of products, processes, and practices. These programs, coupled with increasingly stringent emission and waste disposal regulations in the United States and elsewhere, have served to increase interest in sustainable ("green") product and process design. Examples include the development

Wisconsin Electric Environmental Project

An example of an Environmental Project is contained in a consent decree dealing with an alleged violation of the Clean Air Act by Wisconsin Electric Power Company. Part of the settlement is a full-scale demonstration project of a new technology designed to remove mercury from the flue gas of coal-fired power plants. This project was of interest to EPA because the readiness of the technology is a key component of the rulemaking process with which the Agency was involved. The U.S. Department of Energy (DOE), through the Clean Coal Power Initiative, was seeking proposals for projects designed to demonstrate this type of technology, and Wisconsin Electric successfully proposed a project in which the \$50 million cost was essentially split between DOE and the company. EPA embedded certain features of the project and project schedule in the consent decree. This example demonstrates how the enforcement process can be used by EPA to further technology development, but it also is an example of EPA and DOE partnering together and with the private sector to leverage resources to advance environmental technology. The technology being demonstrated here is the result of a collaborative process in the electric utility industry where companies pool their research dollars to fund the Electric Power Research Institute (EPRI)—yet another example of partnering. EPA's notice that mercury emissions were going to be regulated initiated the original research within EPRI. DOE is charged with keeping coal as a viable option in the energy infrastructure, and thus funds projects that address emerging environmental issues.

Private-Sector Certification Programs

Some certification programs outside of government have had significant effects on stimulating demand for environmental products and technologies. The certification organization Green Seal, for example, has developed green standards for a variety of consumer products, including paints, cleaning products, paper, lighting, tires, and others. Another example of very successful independent certification is the green building certification program entitled "Leadership in Energy and Environmental Design" (LEED) developed by the U.S. Green Building Council (USGBC). The LEED Green Building Rating System is a voluntary, consensus-based national standard for development of buildings with high energy performance and environmentally sustainable features. The LEED rating system for new construction and renovation projects is based on lists of specific green building features that, if included in a project, accrue points toward a rating. The features listed include use of technologies verified in the Environmental Technology Verification or Technology Acceptance and Reciprocity Partnership programs. Depending on the number of LEED features and points included in a design, buildings can achieve different levels of LEED certification. To obtain a LEED rating, building owners must submit detailed, defined technical documentation to USGBC for review. The LEED rating system has stimulated a tremendous amount of voluntary interest across the United States. Private organizations as well as federal and state agencies have made commitments to LEED certification for new construction and major renovation projects.

of mercury-free alkaline batteries and the design of some computers for disassembly and material recovery. EPA does not have the resources or legislative mandate to develop green products and processes itself, but it can do much through collaborations and advice to help stimulate such development. The DfE program, in particular, although small in budget, is a model for the future. The DfE staff works collaboratively with industry groups to share information and develop technologies that reduce the use of environmentally harmful chemicals through chemical substitution and other methods that support the achievement of design criteria mandated by product-focused regulations.

Finding 3.5: Verification of environmental technology performance by EPA through the ETV program stimulates market demand by demonstrating new technology performance in an independent setting under consensus testing protocols with Agency quality assurance of the data. Purchasers who are reluctant to acquire innovative technologies are thus assured that they work and can meet both operating requirements and regulatory standards. Some 360 environmental technologies and products have been voluntarily submitted for verification by vendors who must pay a substantial part of the cost of testing, but consider whether the marketing value of publicly establishing their performance parameters under EPA protocols is worth the cost. ETV was discussed extensively in the Subcommittee's first report. Like DfE, ETV's chief contribution in creating market demand is providing help in overcoming the lack of reliable performance information for purchasers of new technology.

Finding 3.6: Since the mid 1990s, work on development of voluntary certifications for environmental technologies and products by EPA and a variety of nongovernmental organizations has done much to stimulate market demand. Although EPA does not issue certifications directly, it has published criteria for defined (and named) levels of technology performance through a number of programs. In the most prominent example, EPA developed criteria for energy efficiency of appliances and other energy-saving technologies and techniques in the ENERGY STAR program (see the ENERGY STAR program description on page 33 and its metrics of success on page 45). Manufacturers meeting these criteria self-certify and can claim that their product complies with and qualifies for ENERGY STAR status. This program and the related performance criteria have stimulated consumer interest in appliances that meet ENERGY STAR criteria, which in turn has stimulated manufacturers to develop more energy-efficient appliances. Voluntary private-sector certification programs also are effective in encouraging the use of new technology (see description of Private Sector Certification Programs on page 31) and are increasing in number. At the international level, product environmental performance regulations include product certification programs, such as the green labeling programs in the European countries and the certification requirements within China's Administrative Measures on the Control of Pollution Caused by Electronic Information Products. These labeling programs are intended to be the environmental performance equivalent of existing and successful product certification programs, such as ENERGY STAR (see ENERGY STAR and Other Air Quality Improvement Programs on page 33).

Finding 3.7: Waste reduction and technologies to reduce waste production and increase waste recovery can be stimulated through product take-back programs such as those in place for paper, bottles and cans, lead-

ENERGY STAR and Other Air Quality Improvement Programs

ENERGY STAR is a joint program of EPA and the U.S. Department of Energy (DOE) that is helping Americans save money and protect the environment through energy-efficient products and practices. The program was introduced by EPA in 1992 as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas (GHG) emissions. Today, more than 40 percent of the American public recognizes the ENERGY STAR label, which is on major appliances, office equipment, lighting, home electronics, and more. EPA also has extended the label to cover new homes and commercial and industrial buildings. Through its partnerships with more than 8,000 private- and public-sector organizations, ENERGY STAR delivers the technical information and tools that organizations and consumers need to choose energy-efficient solutions and best management practices.

The continued success of the ENERGY STAR program is a result of its focus on practical strategies to remove market barriers. These barriers can hinder investment in cost-effective, energy-efficient products and practices that help individuals and organizations realize significant savings. It enhances the market for energy efficiency by reducing the transaction costs and lowering the investment risks to the point that many more projects become attractive. ENERGY STAR plays a distinct role in the marketplace by providing credible, objective information and tools on which businesses and homeowners can rely to make well-informed energy decisions. Better energy decisions contribute to a better environment by reducing emissions of GHGs, and through ENERGY STAR, the efforts of thousands of homeowners and businesses are adding up to significant contributions to the President's GHG intensity reduction goal for 2012.

A cornerstone of the ENERGY STAR program is identifying efficient products that will reliably deliver energy savings and environmental benefits. EPA and DOE work closely with about 1,500 manufacturers to determine the energy performance levels that must be met for a product to earn the ENERGY STAR. The label is only awarded to products that offer the features and performance consumers want and provide a reasonable payback if the initial purchase price is higher. Over the past decade, ENERGY STAR has been a driving force behind the more widespread use of such technological innovations as LED traffic lights, efficient fluorescent lighting, power management systems for office equipment, and low standby energy use. ENERGY STAR has dramatically increased the use of energy-efficiency products and practices and is well positioned to promote more widespread efficiency improvements.

EPA has established a number of other programs that aim to achieve cleaner air in a cost-effective and beneficial way without the need for regulation. These programs reduce pollution and improve air quality through partnerships with small and large businesses, citizen groups, industry, manufacturers, trade associations, and state and local governments. Examples of these programs include: the **Green Vehicle Guide**, which helps consumers choose the cleanest and most efficient vehicle that meets their needs; the **SmartWay Transport Partnership**, which creates strong market-based incentives that challenge companies shipping products and the truck and rail companies delivering these products to improve the environmental performance of their freight operations; and the **Green Power Partnership**, which encourages organizations to purchase green power as a way to reduce the environmental impacts associated with conventional electricity use.

acid batteries, and computers. Legislated product take-back requirements are the fastest means of market stimulation, and are a rapidly growing international trend (see the next section, *4. International Issues*, for more detailed information). Information and startup assistance, however, can motivate community/industry initiatives for product recovery, sometimes on a large scale, even in the absence of legislation. Computer recovery for disassembly and material reuse in the United States is at an early stage but growing. A host of nonregulatory product stewardship initiatives have been undertaken by individual companies, trade organizations, and nonprofit groups. The nonprofit Product Stewardship Institute, for example, works with companies and government agencies to develop environmentally progressive goals for various stages of product lifecycle (e.g., material selection and recovery).

Finding 3.8: The ability of government and companies to stimulate market demand for environmental technologies and products through preferential purchasing decisions has been well demonstrated. For example, the Federal Government had a central role in expanding the production and use of paper with recycled content through purchasing requirements for federal agencies and contractors. The federal EPP initiative was developed in response to Executive Order 13101 entitled “Greening the Government through Waste Prevention, Recycling and Federal Acquisition.” The EPP initiative encourages the purchase of environmentally progressive products on a continuing basis. This use of the power of large-scale purchasing to grow the market for environmental technologies and products also has been adopted by state and local government agencies as well as private-sector organizations. There is potential for the government and other organizations to do much more in stimulating demand for environmental technologies through direct purchasing as first users or near-first users, and also through development of guidelines for defining green technologies and products.

Finding 3.9: Government subsidies to cover, or help with covering, increased financial cost or risk associated with innovative technologies can do much to stimulate market demand for innovative technologies. As profit potential is rarely involved in decisions about adoption of technology that will prevent or mitigate environmental impact, purchasers (e.g., communities, companies, and individuals) are naturally risk averse. There is usually a modest financial upside and significant financial downside if an innovative environmental technology does not work as advertised. For example, financial incentives for adoption of innovative technologies were included in the wastewater treatment plant construction grants program of the 1970s and 1980s. Similar incentives, through partial subsidies or more generous repayment requirements, could be included in the current water and wastewater revolving fund programs of the present if funds were available. Subsidies for implementation of innovative soil and groundwater remediation technologies were offered by EPA in the 1990s, but were rarely used. Because there appears to be little likelihood for budget expansions that would support direct financial incentives, the Subcommittee will make no recommendations in this area.

Recommendation 3.1: Emission Credit Trading. Trading of emission credits should be a component of environmental programs wherever possible because of its effective role in stimulating use of innovative technology. Emission credit trading programs can be an effective way to achieve regional or national emissions reduction at relatively low cost through voluntary implementation of emission control technology. The weak market for many new technologies can be stimulated through partnership with market forces found in emission credit programs. Under such “cap and trade” programs, industry is given the incentive to achieve emission reduction and maximize efficiency by the ability to sell to other companies emission credits it has gained through reductions in emissions and discharges that go beyond regulatory requirements. The new technologies employed in early reduction programs and highly efficient emission control systems frequently advance the technological state-of-the-art in areas as diverse as pollution prevention, materials substitution, and advanced monitoring. The Agency should engage with states and industry to help shape the most promising trading program alternatives and stimulate market activities that fulfill and sustain the emission trading market objectives.

Recommendation 3.2: Flexible Permitting. EPA should encourage and assist states in developing specific opportunities for greater flexibility in permitting to promote progressive technology development and demonstration. This is particularly important in areas in which innovative technologies are needed to address serious unsolved problems or existing technology is too expensive for widespread implementation. The new SETO should be involved in convening appropriate state and regional officials, including enforcement staff, in several pilot cases to explore options for addressing flexible permitting prior to the permitting event. Successful approaches then should be standardized and publicized in all regions.

Recommendation 3.3: Flexible Enforcement Actions. EPs and SEPs are important tools that can promote technology development and should be used more often. EPA has unique opportunities to demonstrate environmental technologies and create market demand through creative enforcement approaches that promote adoption of innovative environmental technology. Enforcement actions should authorize the development, piloting, or enhancement of environmental technology where appropriate. EPA should specifically include innovative technologies in project ideas for potential SEPs. Acceptance of new technologies in SEPs should acknowledge and provide for protection regarding the performance risks of new technologies. Because there appears to be substantial variation among regional offices related to knowledge of and interest in SEPs, EPA should exhibit leadership in communicating the potential for SEPs and in disseminating best practices regarding the use of innovative technologies in SEPs. Establishment of a technology advocate in each EPA regional office could assist in this effort.

Recommendation 3.4: SEPs and ETC Action Teams. SEP projects should be actively promoted to include support for ETC Action Teams. Action Team problem areas that have sufficient nexus to the environmental conditions impacted by alleged violations could be directly supported by SEPs. Done

well, these projects would provide highly leveraged investments contributing tangibly to mitigating the high-priority technology gaps already identified by the Agency through its ETC prioritization process (see the May 2006 Subcommittee report). The breadth of the Action Team subject areas is such that the necessary linkage to many alleged violations could be readily demonstrated. Therefore, SEPs represent a relatively untapped resource to address high-priority technology gaps already identified by EPA, and the Subcommittee recommends expedited exploration of the full potential of SEPs to help mitigate these gaps.

Recommendation 3.5: Independent and Quality Assured Data. EPA can and should continue to stimulate demand by providing purchasers and the environmental marketplace in general with independent information and quality assured data on the performance of innovative, at or near commercial-ready private-sector technologies. The Agency should expand the voluntary DfE and ETV programs to continue offering technology vendors the opportunity to display the performance capability of their innovations. EPA should explore opportunities to expand the best available technology concept into sustainable technologies in different industries.

Recommendation 3.6: Expanded “Green” Certification Programs. EPA should continue to expand on the success of its voluntary ENERGY STAR program, creating additional “green” programs in the same mold for a wide variety of industries and activities. In addition, the Agency should welcome the opportunity to work with any not-for-profit or private-sector organization interested in creating a robust certification program aimed at reducing pollution, energy usage, water usage, and waste, and in increasing the overall sustainability of commercial, residential, and industrial activity. A relatively low-cost Agency role in such instances could include providing technical support and technology performance verification with industry and other stakeholders providing financial support. As will be discussed in the next section of this report, green product and waste avoidance programs are proliferating across the world based primarily on European regulatory models, and U.S. states are beginning to legislate in this area as well. EPA’s participation in the international discussion relative to both legislated and voluntary product certification programs would be beneficial in stimulating the development of comprehensive product certification programs in the United States.

Recommendation 3.7: Preferential Purchasing. EPA should identify and act on opportunities to stimulate innovative environmental technology development and adoption through Agency preferential purchasing and through preferential purchasing requirements included in procurement specifications. EPA is in a unique position, for example, to influence the technology used for environmental monitoring both by purchasing such technologies and by ensuring that its regulations and procedures for air, water, soil, and waste monitoring reflect current capabilities of systems that produce highly accurate and real-time data. EPA should be a leader among federal agencies in environmentally preferential purchasing, and should provide guidance and assistance to other agencies on how to plan and implement preferential purchasing programs that favor new environmental technologies.

4. International Issues

The Subcommittee has focused its work in the international area on evaluating the role and function of EPA technology assistance activities in the rapidly evolving international marketplace.

Findings

Finding 4.1: The international technology sector is important to EPA and to the United States for several reasons:

- Many environmental problems are inherently international in nature, most notably cross-boundary air and water pollution, global warming, and the prevention of invasive species. The implementation of improved technology in other countries can have a direct impact on the U.S. environment. For example, anticipated deployment along the U.S. border is a primary goal of the diesel retrofit and ultra-low sulfur fuel technology bus project being tested in Mexico City (see Cleaning Up Diesel Emissions in Mexico City on page 38).
- Areas such as drinking water and alternative energy systems have been internationalized by the rise of non-American technology developers entering the U.S. market in force and offering improved technologies for use in this country.
- Other market interests have arisen because, in the face of flattening U.S. markets, the viability and expanding scope of the overseas market encourages developers to investigate technologies that would not be economically practicable for the U.S. market alone.
- Innovation for the world market, whether developed in this country or abroad, has increasing impact on the ability of the United States to benefit from better technology. Environmental technology development has been globalized in the last decade, and EPA's programs must evolve with these trends in mind if they are to remain current.

Finding 4.2: The Subcommittee believes that the Agency has several areas of strength in the international arena:

- EPA's greatest strength is that, as an agency, it is well respected internationally and thus an effective agent in disseminating environmental technology information abroad. It has taken a strong leadership role in demonstration and verification of commercial-ready technology and developed programs as well as test protocols that now are being copied around the world.
- EPA has demonstrated a commitment to technology information diffusion in selected countries with specific environmental problems, such as air pollution in China and Mexico and waste disposal issues in the Eastern European nations.
- EPA responds to "targets of opportunity" around the world when these targets are in line with EPA's strategic goals and objectives. It also works with international agencies such as the United Nations

International Technology Demonstrations Cleaning Up Diesel Emissions in Mexico City

The Challenge: Mexico City's air pollution, with ground-level ozone and particulate matter exceeding national standards 80 percent of the year, affects the health and quality of life of all its residents. Heavy-duty diesel vehicles—buses, trash trucks, commercial vehicles—contribute up to 38 percent of the nitrogen oxides and more than 50 percent of the fine particulates in the air, despite comprising only 5.5 percent of the entire vehicle fleet. Emissions from diesel trucks and buses pose serious public health concerns, ranging from asthma to cardiovascular disease to cancer.

The Initiative: EPA, working with the U.S. Agency for International Development (USAID) and EMBARQ, the World Resources Institute's Center for Transport and the Environment, initiated the Mexico City Diesel Retrofit Project in June 2004. The project was designed to demonstrate how the combined use of low sulfur fuels and diesel retrofit technologies on urban buses can improve air quality and reduce impacts to human health. The project is similar to diesel retrofit projects now underway in several U.S. cities, which have committed to retrofit more than 150,000 diesel vehicles. The Mexico City Diesel Retrofit Project is the first international retrofit project of the United States, and already it is serving as a model for EPA projects in other areas of the world.

The technologies used for the demonstration project are diesel particulate filters and diesel oxidation catalysts that have been performance verified under EPA's Environmental Technology Verification program. The project developed key information on costs and emissions reductions, and is leading to policy recommendations for reducing emissions from other fleets in Mexico City and other cities in Mexico. It also was a concrete demonstration for the benefits of ultra-low sulfur fuel. Mexico has since passed a regulation requiring ultra-low sulfur fuel for the U.S.-Mexico Border by 2007, and for the nation by 2009.

The Results: Ultra-low sulfur diesel fuel (15 ppm) was provided from a U.S. refinery for 20 buses involved in the demonstration. The buses were retrofitted, labeled, and operated on the streets of Mexico City. The Centro de Transporte Sustentable performed baseline emissions testing, testing 1 month after the retrofits were installed, and at the end of the demonstration project (after approximately 11 months of operation) to determine how much the emissions are reduced by the cleaner fuels and cleaner vehicle technologies.

Results of the testing show reductions of 86 to 92 percent in the particulate emissions from the newer vehicles using diesel particulate filters and ultra-low sulfur fuel, and 10 to 23 percent reduction from the older vehicles using diesel oxidation catalysts, a technology most useful for older buses. Although the project size was limited, the potential is great: there are more than 3,000 buses in Mexico City. More important is the opportunity to use this information in the other pollution-choked cities of the world.

Environment Programme (UNEP) and the World Health Organization (WHO) on specific issues. EPA's activities with the U.S./Asia Environmental Partnership over the years have been particularly fruitful.

- The United States, in general, enjoys a prominent position in negotiating trade agreements that establish international environmental standards.

Finding 4.3: Emerging product, operational, and waste regulations in Europe that target the environmental characteristics of products, such as the European Union Restriction on Hazardous Substances in Electronics (RoHS), the Waste Electrical and Electronic Product (WEEE), and End of Life Vehicles (ELV) directives, are causing entire industries to redesign their products to optimize for environmental performance (see International Product Design, Take-Back, and Recycling Standards on page 40 for a description of this rapidly evolving situation). Individual U.S. states, most notably California, are producing similar regulations that are bringing within U.S. borders what has initially been an international phenomenon. These regulations are resulting in the demand for new environmental technologies in the areas of manufacturing, measurement and verification, risk assessment, software, and other tools needed to achieve and ensure desired product performance. They also are resulting in a patchwork of state regulations that could negatively impact the diffusion of environmental technologies in much the same way that varying state septic system regulations have impeded the adoption of new septic system technologies.

The emergence of these product environmental performance regulations and the subsequent demand for product-related environmental technologies offer the Agency several opportunities. First, although the regulation of environmental characteristics is not within EPA's statutory authority, attaining improvements in product design and product environmental performance would generate improvements in the areas where EPA does have authority (e.g., solid waste management) and has identified priority problems. Second, this is an area receiving a great deal of attention in the states that would benefit from EPA's participation and leadership. Third, regulation of this type is being adopted throughout the world and by many U.S. states as the preferred method of regulating waste products. EPA would benefit from participating now, rather than later, in the development of these future-oriented guidelines. Activity in this arena also would be consistent with the Agency's goals in fostering the long-term sustainability of commercial and industrial activity in the United States.

Recommendations

Recommendation 4.1: New International Manufacturing and Recycling Standards and Studies. EPA should emphasize activities focused on building international demand for improved environmental technologies and, in particular, determine the extent to which new international manufacturing and other standards that incorporate environmental parameters will affect U.S. technology standards. As described above, manufacturers around the world are responding to product environmental performance standards and regulations developed in Europe, and states within the United States are beginning to develop regulations that emulate these developments. There is a real risk that states and regions will independently develop differing and perhaps conflicting standards that will introduce complexity and confusion in the marketplace, impeding the development and acceptance

International Product Design, Take-Back, and Recycling Standards

Product-specific directives and regulations that mandate design criteria and end-of-life take-back responsibilities are being implemented by regulators around the world to address significant environmental problems caused by increasing quantities of electronic and other slowly degrading or toxic wastes generated by society. Product-focused approaches emphasize the removal of toxic or difficult-to-manage hazards from products and/or assign to the products' manufacturers the responsibility to take-back, recycle, or pay for the disposal of the products they place on the market. The adoption of these new standards in Europe, Japan, China, and other countries and the nature of the globalized marketplace has placed American manufacturers at a disadvantage and caused numerous states to begin the process of legislating in this area. There now are more than 400 laws governing electronic product design and disposal around the world, up from less than 100 in 2002.

The European Union's (EU) Restriction on Hazardous Substances in Electronics (RoHS) and Waste Electrical and Electronic Equipment (WEEE) directives are typically the model on which other product-focused regulations around the world are based. Redesigning products has resulted in the development of new materials, manufacturing processes, and support products. For example, the RoHS regulations requiring the elimination of lead solder from components and circuitry has spawned a lead-free soldering industry that is supporting the conversion of lead-based products to lead-free. The need to verify that the supply of components needed to build RoHS-compliant products has resulted in the creation of business-to-business software that facilitates a company's query of its supply base regarding compliance, manages the gathered data, and links those data to the subject products for compliance verification. Portable analysis instruments, such as NITON's Lead Paint Analyzer, described in the first Subcommittee report, have become key tools for ensuring a product's compliance with mandated design criteria.

In countries like the United States where the consumer typically bears the financial responsibility, either directly or through taxes, for disposal of obsolete electronic devices, the EU WEEE directive is being considered as a method to address increasing quantities of waste electronics without a corresponding burden on public infrastructure. Although the EU WEEE directive specifically places disposal responsibility on manufacturers of electronic devices, other waste disposal regulations seek to manage end-of-life disposal by requiring special labeling or seller notification of products, charging buyers an "E-Waste" recycling tax or fee, requiring manufacturers to take back their product at the end of functional life, and simple landfill disposal bans. Other product-focused directives and regulations are moving beyond electronics and affecting product types such as "white goods" appliances, automobiles, and truck tires.

All of these options are under discussion and study in U.S. states and many countries outside the EU. State regulators are evaluating product take-back directives and regulations to solve their growing electronic solid waste problems. Fifteen states have either authorized or are considering studies to determine if product-focused approaches would work for them. More than one-half of these states have implemented or proposed implementing all or part of the EU substance restrictions, and one-quarter are proposing the collection of fees at the point of sale to defer future disposal costs. State regulations are being developed with widely varying requirements. Some sort of national harmonization may be necessary to prevent these international environmental standards from becoming a significant barrier to doing business in the United States, as well as preventing the American consumer from purchasing environmentally inferior products.

of new technologies and products. Therefore, in partnership with appropriate state and business organizations, EPA should conduct a major study or series of studies to determine the extent to which these new standards will affect U.S. environmental and technology standards and determine what its role should be in harmonizing regulatory approaches and guiding states, manufacturers, and citizens in this rapidly evolving situation. The Subcommittee believes that EPA has a critical role to play that is as yet undefined—one that may impact many of its present programs and responsibilities.

Recommendations 4.2: Promote International Technology Verification

Programs. EPA’s technology verification programs should be strengthened and promoted internationally as a process that offers technically reliable assessment of new domestic and international environmental technologies. Internationally accepted verification tests and monitoring standards are particularly important in addressing the product content and design standards discussed above. EPA should participate in the ongoing development of similar programs in Europe, Japan, and other Asian nations. In particular, the Agency should promote the use of ETV testing protocols by other nations to allow for the more rapid diffusion of commonly based performance information. Such information strengthens world technology markets and thus speeds commercial development of technologies by assuring purchasers that innovative technology is both environmentally beneficial and cost effective.

Recommendation 4.3: Seek International “Targets of Opportunity.” EPA should continue to pursue, and if possible, expand its policy of addressing international “targets of opportunity,” particularly in areas of cross-boundary pollution prevention/control and on other topics of high priority to the Agency such as mercury control. Such targets may arise from priorities developed by other lead departments and agencies charged with U.S. foreign policy missions. Consistent with the Subcommittee’s recommendations on global climate change (see the next section, 5. *Environmental Technology and Climate Change*), EPA should devote considerable resources to working with other governments on this critical worldwide issue.

Recommendation 4.4: Revive U.S. Department of Commerce (DOC) and U.S. Agency for International Development (USAID) Partnerships. EPA should strengthen its interaction and cooperation with other domestic agencies that are the primary players in the international realm. DOC and USAID, in particular, have the lead in areas such as foreign aid and capacity building and support international opportunities for U.S. environmental technology industries. EPA has had significant innovative technology assistance projects with these agencies in the past and should seek to revive these activities in the future.

5. Environmental Technology and Climate Change

Climate change, a large-scale environmental issue with the potential to impact the entire globe, is one of the most important challenges that EPA will face in the 21st Century. Although the overall federal climate change strategy assigns primary responsibility for the issue to the Department of Energy—in particular, the development of innovative greenhouse gas emission control technology—there are technology areas in which EPA will be required to participate in the future and should be preparing for now.

The *EPA Global Change Research Program Multi-Year Plan* of April 2003, EPA's basic strategy document in this area, states, "It is the mission of EPA to protect human health and to safeguard the natural environment—air, water, and land—upon which life depends." The Plan focuses EPA's research in this area on assessing the potential impacts of climate change on four focus areas: human health, ecosystems, air quality, and water quality. Numerous studies of both macro and regional impacts on all of these four areas have been completed by the Agency and many more are ongoing (see page 43 for the results of several regional impact summaries conducted to date). Funding for greenhouse gas technology-related research and private-sector technology verification, however, ended in 2000.

Building on the 2003 strategic plan, the EPA Administrator further stated in his memorandum of July 6, 2006, that "Our planning must truly be strategic and include consideration of emerging challenges and opportunities. Rather than react or confront problems out of necessity, we should try to anticipate them and adapt our programs accordingly." The Subcommittee agrees with this forward-looking strategy and believes that problem anticipation must be accompanied by a corollary activity in technological solution evaluation. The Subcommittee has considered several areas in which EPA's strategic contribution to development, evaluation, verification, and acceptance of technologies related to climate change mitigation and adaptation can significantly contribute to environmental safety and public health, as well as air and water quality.

Just as technology has proved to be essential to the achievement of healthy air and water standards over the last 35 years, technology research, development, verification, and commercialization will be essential to combating the threats of climate change, both preventing contributions to and mitigating those climate change consequences that affect the environment and human health. EPA should, as a result of its core environmental protection function, continue on its present course of assessing the potential degradation of air and water quality that will be caused by global warming. The Subcommittee also thinks, however, that EPA should expand its role in facilitating the development and deployment of the new technologies that will be needed to address climate change.

Findings

Finding 5.1: Climate change is a large-scale environmental issue requiring significant technological innovation to address a broad range of challenges. The possible negative impact on the environment in the United States over the next 50 years, based on multiple scientific studies, is projected to include, among other things: loss of snow pack and other drinking and industrial water supplies leading to a degradation of water quality, sea level rise, increased flooding, heat-related deaths, decreased crop yield, changes in insect populations, food quality losses, increases in forest fire frequency, increased ozone formation leading to degradation of air quality, and more respiratory ailments. As these impacts and challenges become better defined through EPA's ongoing research (see examples on page 43) and that of others, the Agency will have an expanding role to play in addressing emerging issues. EPA's massive commitment to and success in improving air and water quality over the last three decades are at risk, and many problems, which the nation has viewed as "solved," will require new technology development to address newly defined problems.

EPA Analysis of Expected Climate Change Effects on Specific Regions

The following list, while not comprehensive, provides illustrative examples of some of the higher likelihood effects of climate change that EPA expects in different parts of the United States:

In the Northeast:

- Northward shifts in the ranges of plant and animal species resulting from warmer temperatures
- Coastal erosion, loss of wetland habitat, increased risk from storm surges from sea level rise
- Reduced winter recreation (skiing); increased warm season activities
- Higher summer heat and increase in heat-related morbidity and mortality, especially in urban areas; reduced winter cold stress with associated decrease in cold-related mortality.

In the Southeast and Gulf Coast:

- Increased loss of barrier islands and wetlands
- Intense coastal zone development places coastal floodplains at risk to flooding from sea level rise, storm surge, and extreme precipitation events
- Changing forest character as disturbances (e.g., fire and insect outbreaks) increase
- Higher summer heat; reduced winter cold stress.

In the Midwest and Great Lakes:

- Lowered lake and river levels, resulting from warmer temperatures and increased evaporation, impact recreation, and shipping
- Increased agricultural productivity in many regions resulting from increased carbon dioxide and warmer temperatures
- Higher summer heat and increase in heat-related morbidity and mortality, especially in urban areas; reduced winter cold stress with associated decrease in cold-related mortality.

In the Great Plains:

- Agricultural productivity shifts northward as the potential for drought increases
- Intensified springtime flood and summertime drought cycles
- Higher summer heat; reduced winter cold stress.

In the West:

- Changes in natural ecosystems resulting from higher temperatures and possibly intensified winter precipitation
- Earlier runoff of snowmelt, stressing some reservoir systems
- Rapid population growth coupled with limited, heavily utilized water supplies present significant challenges for securing reliable sources for consumption, power generation, and agricultural needs
- Higher summer heat; reduced winter cold stress
- Increased wildfire potential.

Alaska:

- Forest disruption resulting from warming and increased pest outbreaks
- General increase in biological production from warming; but reduced sea ice and warming disrupts polar bears, marine mammals, and other wildlife
- Damage to infrastructure resulting from permafrost melting
- Retreating sea ice and earlier snowmelt alter native people's traditional life styles
- Opportunities for warm season activities increase.

Finding 5.2: EPA should play a leadership role in solving those specific technical challenges within its sphere of influence and expertise. EPA Administrator Stephen Johnson has stated that “voluntary programs and technological innovation are the best ways to address climate change” (January 19, 2006). As discussed in section 3, *Encouraging Market Demand for Innovative Environmental Technologies*, EPA has made a substantial commitment to voluntary energy conservation programs, which combined with its pollution prevention and waste disposal regulatory programs and the ever increasing cost of energy have been quite effective in ameliorating the growth of energy use on the part of industry, commercial, and community sources (see ENERGY STAR Metrics of Success on page 45 for information on outcome measurements for the ENERGY STAR program). Although other federal organizations—particularly DOE, which has been assigned primacy in the technology area—also are addressing this problem, EPA needs to identify the key environmental issues to which it can contribute solutions to the emerging technical challenges in appropriate programs along the entire technology Continuum. Strategic planning in this area will be multimedia of necessity, and therefore, will require the active participation of the SETO to ensure that cross-media impacts are addressed and that the climate change aspects of technologies developed for other needs are evaluated.

Finding 5.3: Regulatory action drives technology adoption; therefore, EPA needs to utilize its existing regulatory authority and be ready to utilize new authority if and when it emerges from Congress, the courts, or the states. EPA’s authority to regulate emissions of carbon currently is being challenged before the U.S. Supreme Court. The results of that case will have substantial ramifications for the Agency and the country. Concurrently, a number of states, counties, and cities have taken action to regulate CO₂ emissions in various ways. California, for example, seeks to return emissions to a 1990 baseline by 2020. In addition, DOE is sponsoring development of many CO₂ control technologies, some of which will require environmental permitting by EPA, including the enormous zero-emission coal technology, Future Gen. Other regulatory challenges, such as deep well sequestration for CO₂ control, also await EPA decision making. As stated in the 1997 National Academy of Sciences’ report *Preparing for the 21st Century: Technology and the Nation’s Future*, while “...private firms have the primary responsibility for the development and adoption of technology in this country, federal and state governments play an important role in enhancing civilian technology development and adoption through their economic, regulatory, and trade policies, their support for research and development, and their own procurement of technology.”

Finding 5.4 The Subcommittee believes that it is in the interest of major CO₂ generators, particularly in the electric utility industry, for a CO₂ emissions trading market to begin operation at the earliest possible date. Power plants across the country are delaying decisions on new, more efficient technology purchase and installation because of the uncertainties inherent in not knowing key parameters on how such a cap and trade program will operate for CO₂. A key component of this uncertainty is the so-called CO₂ baseline factor against which emission trading is measured and where it will be drawn for each facility. Companies that take early action on technology installation and emissions reduction may well be penalized for such actions, and most have decided to delay improvements until the trading

ENERGY STAR Metrics of Success

- ENERGY STAR products prevented 35 million metric tons of greenhouse gas emissions in 2005 alone—equivalent to the annual emissions of 23 million vehicles—and saved about \$12 billion on utility bills. They also saved 150 billion kilowatt hours (kWh) or 4 percent of the total 2005 electricity demand.
- About 1,500 manufacturers are using the ENERGY STAR to label and differentiate more than 35,000 individual product models.
- More than 800 retail partners are bringing ENERGY STAR qualifying products and educational information to their customers.
- More than 2,500 builder partners are constructing new homes in every state that qualify for the ENERGY STAR, and 70 architecture and engineering firms are using the “Designed to Earn the ENERGY STAR” graphic on drawings.
- About 2,500 private businesses, public-sector organizations, and industrial facilities are investing in energy efficiency and reducing energy use in their buildings.
- More than 30 states and more than 450 utilities and other energy efficiency program sponsors are leveraging ENERGY STAR to improve the efficiency of government buildings and of their customers.
- Americans purchased about 175 million ENERGY STAR qualified products spanning more than 40 product categories in 2005, bringing the total number of ENERGY STAR products purchased since 1992 to more than 2 billion.
- More than 17,000 homes have been improved through state and locally sponsored Home Performance with ENERGY STAR programs.
- EPA added new products to the ENERGY STAR suite by developing energy efficiency specifications for power supplies and a specification for battery charging systems.
- More than 500,000 families, 40 percent more than in 2004, now live in ENERGY STAR qualified new homes and are saving about \$110 million annually.
- EPA launched the ENERGY STAR challenge in 2005, calling on U.S. businesses and institutions to reduce energy use by 10 percent or more in coordination with key associations and states.
- More than 2,500 buildings (480 million square feet) have earned the ENERGY STAR label for superior energy and environmental performance.
- EPA’s energy performance rating system has been used to evaluate about 26,000 buildings, including 38 percent of hospitals, 25 percent of office buildings, 24 percent of supermarkets, 15 percent of schools, and 14 percent of hotel spaces.
- ENERGY STAR partnered with three new focus industries—food processing, glass manufacturing, and water/wastewater treatment—to develop standardized measurement tools and industry-specific best practices.

program becomes defined. Technological approaches that could be saving money for utilities and reducing greenhouse gases at the same time are not being implemented because of this uncertainty. Some states have recently implemented emission registries to begin the process of facilitating CO₂ emission trading, which is expected to begin operation sometime within this decade. Under the requirements of the Clean Air Act Amendments of 1990, however, EPA already has collected 10 years of continuous, detailed, quality assured, and highly accurate CO₂ emissions data from all of the nation's major power plants that could be, but are not being, used for this important purpose.

Finding 5.5: According to a recent issue of *The Economist*, almost one-tenth of America's venture capital is being spent on a broad array of alternative energy projects (approximately \$64 billion in 2006), doubling the amount invested just 2 years ago. John Doerr of Kleiner Perkins states that: "Innovation in clean tech could be the biggest economic opportunity in the 21st Century." The Electric Power Research Institute's *2007 Global Energy Technology Strategy for Addressing Climate Change* states that, "Technology plays a critical role in containing the societal cost of policies to reduce net greenhouse gas emissions... and creating the technological change needed to stabilize concentrations of CO₂ in the atmosphere is a challenge to energy R&D of unprecedented scope." Very little private investment takes place by venture capitalists or customers until the technology is ready for the commercial market. Cost remains a major barrier to technology research and development, and the challenges posed by global warming are enormous. The State of California has proposed committing \$4 billion to the development of clean energy technology. Stanford University's Global Climate and Energy Project sponsors will invest a total of \$225 million over a decade or more as it explores energy technologies that are efficient, environmentally benign, and cost-effective when deployed on a large scale. Other states are considering sponsorship of or are participating in new technology investment programs. Action is needed at all levels of government and by all pertinent agencies, however, to help reduce cost barriers at the research, development, and verification stages. EPA has the expertise to assist in evaluating new technologies to help stimulate private and public investment, particularly through its verification programs.

Recommendations

Recommendation 5.1: Climate Change Technology Planning and R&D. EPA should identify and fund climate change technology development in areas of importance within its purview that need special development assistance. Just as EPA has identified Action Teams to address certain environmental problems, it needs to anticipate and identify specific areas where new technology could help prevent, monitor, or aid adaptation to environmental impacts caused by climate change. Assistance along the entire Continuum for these required technologies needs attention and active, cross-Agency strategic planning for technology development. This planning process should be addressed by the SETO as a priority matter. As stated above, targeted research and development on technologies needed to address the new aspects of environmental degradation expected to occur as a result of climate change is particularly important. Targeted

funding needs to be identified and/or leveraged through partnerships that can help reduce barriers to technology development and adoption. This may require reallocation of funds within existing and future budgets.

Recommendation 5.2: Public/Private and State Partnerships. EPA should establish and cultivate meaningful public/private partnerships for technology development on climate change challenges. The importance of private-sector partnerships becomes markedly more significant when dealing with large-scale environmental issues because of cost and scale, as well as practical implementation issues. In addition, EPA should increase its participation in partnerships with state and regional groups that already are actively addressing the environmental effects of climate change—California and New England being prime examples (see Recommendation 5.4 below). EPA should, for instance, encourage partnerships with respect to CO₂ mitigation, including the creation of an information clearinghouse and publication of technology information. This would help provide and coordinate data for policy makers, businesses, consumers, and legislators to be able to make more informed decisions about technology. Public recognition of results and visible advocacy for successful new technology initiatives are low cost but powerful methods for the Agency to encourage and support development of new environmental technologies.

Recommendation 5.3: Technology Verification and Demonstration Support. EPA should establish and actively promote its leadership role in evaluating climate change technology as new technologies approach the commercialization stage so that purchasers can be assured that they are selecting the best technology for their particular situation. Governments, businesses, and individual consumers are beginning to seek climate-friendly technologies voluntarily in large numbers. Performance claims by vendors in a rapidly expanding marketplace need to be verified to ensure that technologies produce the types of results desired and that purchasers are not dissuaded from further voluntary actions by poor performance of new technology. EPA's verification of private-sector developed climate change technology and publication of its effectiveness is an important source of data for businesses, consumers, and policy makers in this area and should be reactivated. Opportunities for pilot testing should be promoted for technologies where early installment and technology utilization appear key to EPA climate change priorities. EPA also should demonstrate advanced vehicle and engine technologies, consistent with EPA's FY2007-2009 milestones and create pilot programs to use commercially available advanced technology in fleets to produce cost-effective models for emission and fuel consumption reduction.

Recommendation 5.4: EPA's Potential Role in CO₂ Emissions Trading. EPA should utilize its existing database of CO₂ power plant emissions to establish a baseline for electric utilities to use in instituting an emissions trading program in the United States as soon as possible. As a result of the emission monitoring and reporting provisions of the Clean Air Act Amendments of 1990, EPA's Office of Atmospheric Programs is a world leader in operating both emission inventory activities and emission trading programs. The CO₂ database that it has maintained for 10 years is the most available and logical source of plant-by-plant emission data in the country and should be utilized to rapidly establish year-specific baselines for all medium- to large-

sized power plants. Through this mechanism, trading can begin and technology decisions on the part of the electric utility industry that will better protect the environment and lower costs to customers can be implemented.

Recommendation 5.5 EPA's Regulatory Role in Innovative Technology Development. Consistent with its charge to explore “encouraging demand for innovative technologies,” the Subcommittee recommends that EPA drive and enable innovative technology in all media by using not only existing but also new and innovative regulatory and policy approaches to help solve the difficult issues facing the nation with respect to both prevention of and adaptation to climate change. Although new legislation may be necessary for some beneficial actions and court actions for others, EPA’s broad authority to protect the environment through existing laws is already extensive. In particular, the Agency should ensure that all new regulations, no matter which media office they emerge from or which environmental law they implement, include standard evaluations of climate change impacts if appropriate.

Northeastern states and most recently, five western states (California, Washington, Oregon, Arizona, and New Mexico), and others have developed formal state greenhouse gas reduction plans that include quantitative emission assessments, innovative regulatory approaches, and the beginnings of regional emission trading programs. EPA has the opportunity to follow the states’ programs and also to assess co-benefits of use of technology on EPA-regulated air pollutants at significantly reduced cost. EPA also should actively seek and consider suggestions for innovative regulatory approaches that would encourage technology development by the regulated community as well as state, regional, tribal, and local organizations.

III. Appendices

- Appendix A: Charge to the Subcommittee on Environmental Technology**
- Appendix B: List of Subcommittee Members**
- Appendix C: List of Recommendations in the First Report of the NACEPT Subcommittee**
- Appendix D: EPA Administrator's December 19, 2006 Letter to NACEPT Chair**
- Appendix E: Suggested Functions and Duties of the SETO, Regional Technology Coordinators, and Technology Communication Coordinator**

APPENDIX A: Charge to the Subcommittee on Environmental Technology

National Advisory Council For Environmental Policy and Technology

Draft Framework for Developing Recommendations on U.S. EPA's Environmental Technology Programs

Background

EPA Administrator Leavitt has established a vision that will enable EPA to move to a new level of more efficient, effective and collaborative environmental management. He has identified four cornerstones of this effort: better use of science and technology, using market mechanisms, collaboration and networking, and managing for results. These elements must work together to bring about environmental progress. In particular, EPA needs to focus its efforts on the role that innovative technology can play in moving to a model of environmental protection built on the principles of stewardship and sustainable development, which will allow environmental, economic, and social goals to be achieved simultaneously.

The following statement by Paul Gilman, EPA Science Advisor and Assistant Administrator, Office of Research and Development, from a recent editorial in *Science*, provides an overarching context for thinking about environmental technology.

EPA is at its best when it views its role as not just custodial but as cutting edge, providing leadership and prescribing answers to key environmental problems. Today in the same vane, EPA Administrator Michael Leavitt is challenging the Agency to find creative ways to accelerate efforts to protect human health and the environment, and prepare for the future. This challenge can only get more daunting if the suggested increases in world's population (50 %), global economic activity (500 %), and global energy consumption and manufacturing activity (300 %) are achieved in the next 50 years. Here the goal of sustainability can be an important unifying principle. EPA's research and technology programs can be an effective force in the design and measurement of our progress toward sustainable systems.

Technology is undoubtedly a central element in being able to achieve a synergy between environmental protection and economic growth while improving the lives of people around the world. The following quote from a report to the European Parliament, titled [Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union](#), establishes a useful perspective:

The potential of technology to create synergies between environmental protection and economic growth was recognized by the October 2003 European Council. Environmental technologies—taken in the Action Plan to include all technologies whose use is less environmentally harmful than relevant alternatives—are key to this. They encompass technologies and processes to manage pollution (e.g. air pollution control, waste management), less polluting and less resource-intensive products and services, and ways to manage resources more efficiently (e.g. water supply, energy-saving technologies). Thus defined, they pervade all economic activities and sectors, where they often cut costs and improve competitiveness by reducing energy and resource consumption, and so create fewer emissions and less waste.

Without innovative technology, most of the environmental gains that we have achieved over the last thirty years would not have been possible. EPA continues to think strategically about how development and rapid introduction of innovative technology can lead to better and more cost effective environmental management. To do this the Agency must support the role of the private sector in technology development, leveraging its programs and activities to facilitate the deployment of such technologies, and eliminating barriers that discourage or hold back their adoption. While development and sale of commercial-ready environmental technology is the task and proper role of the private sector, the EPA plays an important role in facilitating the creation of sustainable technology in at least the following ways. The Agency:

1. **Helps to identify technology gaps in environmental protection** through an ongoing process of problem identification and setting of environmental goals;
2. **Provides limited and targeted financial support** for needed new technologies through research grants to universities, funding for small business R&D, and research in EPA's laboratory research facilities;
3. **Provides performance verification of new private sector technologies** to reduce uncertainty for technology purchasers and protect the public;
4. **Provides information to the public (states, communities, industrial and commercial purchasers)** on the availability, benefits and effectiveness of innovative and sustainable technologies;
5. **Encourages design and use of sustainable technologies in various public and private sectors through voluntary partnerships;**
6. **Impacts the use of innovative technologies through its policies, regulations, and compliance activities.**

Charge to the Subcommittee

The Subcommittee is asked to assist the Agency in evaluating its current and potential role in technology facilitation, bearing in mind two overarching questions as it formulates its recommendations:

- How can EPA better optimize its existing environmental technology programs to make them as effective as possible in promoting the research, development, commercialization, and implementation of sustainable private sector technologies; and
- What other environmental technology programs and activities should EPA initiate to take advantage of opportunities it may be missing to further the effectiveness of its technology facilitation objectives? (Although EPA is not likely to receive significant additional funding for any new technology activities, the Subcommittee should not feel constrained in its thinking.)

There are several specific areas where NACEPT can advise the Agency on its environmental technology programs. The Subcommittee is asked to consider at least the following types of actions and programs.

1. **Evaluating EPA's Existing Suite of Technology Support Programs.** In a Report to Congress in October of 2003, EPA described the current suite of technology support programs carried out by the Agency's Program Offices, Regional Offices, and the Office of Research and Development. Using information on the entire range of technology programs conducted by the Agency, all of which can be accessed through the Environmental Technology Opportunities Portal (www.epa.gov/etop), the Subcommittee is asked to evaluate the mission and overall approach of the programs individually and collectively, determine whether there are any redundancies or gaps, and consider whether they are appropriately designed to address technology development barriers. The Subcommittee's views on the coverage and focus placed on various environmental problems areas and the effectiveness of these efforts in supporting private sector development and commercialization of the most critically needed new and sustainable technologies are also sought.

2. **Encouraging Demand for Innovative Technology.** EPA's regulatory requirements for the attainment of certain levels of pollutant reduction, as well as ongoing or periodic monitoring of pollutant releases and levels, inherently create a demand for environmental technologies. Other more direct approaches to demand-pull may be needed, however. Specific categories of innovative technologies may warrant assistance from the EPA or other government programs because of their efficiency or sustainability factors or their inherent benefit in addressing certain difficult or intractable environmental problems. Some of the approaches listed below have been used to further such goals by providing incentives to appropriate places in the technology development system. Which of these appear to be particularly worthy of expansion?

- *Direct financial incentives.* Up front capital costs often deter businesses from installing greener technologies that may be more environmentally beneficial and in some cases more cost effective, and thus more sustainable, in the long term. In the past, government funding for the construction of wastewater treatment projects included incentives for purchasing innovative technologies over standard technology. Are new investment incentives needed for either developers or user of new technologies?

- *Creative regulatory and policy approaches.* The way regulations and policies are designed, can provide either incentives or disincentives for technology innovation. For example, emission trading approaches such as those employed through the Acid Rain Program and those proposed in the Clear Skies Initiative are generally considered to provide incentives for innovation. Use of voluntary approaches in lieu of regulations also may encourage technology innovation. For example, the Toxic Releases Inventory encourages firms to find innovative ways to reduce their emissions. Voluntary use of Environmental Management Systems might also encourage firms to find innovative ways of improving their environmental performance. What types of approaches should the Agency consider to encourage technology innovation?
- *Preferential governmental purchasing* that makes the government a first user of innovative technologies is another demand-pull approach that can help move promising technologies into full commercial use. The Federal program for the “Greening of Government” encourages the purchase of environmentally preferable products often produced by innovative technologies. Innovative field monitoring technologies and continuous monitoring devices have been purchased by Federal and State environmental agencies to improve the efficiency and effectiveness of their environmental measurement functions. As “first users” of innovative technologies, government agencies are in an excellent position to demonstrate their benefits. How can government purchasing best be used for innovative technologies? Should EPA encourage states to use grant funds for preferential funding of innovative new technologies such as air monitoring networks and other beneficial uses?
- *Permitting Barriers.* Past EPA and White House reports have highlighted permitting as a barrier to new technology introduction. Beyond these generic recommendations, what specifically about the permitting process is the issue that EPA and its partners can deal with? For example, is technology introduction inhibited by problem owner reluctance due to the cost of failed technologies, lack of confidence in approaching the state regulator, lack of authentic, verified information for the user and the regulator on technology performance in the specific new application, lack of resources by the regulator to divert to evaluating new technology applications, problem owner concern over public acceptance, or other issues?

3. **Reaching Critical Audiences with Innovative Technology Information.** The commercialization of innovative technologies is frequently stymied because of the lack of current and accurate information on their availability, applicability, performance, location, and cost. EPA, through its long years of supporting technology development and evaluation programs, has one of the largest repositories of environmental technology information in the world. Making this store of information available to the numerous public and private entities that need it is a daunting task. In its “Report to Congress on a One-Stop-Shop for Coordination of Programs Which Foster Development of Environmental Technologies,” EPA committed to creating an Environmental Technology Opportunities Portal (ETOP) that would lead users to information on all of EPA’s technology programs through an integrated “one-stop-shop.” This portal became operational on December 31, 2003.

- *Information coverage.* ETOP consists of 16 independent websites created and maintained across the Agency. Some of these are particularly suited to the scientific and engineering community, some to the technology purchasing community and consuming public, some to government entities, some to narrow segments of environmental interest, and some to broad interests. Is the organization of both the ETOP and its component parts adequate in its clarity of purpose, its coverage, and its depth for the various audiences that need access to its information? If not, what other information should be available through this web portal and how should it be organized? Do these gaps require the creation of new programs or simply restructuring the site to make it more user-friendly?
- *Accessibility.* Websites created by the Agency have frequently taken years to gain readership by targeted audiences. How can EPA rapidly inform the numerous and diverse public and private constituency groups mentioned above that the information they require is available through ETOP and easily guide these users to the information they need? What other tools (workshops, conferences, association partnerships, regional and state technology contacts) should the Agency employ to assure that full, but targeted, information reaches appropriate audiences in a timely manner? Is EPA's public recognition of successful new technologies appropriate and effective?

4. **Collaborative Approaches with States, Tribes and Local Governments.** As the governmental entities most directly proximate to the purchasers of environmental technology, the states, tribes and local governments frequently play a pivotal role in encouraging the development and implementation of innovative technologies. States can also place barriers to innovation if they do not have the information required to evaluate the applicability and performance of new technology. Several programs have proved helpful in the past and could be expanded.

- *Public assistance programs.* US EPA Region I has developed an effective program called the Center for Environmental Industry and Technology that provides assistance to both technology developers and technology users seeking solutions to problems. If this program were to be replicated in other Regions, what kinds of assistance should be available through these Centers? Would a Technology Assistance Center at Headquarters be valuable as a central EPA point of contact and a formal link to other Federal, State and local organizations with environmental technology programs? What should its functions be?
- *Cross-State cooperation.* At the State level, differing regulatory requirements and permitting practices may impede the adoption of innovative technologies. The Interstate Technology Research Council (ITRC) is working with the States to establish common data requirements for the permitting of remediation technologies. How should this, and similar programs, such as the Technology Acceptance and Reciprocity Partnership, be expanded to help remove regulatory impediments to the adoption of sustainable environmental technologies?
- *Enforcement interface.* EPA and some State Agencies have had programs offering incentives to companies not in compliance that encourage them to implement pollution prevention solutions, which often involves the adoption of innovative technologies. How can EPA work

more effectively with State Agencies to make information on cost effective innovative technologies available to firms that aren't in compliance, particularly small and medium sized firms? In addition to the enforcement offices in EPA and State Agencies, what other offices should be involved? How can information on enforcement actions and potential customers be effectively conveyed to technology developers and suppliers?

5. **Collaborative Approaches With Others.** EPA can be most effective in encouraging technology innovation if it works collaboratively with numerous and diverse stakeholders. This includes states (see above), other federal agencies, private sector developers and purchasers, and various interest groups. Many of the programs already discussed require engagement with these organizations. Examples of targeted collaborations might include:

- *Working with other federal agencies.* Opportunities for collaborative undertakings with other federal agencies working in the environmental field include preferred purchasing (discussed above), dual use technologies, joint R&D, providing incentives and information sharing. An example of a successful partnership for sharing information is the 10-year-old Federal Remediation Roundtable. Another example of cooperation are the five federal agencies that have provided test beds for private sector technologies being verified by the Environmental Technology Verification (ETV) program, significantly reducing the testing costs to vendors. How can EPA be more effective in getting other federal agencies to serve as demonstrators and first time purchasers of innovative technologies?
- *Dual use technologies.* Since the market for environmental technologies is generally low growth, the greatest opportunities for the commercialization and adoption of innovative technologies may come through taking advantage of dual use technologies that are being developed for other markets. How can EPA engage companies and agencies in defense, energy, health science, food science and other sectors industries that are developing technologies that might also have environmental applications?
- *Working with the private sector.* Many of EPA's programs involve collaboration with the private sector in the development of technologies, such as the CRADA program. The ETV program operates within a broad stakeholder structure that includes state and local permittees, technology testing organizations, and technology vendors and purchasers. Through these programs, EPA provides factual information to states, industry and the public, but does not advocate for a particular company's product or technology. How can EPA best recognize and publicize outstanding new commercially available technologies without negating its non-advocacy policy?

APPENDIX B: List of Subcommittee Members

Chair:

Philip Helgerson
CSC Advanced Marine Center

Liaison to the NACEPT Council:

Dan Watts
New Jersey Institute of Technology

Members:

Linda Benevides
Massachusetts Department of
Environmental Protection

David Dzombak
Carnegie Mellon University

Kenneth Geiser
University of Massachusetts at Lowell

John Hornback
Metro 4/Southeastern States Air
Resource Managers, Inc. (SESARM)

Kristine Krause
Wisconsin Energy Corporation

JoAnn Slama Lighty
University of Utah

Raymond Lizotte
American Power Conversion
Corporation

Oliver Murphy
Lynntech, Inc.

Robin Newmark
Lawrence Livermore National
Laboratory

Patrick O'Hara
Cummings/Riter Consultants

Christine Owen
Tampa Bay Water

Katherine Reed
3M Environmental, Health and Safety
Operations

Norman Richards
Mohegan Environmental Protection
Department, The Mohegan Tribe

Karen Riggs
Battelle Memorial Institute

James Robbins
Environmental Business Cluster

Howard Roitman
Association of State and Territorial Solid
Waste Management Officials

Kent Udell
University of Utah
(Professor and Chair);
University of California, Berkeley
(Professor Emeritus)

EPA Liaisons:

Stephen Lingle
Office of Research and Development
U.S. Environmental Protection Agency

Maggie Theroux
New England, Region 1
U.S. Environmental Protection Agency

Walter Kovalick
Region 5
U.S. Environmental Protection Agency

Designated Federal Officer:

Mark Joyce
Office of Cooperative Environmental
Management
U.S. Environmental Protection Agency

Contractor Support:

Beverly Campbell
Penelope Hansen
Susie Warner
The Scientific Consulting Group, Inc.

APPENDIX C: List of Recommendations in the First Report of the NACEPT Subcommittee

The following is a summary of the recommendations of the NACEPT Environmental Technology Subcommittee's May 2006 report, *EPA Technology Programs and Intra-Agency Coordination* (the full report is available on the Web at <http://www.epa.gov/etop/nacept>).

Finding 1: The EPA Technology Development Continuum

Recommendation 1.1: Broadly publish the Continuum, in both Web and document form, to assist information seekers both within the Agency and outside to find the technology support and data they need to move technology forward. EPA must ensure that the information in the Continuum remains current and up to date.

Recommendation 1.2: Use the Continuum as:

- 1.2.1 **An effectiveness and evaluation tool** to determine the metrics and outcomes of EPA programs;
- 1.2.2 **A prioritization and resource evaluation tool** to make cross-Agency resource decisions; and
- 1.2.3 **An evaluation tool to determine the Agency's effectiveness in working with the other critical stakeholders** in technology development and diffusion, most particularly state and local government and the private sector.

Finding 2: Subcommittee Observations on EPA Technology Programs

Recommendation 2.1: EPA should target its technology support efforts to areas clearly linked to environmental regulations and other publicly stated environmental goals. In particular, the Agency should build its strategic plans around the availability of emerging technology with a clear plan of technology support for those areas it considers to be critical to its success.

Recommendation 2.2: Improved and coordinated metrics need to be developed, used across the entire spectrum of EPA technology programs, and publicized. The Agency has an impressive array of programs but in the absence of consistent and available metrics, it is difficult to see how effective they are in actually bringing needed technologies to implementation or to make valid effectiveness comparisons among individual programs. The Subcommittee understands that the Agency is working on the issue of metrics within all of its programs and that this kind of outcome measurement, particularly applied to the broad area of technology development and deployment, is difficult to construct.

Recommendation 2.3: Although a research focus is consistent with government's traditional role in funding basic research, it is important that other efforts, further along the research and development continuum, continue to be supported. Front-loading of resources on research may be less effective in achieving technology utilization than actively promoting those technologies that have been shown to work. Many innovations begin in the private

sector with little or no government support but require demonstration and/or verification by independent entities to determine their effectiveness. They also may require diffusion activities by the government to achieve regulatory acceptance and thus commercialization.

Recommendation 2.4: Demonstration/verification programs need to be expanded. States support the verification testing of technologies through activities like EPA's Environmental Technology Verification (ETV) Program rather than leaving this testing for each individual state to do on its own. The fact that EPA has verified more than 350 innovative technologies to date and that hundreds more await verification attests to the value of this activity to commercial developers. The fact that the ETV Web Site containing performance data on all of these technologies is visited more than 1,500,000 times each year attests to the value of the information it contains on new technologies. Demonstration and verification programs are major commercialization facilitation activities and help assure that effective, rather than ineffective, technologies are deployed.

Recommendation 2.5: Each EPA technology program should know where to direct technologies to the next step in the development process both inside and outside EPA to ensure that promising innovations move through the Continuum toward commercialization. Program interaction, communication, and focus on commercialization requirements need improvement.

Recommendation 2.6: The Agency should address critical diffusion and utilization gaps that impede new technology from reaching the appropriate markets.

- 2.6.1 **The Subcommittee recommends that the Agency establish a policy that each regional office designates a specific technology information coordinator.** The regions are the front line of the Agency and a primary source for state- and local-level decision makers to obtain guidance on technology and permitting issues, particularly concerning the performance of new technologies. Developers also come to the regions for help in penetrating EPA's technology assistance programs. A regional technology information coordinator would serve to connect regional problems to the funding and resources of EPA Headquarters. The effectiveness of this approach has been demonstrated in Region 1. Headquarters' coordination of these regional technology information coordinators will be critical to their success. The Subcommittee will address the management and coordination issues for EPA's technology programs in future reports.
- 2.6.2 **The Subcommittee recommends that EPA place more emphasis on and increase public awareness of its programs to create a demand for new environmental technologies.** A review of the scope of programs in the Continuum reveals an apparent gap in Agency activities that directly address the creation of markets or market mechanisms for new technologies. One example of such a program is ENERGY STAR, which encourages energy conservation by working with corporations to develop conservation plans. Such "demand-pull" activities can include

government policies such as tax credits and “first purchaser” activities that encourage innovation. The Subcommittee will seek further information on EPA’s past experiences, both positive and negative, with these types of policies at its upcoming meetings.

Recommendation 2.7: EPA should devote more attention and resources to those Agency programs that incorporate and encourage sustainability as one of the goals or criteria for technology development or implementation assistance. As this subject is specifically called out for comment in the charge and the Subcommittee considers that there is an opportunity for the Agency to accomplish important strategic objectives in this area, the Subcommittee will look at the issue of sustainability in more detail over the coming months and make specific recommendations in a future report. The Subcommittee hopes to identify and evaluate several EPA programs that are actively seeking to incorporate this analytically difficult subject into their technology development activities and highlight their methodology and successes.

Finding 3: The Environmental Technology Council (ETC) Action Teams

Recommendation 3.1: EPA should develop a formal and ongoing public process to identify the country’s most pressing environmental problems needing technological solutions, ensuring that the selection is truly focused on environmental problems and not simply on technology development.

Recommendation 3.2: EPA should make the ETC Action Team initiative a core program with high-level Agency support, while streamlining the oversight for both the ETC and its Action Teams.

Recommendation 3.3: The ETC should develop and institute Standard Operating Procedures for Action Teams and ensure that they immediately begin to include appropriate outside stakeholders in their deliberations and activities. The most successful Team activities should be highlighted.

APPENDIX D: EPA Administrator's December 19, 2006 Letter to NACEPT Chair



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 19 2006

THE ADMINISTRATOR

Mr. John L. Howard, Jr.
Chair
National Advisory Council for Environmental
Policy and Technology
Vinson & Elkins, LLP
2801 Via Fortuna, Suite 100
Austin, Texas 78746

Dear Mr. Howard:

I thank the National Advisory Council for Environmental Policy and Technology and its Environmental Technology Subcommittee for the thoughtful and comprehensive recommendations in the report titled *EPA Technology Programs and Intra-Agency Coordination*. These recommendations have stimulated the U.S. Environmental Protection Agency to examine how best to promote the use of innovative technology in carrying out its mission.

You will be pleased to learn that the Subcommittee's report has already helped promote change and achieve positive results. The EPA Technology Development Continuum chapter is a valuable resource as EPA evaluates its programs, as well as an information source for technology developers and users seeking guidance and support from EPA. The Agency has already used the information to restructure the one-stop-shop Environmental Technology Opportunities Portal on its Web site to provide a coherent roadmap of EPA's technology programs.

The report's 15 recommendations were reviewed by the Agency's Science Policy Council. The SPC also sought input from the Environmental Technology Council on how to respond to each of the recommendations. The ETC considered not only the recommendations themselves, but also how they could be implemented and sustained. As a result, the SPC approved four recommended actions that essentially embrace the whole of the NACEPT report recommendations:

1. Establish a Senior Environmental Technology Officer who will be the focal point for key activities recommended in the report like establishing priorities, chairing the ETC, facilitating cross-agency coordination and information sharing, working with the business community and other stakeholders, and developing metrics for measuring effectiveness.

APPENDIX D: EPA Administrator's December 19, 2006 Letter to NACEPT Chair (continued)

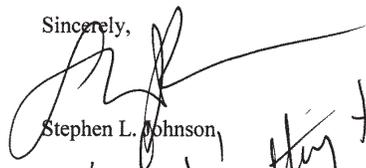
2. Establish the Environmental Technology Council as a core Agency activity with more senior-level membership accountable for results.
3. Establish a Regional Environmental Technology Advocacy Network comprised of a technology advocate in each region to identify opportunities to use technology to achieve better results, share information within the Agency and with stakeholders, serve as liaison with technology programs across the Agency, and serve as member of the ETC.
4. Create an Environmental Technology Verification and Assessment Staff coordinated by the National Risk Management Research Laboratory to provide enhanced technology support to the SETO and the rest of the Agency on issues like technology verifications, state-of-the-art assessments, technology development collaborations, and encouraging sustainability.

We have decided to move forward to implement these recommendations. It is important that EPA increasingly be engaged in promoting and facilitating cost-effective solutions to environmental challenges. Obviously, the implementation of these recommendations has resource implications that must be taken into consideration as we define the specifics of our actions. Dr. George Gray, EPA Science Advisor and Assistant Administrator of the Office of Research and Development, will lead our implementation efforts. Dr. Gray and I will keep the Council informed as we move forward.

I understand that a second report with recommendations from the Environmental Technology Subcommittee will be delivered early next year. We look forward to working with NACEPT as we consider the recommendations in that report.

Again, my thanks to NACEPT and the Technology Subcommittee for its advice and assistance in helping EPA meet its commitment to promote innovative technology in carrying out its mission.

Sincerely,



Stephen L. Johnson

cc: Marcus Peacock, Deputy Administrator
George Gray, Assistant Administrator, Office of Research and Development
Rafael DeLeon, Director, Office of Cooperative Environmental Management
Phil Helgerson, Chair, Environmental Technology Subcommittee

Handwritten notes:
"Sorry to hear of the week! Getting together again for you look forward in January you leadership!"
"Thanks again for your leadership!"
"Aur"

APPENDIX E: Suggested Functions and Duties of the SETO, Regional Technology Coordinators, and Technology Communication Coordinator

Internal responsibilities of the Senior Environmental Technology Officer (SETO) and staff should include functions such as:

- Understand and influence all existing internal technology support activities across the Continuum and assist in the coordination of these programs to ensure maximum effectiveness.
- Ensure that technology programs across the Continuum support the Agency's strategic plan and solution of its highest priority problems that require technology development and deployment. Seek opportunities to add technology activities and metrics to all program office sections in the EPA Strategic Plan, support and coordinate those activities, and report on environmental results.
- Chair and direct the activities of the Environmental Technology Council (see below), including updating current priorities, Action Teams, and followup on previous Environmental Technology Subcommittee recommendations.
- Efficiently resolve internal and partnership disputes related to environmental technology commercialization and deployment. EPA should consider creating an innovative technology appeals board to address and resolve issues that arise in a timely manner.
- Identify international programs that have an environmental technology component and seek opportunities to understand the international market for technologies to encourage investment in developing technologies and promote export of U.S. technologies.
- Develop and be responsible for keeping current a central, consolidated, and simple clearinghouse for commercial-ready technologies and associated performance data to assist purchasers in getting the best technology for their particular situation.
- Educate staff about the issues faced by technology developers—there should be a list of Frequently Asked Questions about technology development and partnering. Establish performance expectations for regional technology advocates and consider recognition programs for staff members who take risks to use environmental technologies that achieve results.
- Establish clearly defined metrics for program success that include the most important elements for technology development along the entire Continuum.
- Oversee communication and outreach activities, particularly the quality of the Agency's various technology Web sites, to achieve outstanding information flow to the entire technology development, commercialization, and purchasing community.

External responsibilities of the SETO should include:

- The authority to represent the Agency as a technology champion and create external events and communication tools that highlight successful technology commercialization and uses.
- Act as the primary external spokesperson for environmental technology, including providing advice to Congress. Establish communication with and among appropriate government agencies at all levels.
- Establish relationships with key governmental, external nongovernmental organizations, and private-sector actors, including the investment community and appropriate international organizations. Build relationships with other federal agencies and encourage partnership formation wherever appropriate.
- Establish relationships with state entities of all types, including state small business development agencies, as well as CalPERS and other state funds that invest in clean technology. Establish and chair an external technology advisory board to provide input and expertise into technology activities. Work with the Environmental Council of the States and other state organizations to engage states in all aspects of technology implementation and support state environmental technology innovation programs such as the Technology Acceptance and Reciprocity Partnership and the Interstate Technology and Regulatory Council.

Functions of the Regional Technology Information Coordinator:

- Work day-to-day with regional staff to facilitate the use of new technologies as a primary tool to improve environmental performance and solve problems.
- Serve as the external contact for companies needing access to services, markets, or regulatory assistance.
- Communicate with states to respond to their technology information and policy needs and learn from their areas of expertise.
- Coordinate routinely with regional counterparts and through quarterly meetings with the Senior Environmental Technology Officer.
- Staff the Environmental Technology Council and recruit members for the Action Teams.
- Seek technology solutions to achieve environmental results in all regional media programs and enforcement (see section [3. Encouraging Market Demand for Innovative Environmental Technology](#)).

Functions of the Technology Communication Coordinator under the SETO:

- Ensure effective communication of data and information between scientists/engineers/regulators throughout EPA. The SETO and Regional Coordinators should lead the effort to move other offices toward proactive, engaging technology outreach.
- Devote the resources for one person to continually monitor and update the Environmental Technology Opportunities Portal (ETOP) Web Site and all of its components. Material that is outdated, poorly organized, or confusing should be removed rather than left to confuse the public and reduce Agency credibility. This person should report to the recommended SETO.
- Ensure timely information reporting and use timeliness of public reporting as a metric of success in all technology programs. Timely reporting of environmental technology information (data, performance, etc.), no matter where that technology is on the Continuum, is imperative for commercialization. Within the context of this rapidly moving environment, a multi-year turn-around for report approval is not acceptable.
- Provide short- and long-term data on environmental technologies in a searchable Web-based format to ensure that ongoing information is captured. The data should not only reflect initial stage verification but also performance data, operation and maintenance information, and costs.

