EPA Technology Programs and Intra-Agency Coordination

May 2006

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.

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Chairman's Prologue

For the past four decades, significant environmental progress has been made in cleaner air, cleaner water, and better waste prevention and management. Much of this progress is attributable to the development and use of innovative technologies to address priority environmental problems. Today, however, the U.S. Environmental Protection Agency (EPA), states, and local governments, as well as other public and private organizations are thinking much more holistically about how to achieve sustainability; maintaining or improving the current levels of environmental protection yet striving for higher levels of environmental performance while simultaneously strengthening U.S. global competitiveness. What is the role of EPA's environmental technology programs in this new, more sustainable environmental protection paradigm and what can the Agency do to improve their impact? This is essentially the charge that was posed to the National Advisory Council for Environmental Policy and Technology (NACEPT).

The EPA Administrator established the NACEPT Subcommittee on Environmental Technology in November 2004 to address this charge and make recommendations on the future direction of EPA's environmental technology programs. The Subcommittee includes knowledgeable representatives of the environmental, industrial, public policy, scientific, academic, and government—state, tribal, and local—communities. We are working with EPA senior managers and subject matter experts to assess the Agency's current programs and to identify improvements and new initiatives that would increase their effectiveness.

Opportunities for sustained environmental protection must be addressed today to provide effective protection in the future and to avoid the higher costs of delayed action. Industry is responding to an increasing recognition that pollution of all types is appropriately accounted for as material and energy waste, and waste is an avoidable cost. Fortunately, many responsible businesses understand that optimizing processes to reduce emissions of all types is not just good corporate citizenship, but increases productivity and helps their bottom line. Nonetheless, challenges remain.

Today's technological tools, particularly in the rapidly evolving measurement and monitoring arena, offer real-time, highly accurate information and responsiveness undreamed of in past years. Innovative environmental technologies in all areas are potentially more effective and less costly than older methods. The opportunity to move forward on developing technologies to address the far more complex environmental problems that still confront us appears bright. The public's demand for accountability and responsibility is rising and expectations of environmental stewardship are higher than ever before. Our Nation needs affordable, effective technologies that can be used to solve real problems that impact our health and the world in which we live.

The complex research, development, and marketing road from an innovative idea to an implemented technology is extremely challenging. Regulatory, institutional, and other barriers have prevented or slowed many efforts at technology commercialization. EPA's role in this process must be justified by the extent to which new technologies provide solutions to environmental problems and produce real environmental results. EPA cannot and should not address technology development and marketing alone, but must remain a leader in that effort. To meet this challenge, EPA has evolved from an agency that primarily regulates into an agency that both regulates and facilitates. Agency leaders understand that single-focus regulatory approaches to complex environmental problems will not assure that pollution is actually reduced. New technologies are essential—technologies developed and put in place primarily by private-sector inventors and entrepreneurs.

EPA's role as a facilitative leader in the technology development process is evolving, but it is clear that the Agency must play a stronger motivating and facilitating role in assisting promising technologies through the development continuum toward commercialization and use. This help may take many forms—research grants to small businesses for bench- and pilot-scale investigation; full-scale demonstration funding for critical problems not being addressed by state or local government or the private sector; verification of performance for commercial-ready devices to determine their efficacy and cost so that they will be seriously considered in the marketplace; regional and multi-state permit assistance for complex new technologies; and readily available, reliable information on new, cost-effective technologies. The reality of budgetary resources and the complex environmental marketplace, however, means that EPA cannot be all things to all technologies and must strive to select its critical roles strategically.

Looking toward the future, it seems obvious that technology will play a critical role in EPA's ability to meet its core goals while supporting continued economic growth. Regardless of the approach or motivation—regulatory or voluntary, enforcement or stewardship, prevention or control—technology is a lynchpin in achieving cost-effective environmental protection. EPA must confront several upcoming strategic decisions concerning its technology programs. This report contains recommendations that, if implemented by EPA, would raise the profile of technology programs across the Agency, make these efforts more strategic, and strengthen their effectiveness. Clearly, the Agency must make tough decisions about what programs and activities it will expand, continue, reduce, or eliminate. EPA needs to act promptly to establish resource allocations that support activities that reflect its unique set of core competencies and regulatory authority—especially initiatives that others are unable or unwilling to undertake independently. Implicit in these actions are decisions on activities that the Agency should not carry out because they are better addressed by others. Limited resources must be focused on programs through which EPA can effectively apply its specialized knowledge and regulatory authority to facilitate development and deployment of technologies by others through stronger partnerships and influence.

Our initial review of EPA's technology programs confirms that the Agency is aware of these new realities and the additional reality of today's constrained resources. It has been a privilege to view the accomplishments and challenges of the Agency with the purpose of providing recommendations that can be both effective and measurable.

This first report and its recommendations address EPA programs and assess intra-Agency coordination. Additional reports will outline avenues for EPA to strengthen its support for the discovery, verification, approval, and deployment of new technology, and to create stronger, more effective programs that will mobilize powerful resources of industry, the scientific and academic community, federal and state agencies, and other domestic and international partners.

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

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List of Acronyms

CATC	Clean Air Technology Center
CDC	Clean Diesel Combustion
CEIT	Center for Environmental Industry and Technology
CLU-IN	Clean-Up Information
CRADA	Cooperative Research and Development Agreement
CWA	Clean Water Act
DfE	Design for the Environment
EPA	Environmental Protection Agency
ETC	Environmental Technology Council
ETOP	Environmental Technology Opportunities Portal
ETV	Environmental Technology Verification
FTTA	Federal Technology Transfer Act
IAC	Innovation Action Council
ITRC	Interstate Technology and Regulatory Cooperation
LQSR3	Laboratory Quality System Requirements 3
MCL	Maximum Contaminant Level
NACEPT	National Advisory Council for Environmental Policy and Technology
NCER	National Center for Environmental Research
NETC	National Environmental Technology Competition
NGO	Nongovernmental Organization
NLLAP	National Lead Laboratory Accreditation Program
NODA	Notice of Data Availability
OAR	Office of Air and Radiation
OECA	Office of Enforcement and Compliance Assurance
OIA	Office of International Affairs
OPPTS	Office of Prevention, Pesticides and Toxic Substances
ORD	Office of Research and Development
OSWER	Office of Solid Waste and Emergency Response
OW	Office of Water
QA	Quality Assurance
R&D	Research and Development
RBLC	Reasonably Available Control Technology/Best Available Control Technology/Lowest Achievable Emission Rate Clearinghouse
RSS	Really Simple Syndication
SBIR	Small Business Innovation Research
SDWA	Safe Drinking Water Act
SEP	Supplemental Environmental Project
SITE	Superfund Innovative Technology Evaluation
SOP	Standard Operating Procedures
SPC	Science Policy Council
STAR	Science To Achieve Results
TAC	Technology Assistance Center
TIP	Technology Innovation Program
TTEP	Technology Testing and Evaluation Program
ULSD	Ultra-Low Sulfur Diesel

I. Executive Summary

Background and Process

The mission of the U.S. Environmental Protection Agency (EPA) 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 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 Subcommittee on Environmental Technology of the National Advisory Council for Environmental Policy and Technology (NACEPT) to evaluate and make recommendations on EPA's stimulation, facilitation, and use of innovative technology in carrying out its mission. The 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 since that time. Numerous presenters from EPA, other government agencies, states, nongovernmental organizations (NGOs), and the private sector have briefed the Subcommittee on a broad spectrum of technology issues (see Appendix C for the list of presenters to date). Working groups comprised of Subcommittee members have been formed to address specific issues and make preliminary recommendations to the full Subcommittee.

The Subcommittee is reviewing 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. In this and subsequent reports, the Subcommittee seeks to answer the question 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, and what other programs and activities should the Agency undertake to achieve this goal?*

In general, the Subcommittee has been most impressed with the broad and effective spectrum of 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, but has more influence and activity in some areas than in others. Within the last 2 years, two particularly significant overarching events have

taken place to improve information flow and coordination across the Agency and provide improved transparency to other government agencies and the public:

- Through its many years of technology evaluation, EPA has developed a broad range of programs and a large store of technology information. Making this information available to the numerous public and private entities that may wish to use it is an Agency goal. In its "Report to Congress on a One-Stop-Shop for Coordination of Programs Which Foster Development of Environmental Technologies," EPA's Office of Research and Development (ORD) committed to creating an Environmental Technology Opportunities Portal[1] (ETOP) that would more easily lead users to information on all of the Agency's technology programs through an integrated "one-stop-shop." This portal became operational on December 31, 2003.

- In the same report to Congress, EPA committed to implementing the cross-Agency Environmental Technology Council (ETC) to achieve improved, real world environmental results through the application of innovative technology. The ETC will achieve this goal by identifying priority environmental problems that need new technological approaches and coordinating efforts by EPA and others to identify and implement technology solutions. Success is attained when identified technologies are adopted for use and environmental results can be measured. The ETC is now in full operation and has created 11 Action Teams, which are at work on specific problems that require new technology to achieve economical environmental solutions.

This first Subcommittee report focuses 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 contains the *EPA Technology Development Continuum*, the entire text of which can be found in Appendix D. The Subcommittee has reviewed a substantial subset of EPA's many and diverse technology facilitation programs, 24 of which have been identified to date. These programs reside in the Agency's media program offices (i.e., Air and Radiation, Water, Solid Waste and Emergency Response, and Prevention, Pesticides and Toxic Substances), ORD, and one regional office (i.e., Region 1).

Future reports will focus on the critical area of the Agency's ability to build, join, coordinate, and sustain partnerships both internally and with key government and private-sector organizations outside of EPA, on management issues, and on other topics of importance to environmental technology deployment in the United States and abroad.

[1] The Environmental Technology Opportunities Portal (ETOP) is accessible on the Web at www.epa.gov/etop

Technologies Will Achieve Real Results

EPA Administrator Steve Johnson predicts that safeguarding the country's water supply will be one of the pressing environmental concerns of the 21st century, emphasizing that "the answer is going to be the technologies." Johnson said, "My focus is on advancing technologies and achieving real results."

—*Los Angeles Times*, June 9, 2005

Findings and Recommendations

Finding 1: The EPA Technology Development Continuum

The quality and coverage of EPA's technology development programs are praiseworthy. The complexity posed to the public in determining which programs conduct which kinds of functions on what kinds of particular pollution problems can be daunting, however. The recent creation of ETOP, a single Web address through which EPA technology programs can be accessed, is a major step forward, but a clearer presentation or "map" of activities is needed. The Subcommittee's first finding, reached at its initial meeting, was that EPA's many and diverse technology facilitation programs would benefit from a reorganized presentation to its numerous audiences. The Subcommittee has worked with the Agency for the past year to identify and characterize 24 EPA programs that develop and promote innovative technologies and to array them across a continuum of research and development activities.

The *EPA Technology Development Continuum* (see Appendix D), contains common information on all EPA technology programs identified to date, arranged in order of the technology stage to which they relate, and identifies where in EPA these programs occur and how to access them. This Continuum starts with programs focused at the earliest stages of technology idea development; moves through programs focused on bench, pilot, and demonstration stages; and on to programs that conduct commercial technology performance verification and provide information diffusion on fully commercial-ready technologies. The Subcommittee believes that EPA and its many and varied outside constituencies will benefit from this reorganized presentation of the Agency's technology activities.

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 assure 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

Having completed the Continuum and received briefings on all of the major technology programs across the Agency, the Subcommittee is impressed by EPA's past and present work on technology development. Looking toward the future, the Subcommittee believes that EPA must strategically select and execute its technology programs with an eye to sustaining those that are core functions in supporting the entire system of technology development both inside and outside the Agency. In a time of increasing budget scrutiny and limited resources, the Agency will need to focus its programs on strategic goals and efforts that can have the greatest impact. Although the Subcommittee cannot substantively review the goals and performance of all EPA technology programs, it offers to the Agency the following general recommendations:

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: 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: For each EPA technology program, the Agency should know where to direct technologies to the next step in the development process both inside and outside EPA to assure 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 designate a specific technology information coordinator.** The regions are the front line of the Agency and a primary source for state and local 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 on 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.

America's Global Leadership Depends on Technological Advances

"In this century, the greatest environmental progress will come about not through endless lawsuits or command and control regulations, but through technology and innovations."

—President George W. Bush
State of the Union Address, February 27, 2003

"America's economic strength and global leadership depend on continued technological advances. Federal investment in R&D has proven critical to keeping America's economy strong by generating knowledge and tools needed to develop new technologies."

—President George W. Bush
State of the Union Address, January 31, 2006

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 Action Teams

Under the auspices of the newly created ETC, EPA has conducted a prioritization process to identify the most serious environmental problems that await technology availability for solution. Eleven ETC Action Teams, consisting of both headquarters and multi-regional staff, are now focused on these problems across the Agency and are addressing a diverse array of technological challenges. The Subcommittee agrees with the overall objectives of this initiative and has found several areas of notable strength. At this early stage of its implementation, however, there are a number of adjustments and changes that the Agency should consider.

Recommendation 3.1: EPA should develop a formal and ongoing public process to identify the country's most pressing environmental problems needing technological solutions, assuring 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 (SOPs) for Action Teams and assure that they immediately begin to include appropriate outside stakeholders in their deliberations and activities. The most successful Team activities should be highlighted.

Future Plans

The NACEPT Subcommittee on Environmental Technology began its work in November 2004, and has been chartered for 2 years. The Subcommittee expects to meet several times during 2006 and plans to take up and report on the following additional topics:

- National and international technology partnerships
- EPA technology management and strategy
- Encouraging demand (demand-pull programs and opportunities)
- Communications, education, and outreach (internal and external)
- The extent to which current EPA technology programs on the Continuum address large-scale issues such as sustainability, global climate change, and catastrophic events.

II. Introduction

In October 2004, the Office of Research and Development (ORD) of the U.S. Environmental Protection Agency (EPA) 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 EPA 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 Subcommittee on Environmental Technology was formed (see Appendix B for the membership list) and shortly thereafter held its first meeting.

The charge document posited the following core question: 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; and what other programs and activities should it undertake to achieve this goal? In particular, EPA requested the Subcommittee to review its effectiveness in the following five areas:

1. Evaluating the existing suite of technology support programs, both individually and collectively, with particular focus on redundancies or gaps and the extent to which they are appropriately designed to address technology development barriers.

2. 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.

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

4. 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.

5. Collaborating with other federal agencies and the private sector to assure that all major stakeholders in the complex process of bringing innovative technology to market are represented in the consideration and implementation of EPA's technology programs.

The full Subcommittee has held five meetings to date. Meeting agendas have included presentations by experts on overview issues, such as the state of the marketplace for environmental technologies both within the United States and abroad, as well as extensive briefings on the many and varied environmental technology research, development, and proliferation programs conducted by EPA (see Appendix C for the list of presenters). Working groups comprised of Subcommittee members have been formed to address specific issues and make preliminary recommendations to the full Subcommittee.

After 1 year of deliberation, the Subcommittee now issues the first in a series of reports. This report focuses its evaluation and recommendations on EPA's broad spectrum of technology programs and coordination among them. As such, it addresses primarily the first and third of the charge topics listed on page 7. Future reports will focus on the remaining elements of the charge and further findings and recommendations on the subjects discussed in this report, if warranted.

EPA's mission is the protection of 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 the role of technology is critical to 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.

In general, the Subcommittee has been most impressed with the broad and effective spectrum of programs presented 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, but has more influence and activity in some areas than in others. Within the last 2 years, two particularly significant overarching events have taken place to improve information flow and coordination across the Agency and provide improved transparency to other government agencies and the public:

- Through its many years of technology evaluation, EPA has developed a broad range of programs and a large store of technology information. Making this information available to the numerous public and private entities that may wish to use it is an Agency goal. In its "Report to Congress on a One-Stop-Shop for Coordination of Programs Which Foster Development of Environmental Technologies," EPA's ORD committed to creating an Environmental Technology Opportunities Portal[1] (ETOP) that would more easily 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.

[1] The Environmental Technology Opportunities Portal (ETOP) is accessible on the Web at www.epa.gov/etop

- In the same report to Congress, EPA committed to implementing the cross-Agency Environmental Technology Council (ETC) to achieve improved, real world environmental results through the application of innovative technology. The ETC will achieve this goal by identifying priority environmental problems needing new approaches and coordinating efforts by EPA and others to identify and implement technology solutions. Success is attained when identified technologies are adopted for use and environmental results can be measured. The ETC is now in full operation and has created 11 Action Teams, which are at work on specific problems that require new technology to achieve environmental and economic breakthroughs.

The Subcommittee is reviewing 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. This first Subcommittee report focuses 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 contains the newly developed *EPA Technology Development Continuum*, the entire text of which is provided in Appendix D. The Continuum displays, for the first time, the full range of EPA's many and diverse technology facilitation programs. The Subcommittee has reviewed a substantial subset of these programs, 24 of which have been identified to date. They reside in the Agency's media program offices (i.e., Air and Radiation, Water, Solid Waste and Emergency Response, and Prevention, Pesticides and Toxic Substances), ORD, and one regional office (i.e., Region 1). Future reports of the Subcommittee will focus on the critical area of the Agency's ability to build, join, coordinate, and sustain partnerships both internally and with key organizations outside of EPA, on its ability to work effectively with the private sector, and on other topics of importance to technology deployment in the United States and abroad.

III. The EPA Technology Development Continuum

The Subcommittee's first finding, reached at its initial meeting, was that EPA's many and diverse technology facilitation programs would benefit from a reorganized presentation to its numerous and diverse audiences. The recent creation (December 2003) of a single Web address through which EPA technology programs can be accessed, ORD's ETOP, is a major step forward in centralizing access to the Agency's technology information; however, a clearer presentation or "map" of activities is needed. For example, programs that are designed to assist technology development in all media areas are largely indistinguishable from those that focus solely on a single area such as hazardous waste remediation or air pollution monitoring. Programs exclusively focused on technology research may be confused with those that aim only at information diffusion. For most programs, it is unclear where their activities fit in the continuum of technology development efforts conducted by the Agency and where they place their primary emphasis. The definition and scope of EPA technology programs is unknown to many outsiders wishing to find help or information.

The Subcommittee has worked with EPA staff for the past year to design and execute such a map. The project has involved the following three major steps:

1. The first step was to create a clearly defined, but relatively simple, continuum of technology development activities showing where, on the lengthy process from an innovative idea to a commercially available technology, each EPA program places its emphasis. A key aspect of this task was to clearly articulate how EPA defines the multiple steps in the process of technology development. These steps are:

    - Research/Proof of Concept
    - Development (pilot-stage activities)
    - Demonstration (full-scale challenge testing/debugging)
    - Verification (common protocol testing of commercial-ready products)
    - Commercialization (private-sector product manufacturing and marketing)
    - Diffusion/Utilization (information dissemination to key audiences).

2. The second step was to determine the major programmatic information components needed by the interested public about each EPA program. What are the factors that will help people outside EPA (and perhaps inside) find the technology programs of direct relevance to their needs? These information components are:

    - Brief program description
    - Areas of primary and secondary focus on the Continuum
    - Media focus (e.g., air, drinking water, all media)
    - Type of support provided (e.g., research grants, testing cost-share)
    - Approximate range of FY2005 funding
    - Responsible office

- Web site address
- Program description.

3. The third step was to pull together the information on each factor for the 24 technology programs identified to date (additional programs may be identified in the future), and place it in the report. This work is now completed. Figure 1[2] (on pages 14-15) presents an overview of the activity.

The full report entitled *EPA Technology Development Continuum*, with definitions and programmatic information, is found in Appendix D. It contains common information on all EPA technology programs identified to date, arranged in order of the technology stage to which they relate, and identifies where in EPA these programs occur and how to access them. This Continuum starts with programs focused at the earliest stages of technology idea development; moves through programs focused on bench, pilot, and demonstration stages; and on to programs that conduct commercial technology performance verification and provide information diffusion on fully commercial-ready technologies. The Subcommittee believes that EPA and its many and varied outside constituencies will benefit from this reorganized presentation of its technology activities. To our knowledge, this document is the most fully comprehensive collection and characterization of EPA technology programs produced by the Agency to date.

Recommendations of the Subcommittee

The Subcommittee offers the following recommendations pertaining to the Continuum:

- **Broadly publish and distribute the Continuum.** The Subcommittee suggests that the Agency publish the *EPA Technology Development Continuum* both as a document and as an introduction to its ETOP one-stop-shop Web site. It also should be included, in abbreviated form, as an appendix to the many Agency activity overview documents published each year as an aid to understanding the scope and focus of EPA technology programs. Environmental technology is a fast moving field, and the Agency is constantly in the process of evolving its focus to conform to new circumstances. The Subcommittee believes that a concerted effort should be maintained to keep this document current to avoid confusing and misinforming the public with out-of-date information and thus lowering its credibility and efficacy as a data and information source.

- **Use the Continuum as an effectiveness and evaluation tool.** EPA should evaluate the effectiveness of its technology facilitation efforts across the continuum, including results such as the market penetration by well-performing technologies supported with Agency research funding and/or demonstration and verification evaluations and Agency information programs. By assessing the market impact of the individual programs, areas of

[2] References to the "Continuum" throughout this report refer to the totality of the document found in Appendix D and not solely to Figure 1.

strengths and weaknesses are revealed and, most importantly, areas in which the process breaks down are identified.

- **Use the Continuum as a prioritization and resource evaluation tool.** The Subcommittee further recommends that EPA encourage the members of its cross-Agency ETC and managers at all decision-making levels to use the Continuum as a tool to facilitate candid discussion of its priorities, gaps, and redundancies. Coordination and evaluation is necessary for a coherent and effective technology development strategy and difficult to achieve in an agency as "stove-piped" as EPA. The Subcommittee recognizes that the Agency has limited resources and must make choices to focus its efforts. The Subcommittee further understands that EPA has chosen to devote an increasing portion of its technology resources to a limited number of high-priority projects (e.g., innovative automotive design, arsenic control in small drinking water systems). Limited resources and increased focus on certain high-visibility problems will require that very careful prioritization, conducted across all EPA programs rather than simply within each program, be carried out to assure that the most critical efforts in assisting high-performing, private-sector technologies are supported in future years. This may require dropping some programs to increase support for others—such as performance verification—in which EPA clearly has a unique or important facilitation function.

  Example *The presence of arsenic in drinking water, particularly in small systems with limited resources, has been identified as a major technology challenge. This problem is being addressed by the Agency in a comprehensive manner. EPA has funded bench- and pilot-scale research in its own laboratories, given Small Business Innovation Research (SBIR) Program contracts to developers, funded numerous technology demonstrations in small communities, verified commercially available technology performance through the Environmental Technology Verification (ETV) Program, and facilitated state permitting and implementation of high-performing systems through the Interstate Technology and Regulatory Cooperation (ITRC) Program.*

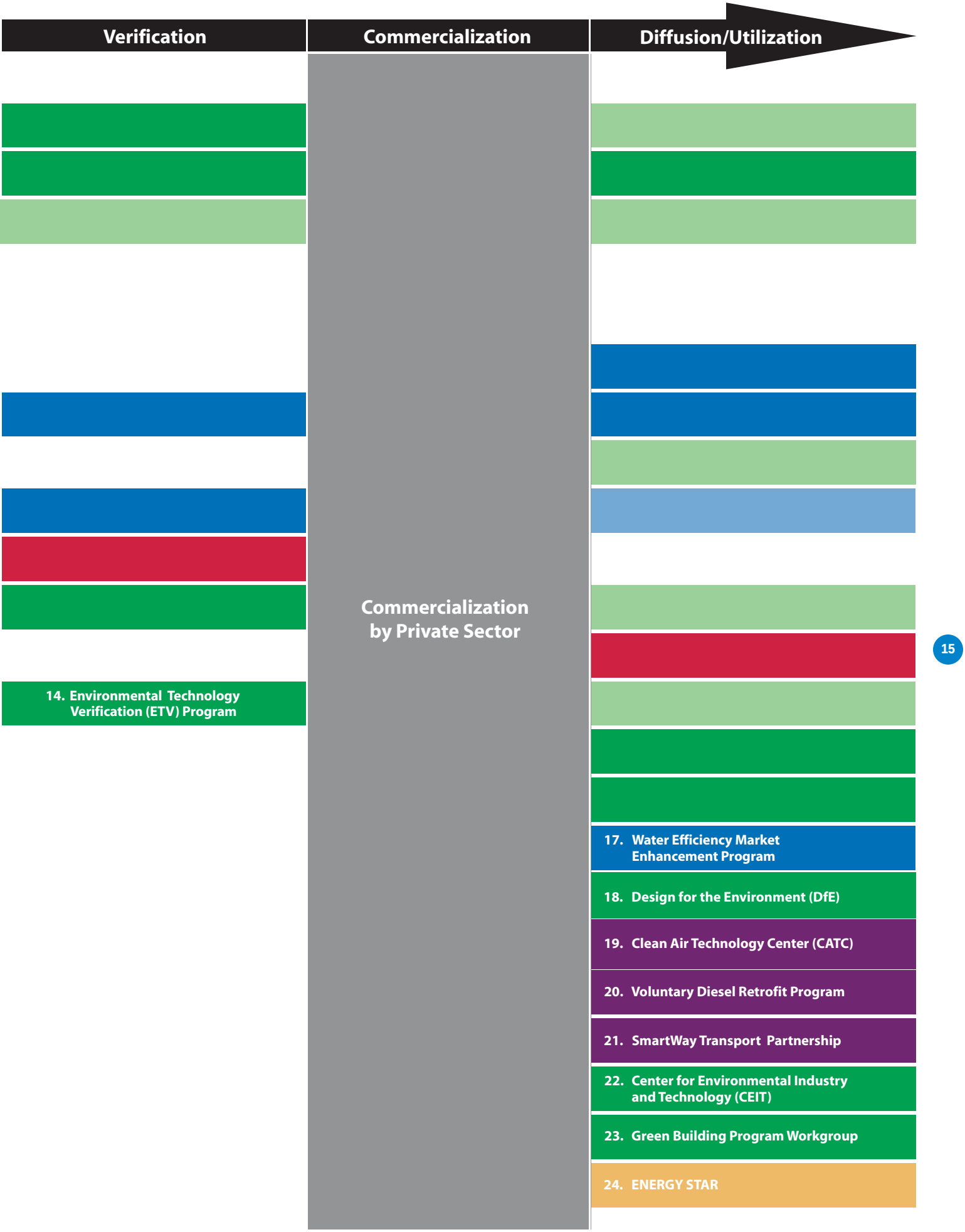
- **Evaluate private-sector interface with Agency programs.** In light of the Agency's specific charge to the Subcommittee, the Subcommittee particularly recommends that EPA use the Continuum to evaluate the extent to which the private sector—researchers, technology developers, technology consultants, purchasers, and users—are involved in, communicated with, and aided by the suite of programs displayed. Although some programs actively involve vendors, technology consultants, and buyers, many do not, making their outputs less market focused, observable, and useful to these critical audiences.

  Example *A recent independent survey of 120 California environmental start-up companies in the clean and renewable energy sector requested the prioritized value of assistance among 10 government agencies, including federal, state, and local entities. The categories of impact included research, development (i.e., SBIR, Cooperative Research and Development Agreements [CRADAs]), demonstration, verification, co-marketing, regulatory assistance, and funding assistance. EPA ranked last in all areas except regulatory assistance. If EPA wishes to further the implementation of innovative technology, it must become visibly effective in aspects other than regulatory assistance across all media.*

Research/Proof of Concept	Development	Demonstration
1. Science To Achieve Results (STAR) Program		
2. Federal Technology Transfer Act (FTTA) Activities		
3. ORD In-House Technology Research		
4. Small Business Innovation Research (SBIR) Program		
5. Clean Automotive Technology Program		
6. Water Nonpoint Source Grants Program		
7. Small Drinking Water Systems and Capacity Development		
	8. Water Security	
		9. National Environmental Technology Competition (NETC)
		10. Arsenic Demonstration Program
		11. Superfund Innovative Technology Evaluation (SITE) Program
		12. Technology Testing and Evaluation Program (TTEP)
		13. Technology Innovation Program (TIP)

15. Green Engineering Program

16. Green Chemistry Program


Verification
Commercialization
Diffusion/Utilization
Commercialization by Private Sector
14. Environmental Technology Verification (ETV) Program
15
17. Water Efficiency Market Enhancement Program
18. Design for the Environment (DfE)
19. Clean Air Technology Center (CATC)
20. Voluntary Diesel Retrofit Program
21. SmartWay Transport Partnership
22. Center for Environmental Industry and Technology (CEIT)
23. Green Building Program Workgroup
24. ENERGY STAR

Superfund's Technology Innovation Program: Diffusion Done Right

The mission of the Technology Innovation Program (TIP) is to advocate for more effective, less costly approaches (i.e., "smarter solutions") by government and industry to assess and clean up contaminated waste sites, soil, and groundwater. Working with other federal agencies, states, consulting engineering firms, responsible parties, technology developers, and the investment community, TIP provides robust technology and market information and works to remove policy and institutional impediments related to the deployment of these technologies. The scope of the mission extends to Superfund sites, corrective action sites under the Resource Conservation and Recovery Act, underground storage tank cleanups, state voluntary cleanup programs, and Brownfields. Innovative technologies of interest are used for field sampling and analysis and management (both treatment and containment) of contaminated soil and groundwater.

The program, which was started in the 1980s, carries out a broad variety of activities to achieve its information diffusion mission ranging from one-on-one technical assistance, partnership activities, and training programs to use of cutting-edge, high-tech communication tools. TIP works through the application of a number of mutually supportive and reinforcing tools and effects. Diffusion activities are centered on creating numerous learning opportunities for practicing remediation professionals. The program focuses on primary customer groups to make them aware that these resources exist and provide multiple opportunities for them to interact with and learn from leading practitioners. New information is collected and documented in reports and databases that are easily accessible. Some of these diffusion activities include:

- TIP's Clean-Up Information (CLU-IN) family of Web sites is a major repository of remediation technology information, providing easy access to a wide variety of resources, including documents, databases, case studies, videos, training, technical support, live Webcasts, newsletters, and news feeds. CLU-IN also supports RSS (Really Simple Syndication) feed that automatically sends information about new Web content.

- On the first of every month, TIP's listserv TechDirect provides subscribers immediate access to new technology and policy reports, Webcasts, solicitations, and symposia free of charge. It currently serves more than 24,000 subscribers interested in remediation.

- In 1998, TIP began a series of live online forums to present and discuss technology advances and policy directions through live interactive Webcast seminars. These seminars reach geographically diverse audiences with current and practical information on technical advances occurring in the remediation field. The format is flexible and often involves several speakers delivering formal presentations followed by question-and-answer periods. A supporting page of related downloadable documents is provided to participants. More than 240 sessions on 24 different topics have been broadcast, many attracting more than 200 people per session. In the last 8 years, these live Webcasts have reached 45,000+ participants in more than 1,500 U.S. cities in 54 states and territories. In addition, professionals from more than 57 countries on 6 continents have participated in the seminars. The events also are recorded, archived, and made available in a variety of formats. Most recently the presentations have been made available in Podcast format, which allows practitioners to subscribe to the Podcast service and be notified when new content is available for their portable drive (e.g., iPod, MP3 player).

IV. Subcommittee Observations on EPA Technology Programs

EPA's goal across all of its many and varied environmental technology programs is to assure that a steady stream of innovative and cost-effective technologies continues to be implemented within the United States and abroad. This is a critical environmental protection function required by the numerous laws that the Agency administers and by its overall responsibility to ensure appropriate real-world protection from the air, water, and land impacts of human activity. Over the past 30 years, EPA's regulatory activity has been a major force in bringing new environmental technologies into being. Because almost all environmental technologies—old and new, effective and non-effective, cost-effective and costly—ultimately are brought into use through actions of private-sector developers, the government's role in this area is increasingly one of support, facilitation, and monitoring rather than prescription and control. To achieve this goal, the Agency carries out three basic functions, most with the participation of the private sector, to assure the development and deployment of technologies that address the prevention, detection, and control of environmental pollutants. EPA programs support:

- 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.

- Technology information diffusion to targeted audiences, such as states, local governments, associations, and many private-sector organizations, to facilitate the spread of information on technologies that are available, proven to be effective, and affordable.

Recommendations of the Subcommittee

The Subcommittee believes that all three aspects of EPA's work are critical and are being carried out with varying degrees of success in diverse programs across the entire Agency. Although it is not possible or appropriate for the Subcommittee to evaluate and comment in detail on the entire suite of EPA's technology activities, the Subcommittee makes the following recommendations based on its review of many Agency programs. Several examples of Agency programs that exemplify the recommendations advocated by the Subcommittee are included.

- **Strategic resource focus is needed.** Overall, EPA funding of technology programs is insufficient to support the development of all environmental technologies. 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. The Subcommittee believes that such a strategic plan process will cause EPA to place more emphasis on the back or commercial end of the Continuum where technologies are emerging into the market and their performance characteristics and costs are known.

- **Improved and coordinated metrics need to be developed.** EPA has an impressive array of programs but in the absence of consistent and available metrics, it is difficult to see whether or not they are effective in actually bringing needed technologies to implementation. The Subcommittee understands that EPA is working to develop these effectiveness measurements on a program by program basis, but suggests that a more holistic metrics system that takes ultimate environmental goals into consideration may be needed. Are these programs in their totality actually empowering the private sector to bring new technologies that improve the environment and reduce costs to communities and industries? EPA should create tools that measure the effectiveness of all of its programs in working together with the private sector to solve environmental problems. It then should use that information in setting program and resource priorities and effectively publicize its successes.

- **Although a research focus is consistent with government's traditional role in funding basic research, it is important that other efforts further along in the development process continue to be supported.** Front-loading of resources on research may be less effective than actively promoting those technologies that have been shown to work. With the exception of programs focused on specific problems such as arsenic removal from small drinking water systems and homeland security, which appear to be well funded, most technology resources are front-loaded in programs at the research end of the Continuum. Many innovations begin in the private sector with little or no government support but require demonstration and/or verification of performance by independent entities to achieve commercialization. Many technologies require expanded, 21st century diffusion activities (e.g., list serves, Podcasts) on the part of independent and trusted institutions to reach information customers and overcome the inertia of old systems. EPA has filled these needs in a number of its programs (see the description of Superfund's Technology Innovation Program on page 16) and the need for them has not diminished.

- **Verification programs need expansion.** The Subcommittee is concerned that important technology assistance programs in demonstration and verification of private-sector technologies continue to be reduced in size or eliminated. Numerous past studies of the environmental marketplace have identified the lack of trusted information on near and fully commercial-ready technologies to be a major barrier to the use of innovative technologies. State and local governments, technology consultants, and technology purchasers are known to be risk averse when evaluating the deployment of new technology. This causes them to "stick with the old," less effective/efficient technology rather than employ

EPA's ETV Program: World Leadership in Performance Verification

The ETV Program provides credible information on the performance of innovative technologies at their point of entering full-scale commercialization. Its primary customers are the purchasers of new technologies and the consulting engineers and state and local permitters who are so influential in determining which technologies are selected and bought. The program tests technology in all environmental areas other than remediation.

Started in 1995, ETV has an outstanding record of assisting new technologies to commercialization by designing consensus-based testing protocols through broad-based stakeholder groups, simultaneously testing multiple technologies under these protocols, and publicizing the results on its popular Web site (the ETV Web Site is among the most utilized at the Agency with more than 1.5 million hits each year). ETV was created to address a major barrier to the entrance of innovative technologies into the marketplace—lack of credible data and information on new technology performance characteristics and cost. EPA's independence and high-quality assurance standards stand behind all verification tests. Regulators use the information to make permitting decisions for new technology, and technology purchasers are able to base purchase decisions on reliable ETV information. Good performance reports by technologies tested under ETV are used by developers and vendors to sell technologies around the world.

More than 350 innovative technologies addressing diverse environmental problems have been tested in the program, and 82 consensus testing protocols have been created and are being used in a number of other countries that now are initiating verification programs.

State governments depend increasingly on information from ETV to decide on the permitability of new technologies. For example, a 2003 survey by the Association of State Drinking Water Authorities indicated that 24 states use ETV to reduce the frequency of testing, 13 use ETV reports as a prerequisite for permitting, and 15 use it as the primary source for decision-making.

ETV partners with a wide variety of public and private organizations to carry out its work:

- The Departments of Defense, Energy, and Agriculture, as well as the National Oceanic and Atmospheric Administration and the U.S. Coast Guard, have supported EPA in testing technologies of mutual interest.
- The States of New York, Texas, Connecticut, Massachusetts, North Carolina, and Illinois have supported ETV verification activities.
- ETV has the **most extensive stakeholder process at EPA** with 805 market-representing participants in 21 stakeholder groups (members, with the exception of state representatives, participate at their own expense).

Environmental technology vendors support the program, paying approximately one-third to one-half of the testing costs. Vendor surveys show virtually all are using their ETV data to market their technologies, and **92 percent would recommend participation in the program** to others. Numerous vendors have returned with two and even three new technologies to be verified after their first experience with ETV.

A report documenting ETV program outcomes through a series of case studies that show actual impacts of the program (e.g., regulatory response, vendor sales, pollutant reduction, and human health outcomes, where possible) was released in March 2006 and can be found on the ETV Web Site at www.epa.gov/etv.

innovations that could save substantial amounts of money while improving environmental quality. EPA's role in developing and disseminating independent, quality assured data and information on private-sector technology performance is of ongoing importance in facilitating that process. In particular, states support the verification testing of technologies through programs like ETV rather than leaving this testing for each individual state to do on its own. Individual state or vendor testing is costly, redundant, and produces data that, in the absence of common protocols and quality assurance procedures, are not comparable. 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 activities that help assure that effective, rather than ineffective, technologies are deployed (see the description of the ETV Program on page 19).

- **Program interaction, communication, and hand off need improvement as technologies move toward commercialization.** Although some programs closely interact with each other (e.g., Superfund Innovative Technology Evaluation [SITE] Program with TIP, SBIR with ETV) and appear to understand the commercialization objective, others seem to be operating in a vacuum. There should be a clear hand-off trail from one program to the next for the most promising technologies. The Subcommittee fully understands that few technologies enter EPA programs at the research stage and in a tidy fashion move through the Continuum to diffusion. The technology development process is necessarily somewhat chaotic with private-sector developers moving into and out of government supported programs in an irregular fashion. Nonetheless, for each program, EPA should know where to direct technologies to the next step both inside and outside the Agency to assure that promising innovations move through the Continuum toward commercialization. Closer interaction and coordination is needed across all appropriate programs and the goal of moving the high-performing, cost-effective technologies on to commercialization is of the highest importance at all stages of technology development. The SBIR Program provides a good example of how such integration and coordination can serve to move a promising technology along the Continuum (see the description of the SBIR Program on page 21 and the NITON Lead Paint Analyzer example on page 23).

- **Critical diffusion and utilization gaps exist.** Although there are a number of small programs in the diffusion and utilization area, there appear to be serious gaps. These gaps, critical to effective technology diffusion, may deter much of the progress that is made at earlier stages in bringing forward needed technologies to full implementation. These gaps include:

  1. Lack of regional technology focus. There appears to be only one regional program specifically focused on technology facilitation and that one is very small. The regions are the front line of the Agency and a primary source for state and local decision makers to obtain guidance and help on technology and permitting issues, particularly

EPA's SBIR Program: Moving New Ideas Forward to Commercialization

EPA is one of 10 federal agencies that participate in the SBIR Program established by the Small Business Innovation Development Act of 1982. The purpose of this program is to strengthen the role of small businesses in federally funded R&D and help develop a stronger national base for technical innovation. Managed by the National Center for Environmental Research (NCER) within EPA's Office of Research and Development (ORD), EPA's SBIR Program is an important part of the Agency's R&D efforts and it helps EPA achieve its mission to protect human health and safeguard the environment. Through the SBIR Program, EPA makes awards to small, high-tech firms (with no more than 500 employees) to help them develop and commercialize cutting-edge environmental technologies that improve our environment and quality of life, create jobs, increase productivity and economic growth, and improve the international competitiveness of the U.S. technology industry.

EPA establishes annual priority technology categories and announces annual solicitations for Phase I and Phase II research proposals in those categories. Under Phase I, the scientific merit and technical feasibility of the proposed concept is investigated through 6-month contracts of up to $70,000. Before funding Phase II (24-month contracts up to $225,000), EPA determines whether the research idea, often on high-risk advanced concepts, is technically feasible, whether the firm can do the high-quality research required, whether the company has made sufficient progress to justify a larger effort, and whether the technology has commercialization potential.

To assure that promising early-stage technologies continue to move through the system toward full implementation, EPA has added several commercialization enhancing activities to its SBIR Program:

- Technical assistance to SBIR companies through a separate contractor for development of business plans.
- Up to $70,000 for technologies close enough to full commercialization to be accepted into an EPA technology verification testing program.
- An additional year as a Phase II Option for firms with at least $100,000 in third-party financing.
- A database of companies that have successfully completed Phase II that is provided to the regions to identify SBIR technologies that could possibly be used in Supplemental Environmental Projects (SEPs) as part of enforcement settlements.

Since its inception, EPA's SBIR Program has provided approximately $100 million to support the development of 980 innovative technologies, many of which are now in place across the country providing real-world protection to the Nation's air, water, land, and public health. These innovations are a primary source of new technologies that can provide improved environmental protection at lower cost with better performance and effectiveness.

According to the Small Business Administration, more than 39 percent of the Phase II projects funded by federal SBIR Programs result in commercialization of a product or service. Many companies funded by EPA's SBIR Program have successfully commercialized their technologies, and profiles of 29 of these technologies are available on the SBIR Web Site at www.epa.gov/ncer/sbir/success/pdf/stories05.pdf. These companies have demonstrated commercial success through product sales, partnerships and collaborations, licensing, and receipt of follow-on funding from industry, investors, and other government agencies. They also have demonstrated technologic success through the receipt of R&D awards and patents, third-party testing, full-scale demonstration, and approval as a standard method. Many companies have adapted a technology platform to multiple applications to increase their market share and many have installations throughout the world. Equally as important, these companies have shown innovation in addressing current and emerging environmental issues by developing technologies that monitor, treat, and prevent pollution, providing significant public health and environmental benefits.

concerning the performance of new technologies. State and local permitters have been identified as among those most in need of technology information and most likely to rely on command and control mechanisms. Developers also are likely to go to the regions for help and guidance in penetrating EPA's technology assistance programs. The Subcommittee recommends that the Agency establish a policy that each regional office will designate a specific technology information coordinator. This individual should be cognizant of technology developments in all media and technology programs across the Agency. 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 (see the description of Region 1's Center for Environmental Industry and Technology on page 24). Coordination should be supplied by headquarters, perhaps under the auspices of the ETC. The Subcommittee plans to address the management and coordination issues for EPA's technology programs in a future report.

2. Lack of "demand-pull" activities. The Subcommittee recommends that the Agency place more emphasis and increase public awareness of its programs to create a demand for new environmental technologies. A review of the programs arrayed on the Continuum, reveals an apparent gap in Agency programs 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.

- **Sustainability focus.** The Subcommittee recommends that EPA devote increased attention to the important area of sustainability. Expanding programs in energy independence, global climate change, and water infrastructure over the next decade offer opportunities for broadening the Agency's experience with sustainability concepts. Although EPA identifies sustainability as a desirable objective of environmental practices, its technology programs do not appear to consistently require measures of sustainability in the review or assessment of new technologies. Efforts to identify and employ sustainability criteria as a component of technology evaluation may be helpful. In addition, the Agency should consider the development of programs that introduce an intentional search for technology and innovation that improve sustainability in problem areas. 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.

NITON's Lead Paint Analyzer: Assisting Innovative Technologies to Successful Commercialization

With support from EPA's SBIR, ETV, and ETC Programs, NITON LLC (now Thermo Electron Corporation NITON Analyzers Business Unit) developed, improved, and commercialized X-ray fluorescence (XRF) analyzers to detect lead in paint, soil, and dust.

Lead has been associated with a number of environmental and health risks. The importance of this technology is described in ETV's 2006 Case Studies report *Demonstrating Program Outcomes*, which estimates that portable technologies for measuring lead dust could be deployed at approximately 16.5 million housing units out of an estimated potential market of 66 million that were built before 1978 to: (1) screen for lead hazards and assess potential risks; (2) investigate instances of elevated blood lead levels in children; (3) identify lead hazards after renovation and remodeling; (4) assist prospective purchasers in identifying lead hazards; and (5) develop a focused and cost-effective sampling and analysis strategy when combined with confirmatory fixed-site laboratory analysis. Ultimately, the information provided by these technologies can assist in the reduction of lead exposure, with associated human health and economic benefits, particularly for children. Of the 16.5 million pre-1978 residences where the technologies could be used, an estimated 2.6 million might house young children.

SBIR Assistance. Funding from EPA's SBIR Program assisted NITON in developing and commercializing the first ever one-piece, hand-held analyzer, the NITON XL-309 Lead Paint Analyzer in 1994. Since then NITON has made various improvements to its technology and developed a number of new lead analyzer products. In 2004, NITON introduced the newest generation of this technology, the XLp 300 Series Lead Analyzer. Building on the success of the company's award winning XL-300 Series analyzer, the XLp 300 provides fast, accurate lead analysis for inspections and risk assessment and screening, it is easy to use, and it offers advanced reporting and data integration tools. The new hand-held device dramatically enhances inspector productivity—providing dependable results in seconds—even at or near action levels. The XLp 300 features an integrated touch-screen display and advanced, intuitive user interface, along with a built-in barcode scanner, virtual keypad, and optional BlueTooth™ wireless PC communication. The XLp 300 uses a ^{109}Cd source to measure the concentration of lead in paint, even when covered by 50 or more layers of non-lead paint of unknown thickness and composition. Positive/negative classifications are displayed automatically when 95 percent confidence is achieved, and the results are continuously displayed and updated.

ETV Assistance. In 2001, NITON participated in the "Evaluation of Field Portable Measurement Technologies for Lead in Dust Wipes" conducted by EPA's ETV Program. ETV verified the performance of commercially available field analytical technologies for analyzing dust wipes for lead. Data from the XL-300 Series showed excellent agreement with the estimated lead value for the range of samples analyzed, with very few false negative results. The ETV Case Studies report states that ETV verification of these technologies "could potentially help portable laboratories and field service and measurement organizations obtain accreditation under the National Lead Laboratory Accreditation Program (NLLAP) in the near future." Debbie Schatzlein of NITON states, "The advantage of the ETV Program to a manufacturer is being able to prove the viability of their technology."

ETC Assistance. The ETV Case Studies report found that the device could be used to "clear residences for occupation following future abatements or future applications of lead controls," but only if "the technology is used by a portable laboratory or field service and measurement organization that has been accredited by the NLLAP." The ETC Lead Paint Action Team is working to overcome the barriers to NLLAP accreditation for portable laboratories. EPA's Office of Pollution Prevention and Toxics has released the draft Laboratory Quality System Requirements 3 (LQSR3); the LQSR is a complex set of requirements that a laboratory must meet to become NLLAP accredited, and the LQSR3 has been proposed so that portable technologies, such as XRF portable analyzers, could be used by portable laboratories that have demonstrated an appropriate level of performance to become NLLAP accredited. The Action Team is considering a LQSR3 pilot with a state and the NLLAP accrediting organizations to further define the performance standards that will be necessary for implementation of the LQSR3.

CEIT: EPA Region 1's Technology Assistance and Diffusion Program

Initiated in 1993 by EPA Region 1, the Center for Environmental Industry and Technology (CEIT) serves as an information doorway for developers seeking to access EPA resources and attention, and for state, local, and private-sector users seeking data on new technology. CEIT has developed numerous tools and programs to facilitate the flow of information both to and from innovators and government. Region 1 believes that a small investment in resources to coordinate technology development with regional problem solving can provide a major benefit to state and local governments, as well as to technology developers and users. Some of the information transfer activities conducted by CEIT include:

- **CEIT Web Site** (www.epa.gov/ne/assistance/ceit) receives about 14,000 hits per month and contains the **Innovative Technology Inventory**, an inventory of commercially available innovative environmental technologies. Currently, 190 technologies are listed. CEIT creates **Virtual Trade Shows** on specific, high-visibility technology areas. For example, storm water and decentralized waste water trade shows, which address non-point source pollution, list 58 technologies and are widely publicized.

- ***EnvirotechNews*** is a monthly electronic newsletter published by CEIT with 1,500+ subscribers. It disseminates time-critical information to the environmental technology industry in New England on upcoming government technology funding opportunities, ETV performance testing events, and other opportunities of interest.

- **Technology Connection** is an anonymous match-up service designed to facilitate connections between potential technology users and environmental technology developers. CEIT receives anonymous environmental problem statements through the Technology Connection Web Site, and then matches them with problem statements from offices within Region 1 and summaries of recent enforcement actions. These then are released as technology needs announcements under the heading of Technology Opportunities on the Web site, and the responses of developers are forwarded to the requesting party.

- **New England Interstate Regulatory Cooperation Project** is a forum for federal and New England state regulators to discuss specific technology needs and to reduce regulatory barriers to implementation. This project helps to create a broader regional marketplace for new technologies by standardizing the data needed for permitting and deployment of the new technologies both within states and across state boundaries.

- ***TECHNOVATION*** is a technical bulletin published periodically by CEIT, which highlights government programs and new technologies of interest to the regulated community and technology developers. Usually 12-14 pages long, recent issues have focused on the SBIR Program, the ETV Program, and EPA's public databases.

- **SBIR Proposal Preparation Workshops** are conducted by CEIT to help developers, frequently small businesses inexperienced in applying for government funding, understand the criteria of the SBIR Program and how to write an effective SBIR proposal. CEIT also provides input to the SBIR Program on critical technology needs in Region 1 so that these needs can be addressed by future SBIR solicitations.

- **Field information** is provided by CEIT to major EPA programs on a regular basis. In particular, CEIT provides frequent input to the ETV Program on setting technology testing priorities in air, water, and monitoring categories; encourages New England state and local officials to participate in ETV stakeholder groups; and has encouraged hundreds of companies to have their technologies tested in the program.

V. The Environmental Technology Council Action Team

As one of EPA's newest efforts to make the adoption of new technology faster and more effective, the Subcommittee has examined the recently created ETC and the operation of its Action Teams (the ETC was created by EPA in 2004). The ETC is a cross-Agency council chaired by three senior managers from ORD, a program office (currently the Office of Solid Waste and Emergency Response), and a region (currently Region 1). Membership consists of Agency managers and staff from each media program office, ORD, the Office of Enforcement and Compliance Assurance, and all 10 regions. The ETC's three primary functions are to:

1. Identify the priority environmental problems where technology is a critical factor in providing a cost-effective solution.

2. Screen the problems using stakeholder input to determine priority for the Council's attention.

3. Set up temporary Action Teams to address problems. Each team will evaluate the status of possible technology solutions and take actions to address the problem.

The ETC conducted the first prioritization process last year. The 11 Action Teams now functioning across the Agency are addressing a diverse array of technological challenges as shown in Table 1.

Table 1. Environmental Technology Council Action Teams
Arsenic MCL Compliance for Small Drinking Water Systems
Reducing Pollutants from Energy Production Through Coal Gasification
Reducing Pollution from Concentrated Animal Feedlot Operations (CAFOs)
Continuous Monitoring of Fine Particulates
Solving the Lead Paint Problem
Reducing Pesticide Spray Drift
Recovering the Value of Waste for Environmental and Energy Sustainability
Remote Sensing of Pollutants
Rapid Detection of Microbial Contaminants in Drinking Water
Promoting Sustainable Use of Contaminated Sediments
Reducing Urban Runoff

The Subcommittee agrees with the overall objectives of the initiative and has found the following areas of notable strength:

- The elevation of these specific problem areas promotes dialogue and shared ideas to address the identified issues within existing resources.
- Identification of particular problem areas through this kind of a cross-Agency prioritization process sends a strong message to the research and development community on the importance of the selected areas.
- The ETC will provide a new opportunity for private-sector technologies to be brought to the attention of managers across EPA, and for collaboration with other federal agencies.
- The ETC can publicly identify technologies and expertise that are useful for stakeholders.
- Most importantly, an expedited and cross-Agency action approach should allow EPA to solve real environmental problems more quickly than they would otherwise be addressed.

Recommendations of the Subcommittee

At this early stage of its implementation, however, there are a number of adjustments and changes that the Agency should consider. The Subcommittee offers the following findings and recommendations concerning the ETC:

- **EPA should develop a formal and ongoing public process, including the opportunity for input from stakeholders, to identify the country's most pressing environmental problems needing technological solutions, assuring that the selection is truly focused on environmental problems and not simply on technology development.** EPA's periodic public selection of the environmental problems most in need of technological innovation for more rapid and/or cost-effective solutions is a critical function and should be firmly established as a regularly scheduled and highly visible process. Identification of these technology gaps alone will have an impact on the direction of technology development in the private sector and focus developers on future opportunities rather than those of the past. This activity must be clearly focused on problems seeking solutions rather than on technologies seeking commercialization. Several of the first group of 11 Action Teams appear to be in the latter category (e.g., "coal gasification" and "remote sensing of pollutants") and should either be refocused on specific problems or reevaluated for inclusion in the program. Consultation with outside stakeholders would enrich the selection process, add market credibility, and increase public understanding of the problems identified.

- **EPA should make the Action Team initiative a core program with high-level Agency support, while streamlining the management structure for both the ETC and the Action Teams.** The cross-media and cross-regional ETC Action Team initiative should be a core function of EPA and a regular part of Agency operations rather than a special activity. Matrix-managed efforts of this type are inherently difficult to sustain and thus, some management structure adjustments may be required. EPA needs to streamline the oversight for the entire program. The ETC formally reports to the EPA Science Policy Council (SPC) and consults with the EPA Innovation Action Council (IAC), which have overlapping members, all at the Deputy Assistant Administrator and Deputy Regional Administrator levels. The IAC also monitors the performance of the Action Teams. EPA should evaluate possibilities for simplifying, streamlining, and formalizing the management of the ETC and its Action Teams (i.e., assess the relative supervision roles of the IAC and SPC). Follow-through by all managerial participants is important and sometimes difficult to maintain in a program with few resources. In addition, a high-level (e.g., Deputy Assistant Administrator or Deputy Regional Administrator) EPA champion should be identified when an Action Team is established to help provide visibility, motivation, resources, and connections for the Team.

- **The ETC should develop and institute Standard Operating Procedures (SOPs) for Action Teams and assure that they immediately begin to include appropriate outside stakeholders in their deliberations and activities. The most successful Team activities should be highlighted.** Improvement of the operational framework for Action Teams is necessary to make them effective in achieving their goals. It does not appear that objectives, deliverables, or metrics of success have been established for each problem. These are important for determining what products will result at the end of a team's life and when the problem has been solved or the effort has failed. There is no defined lifespan for individual Action Teams, and no defined sunset criteria. The Action Team formation, operation, communication, and termination processes need to be better defined. For these and other reasons, an SOP for the ETC Action Teams needs to be developed. Among other things, the SOP needs to require the establishment of objectives and performance metrics, regular meeting schedules, comprehensive meeting minutes, and an ongoing list of action items. At least a minimal amount of administrative support should be provided to each Action Team for this purpose.

The SOP also should include a methodology for the selection and participation of outside stakeholders and organizations. Early stakeholder input would result in better problem definition, shared action items, better outreach, and a greater likelihood of successful implementation at the conclusion of the effort. No process appears to exist for seeking the broadest range of technologies to evaluate for solutions to the identified problems. Connections with other organizations and practitioners may be particularly helpful in identifying dual-use and cross-over

technologies. Communication strategies have not been developed to provide technology diffusion to stakeholders. To address these and other problems, Action Team membership should be broadened to include additional stakeholders, such as university researchers, state and local officials, industry groups, and those who will ultimately benefit from the solved problem—developers and users.

Finally, the ETC should highlight activities of the most active Action Teams and broadcast successes both within the Agency, to advance the overall program, and outside EPA, to assure that implementation occurs. EPA headquarters and regional offices should provide recognition to the Action Teams and their members through newsletters, stories, awards, and other means. As in most endeavors, communication is essential.

VI. Future Plans

The NACEPT Subcommittee on Environmental Technology began its work in November 2004, and has been chartered for 2 years. The Subcommittee expects to meet several times during 2006 and plans to take up and report on the following additional topics:

- National and international technology partnerships
- EPA technology management and strategy
- Encouraging demand (demand-pull programs and opportunities)
- Communications, education, and outreach (internal and external)
- The extent to which current EPA technology programs on the Continuum address large-scale issues such as sustainability, global climate change, and catastrophic events.

VII. Appendices

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 30 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. Although 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 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 problem areas and the effectiveness of these efforts in supporting private sector development and commercialization of the most critically needed new and sustainable technologies also are 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 users 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 also might 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 Web sites 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.* Web sites 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 also can 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.* U.S. 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 are not 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 pages 33-34), 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 (see pages 32-33), 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.* Because 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 also might 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 permitters, 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: Members of the National Advisory Council for Environmental Policy and Technology (NACEPT) Subcommittee on Environmental Technology

Chair:

Philip Helgerson
Senior Program Manager
CSC Advanced Marine Center

Liaison to the NACEPT Council:

Dan Watts
Executive Director
York Center for Environmental Engineering and Science
New Jersey Institute of Technology

Members:

Linda Benevides
Director of Green Business Development
Executive Office of Environmental Affairs
Massachusetts Department of Environmental Protection

John Crittenden
Richard Snell Presidential Professor of Civil and Environmental Engineering
Department of Civil and Environmental Engineering
Ira A. Fulton School of Engineering
Arizona State University

David Dzombak
Professor of Civil and Environmental Engineering
Department of Civil and Environmental Engineering
Carnegie Mellon University

Kenneth Geiser
Co-Director
Lowell Center for Sustainable Production
Work Environment Department
University of Massachusetts–Lowell

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

Kristine Krause
Vice President, Environmental Group
Wisconsin Energy Corporation

JoAnn Slama Lighty
Professor of Chemical Engineering
Department of Chemical Engineering
University of Utah

John Lindstedt
President
Artistic Plating Company

Raymond Lizotte
Product Environmental Compliance Engineer
Environmental Programs Office
American Power Conversion Corporation

Oliver Murphy
President
Lynntech, Inc.

Robin Newmark
Water and Environment Program Leader
Energy and Environment Directorate
Lawrence Livermore National Laboratory

Patrick O'Hara
President
Cummings/Riter Consultants

Christine Owen
Water Quality Assurance Officer
Tampa Bay Water

Katherine Reed
Staff Vice President
3M Environmental, Health and Safety Operations

Norman Richards
Administrator
First People's Environment, LLC

Karen Riggs
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Environmental Assessment and Exposure
Battelle

James Robbins
Executive Director
Environmental Business Cluster

Howard Roitman
Director of Environmental Programs
Colorado Department of Public Health and Environment

Kent Udell
Professor and Vice-Chair
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Stephen Lingle
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Maggie Theroux
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Walter Kovalick
Director
Technology Innovation and Field Services Division
Office of Superfund Remediation Technology Innovation
Office of Solid Waste and Emergency Response
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Designated Federal Officer:

Mark Joyce
Associate Director
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U.S. Environmental Protection Agency

Contractor Support:

Beverly Campbell
Penelope Hansen
Carolyn Swanson
The Scientific Consulting Group, Inc.

Appendix C: EPA Program and Other Issue Presentations to the NACEPT Subcommittee on Environmental Technology (November 2004 – September 2005)

Presenters/Panelists	Presentation Topics
EPA Presenters	
Jay Benforado, Office of Policy, Economics and Innovation	Innovation at EPA
Steve Lingle, ORD; Walt Kovalick, OSWER, and Maggie Theroux, Region 1	The Environmental Technology Council (ETC)
Myles Morse, ORD	Environmental Technology Opportunities Portal (ETOP)
April Richards, ORD	Small Business Innovation Research (SBIR) Program
Laurel Schultz, ORD	Cooperative Research and Development Agreement (CRADA) Program
Maggie Theroux, Region 1	Center for Environmental Industry & Technology (CEIT)
Teresa Harten, ORD	Environmental Technology Verification (ETV) Program
Clive Davies, OPPTS	Design for the Environment (DfE)
Walt Kovalick, OSWER	Technology Support for Cleanup Programs
Larry Weinstock, OAR	EPA Air and Radiation Technology Programs
Mary Smith, OW	EPA Water Technology Programs
Jim Edward, OECA; Susan O'Keefe, OECA Technology Programs	EPA Enforcement and Compliance Assurance
Sally Gutierrez, ORD	Technology Programs at EPA Laboratories
Sol Salinas, OIA; Joseph Ferrante, OIA	EPA's International Programs
Kristin Pierre, OPPTS	Green Suppliers Network Case Study
Other Presenters/Panelists	
Lars Olaf Hollner, European Union	International Views: Trends and Directions on Environmental Technology
David Rejeski, Woodrow Wilson Center	Creating a New Environmental Technology Strategy
Andrew Patterson, Environmental Business Journal	Status of Private Sector Environmental Technology Industry
Clayton Teague, National Nanotechnology Coordination Office, Office of Science and Technology Policy	New Technology Horizons: Nanotechnology
Kei Koizumi, American Association for the Advancement of Science	Status of Governmental Support for Environmental Technology
Alvin Firmin, CDM; Richard Craig, Weston Solutions	Perspectives of Representatives from the American Council of Engineering Companies
Carlos Montoulieu, U.S. Department of Commerce	International Environmental Technology Markets
John Ferland, Maine Center for Enterprise Development	Technology Incubation and Development
Owen Boyd, SolmeteX; Dan Ostrye, SeptiTech; Stuart Nemser, Compact Membrane Systems; and Joseph Pezzullo, CES	Perspectives of Technology Vendors
Kristine Krause, Wisconsin Energy Corporation	Electric Power Research Institute Mercury Control Case Study
Bob Mueller, New Jersey Department of Environmental Protection	Interstate Technology and Regulatory Council/Technology Acceptance and Reciprocity Partnership Case Studies

APPENDIX D: EPA Technology Development Continuum

Purpose — To provide a guide for those inside and outside the Agency to the EPA programs that address environmental technology, and the type of support these programs provide along the path from development to commercialization.

What Is the Technology Continuum? — Successful environmental technologies progress along a research and development (R&D) continuum from basic research to full-scale commercialization and utilization. This continuum generally includes six phases that should not be viewed as a necessarily linear process but as interdependent activities whose boundaries often are blurred. The six phases are: (1) basic research and proof of concept, (2) technology development, (3) demonstration at either pilot or full scale, (4) verification of performance at the commercialization stage, (5) commercialization by the private sector, and (6) diffusion activities and utilization by customers. Definitions of these phases are found below. An important aspect of this continuum is that at every stage, technologies that fail to perform or are seen as economically infeasible move to the sidelines and are not further developed for utilization. This weeding out process is inherent in all fields of research, but particularly true of technology development.

Definitions of activities performed at different points along the continuum of technology research, development, and diffusion/utilization are quite fluid. In addition, different industry, media, and government program sectors may place different activities in different places along the continuum. The definitions provided on the next page, therefore, are used primarily to give clarity to the reader in the context of the terms used in the mapping of EPA's environmental technology programs and should not be considered definitive in the context of all EPA technology programs. The process described takes between 5 and 15 years, which is fairly typical of technology development in other fields.

EPA's Environmental Technology Programs — EPA seeks to encourage academic, public, and private sector developers to invest time and money in the creation of new, cost-effective environmental technologies by providing them with a variety of tools and opportunities to further their efforts. EPA also provides guidance through its programs and research solicitations on areas that the Agency thinks are most in need of innovative technologies. Figure 1 illustrates how EPA focuses its activities by mapping Agency environmental technology programs along the R&D continuum. The 24 programs arrayed across one or more phases of the continuum were taken from the Environmental Technology Opportunities Portal (www.epa.gov/etop), which provides a one-stop-shop for information on EPA's technology assistance programs.

Descriptions of the individual programs follow. They are presented in order of where the program's primary emphasis begins on the continuum (e.g., programs that have a primary emphasis on supporting research/proof of concept appear first in the figure). In addition to a brief overview of each program, the descriptions note the primary and secondary (if any) emphases of the programs, the target media areas, the purpose and type of support provided by EPA, the responsible EPA office, and a Web site for more information. No specific information on resources has been provided in the program descriptions because resources vary from year to year. To provide an approximation of the size of the programs in Fiscal Year 2005, they have been assigned to one of the following three categories:

- $ = Programs with less than $1 million/year
- $$ = Programs with $1 million/year to $10 million/year
- $$$ = Programs with greater than $10 million/year

A graphic depiction of these programs along the continuum is presented in Figure 1, with primary functions in dark shading and secondary functions in light shading.

Definitions of Environmental Technology Development Stages[1]

Research/Proof of Concept
To conduct basic and/or bench-scale research on a technology approach or idea within categories that show the potential for solving various types of intractable, challenging, or expensive environmental problems. The result of this stage of development is a technology that shows enough promise both technically and in market potential to allow it to garner ongoing scale-up support.

Development
To move from bench to pilot stage research on a given technology. This stage of the scale up may require a number of pilot-scale activities and various false starts that need correction. The result of this stage of development is a one-of-a-kind technology that shows enough promise both technically and economically to allow it to garner support for scale up and full-scale demonstration.

Demonstration
To construct and conduct tests on first time or early stage technology at full scale under varying conditions to show its range of performance, determine its applicability and weaknesses, optimize its operational parameters, and determine its costs. The demonstration stage can be characterized by substantial redesign and debugging until final "robustness" and optimization can be established. Final results may be used to market financial backers and even customers.

[1] These definitions should not be considered definitive in the context of all EPA technology programs.

Verification
To test and publicly report the performance of a commercial-ready technology under specific, predetermined protocols designed by stakeholders and quality assurance procedures stipulated by EPA. Technologies within a given class are tested by independent organizations in the same or similar manner to assist purchasers and permitters in comparing the environmental and operational performance of competing products and technologies. Results, if positive, are used for direct customer marketing purposes.

Commercialization (Private Sector)
To prepare for, finance, and implement full-scale manufacturing and marketing activities moving from one or few-of-a-kind to reliably produced and replicable technology. This often includes developing business plans, entering into partnerships, securing working capital, arranging for manufacturing facilities, and developing channels for distribution.

Diffusion
To implement a full-scale marketing plan for products or technology, including interface with appropriate authorities. This stage is characterized by intensive marketing to all appropriate stakeholders and can be assisted by government through a broad array of tools such as Web sites, targeted conferences, list-serves, and information targeting state and local authorities.

Utilization
To encourage the adoption and/or purchase of fully developed and proven new technology by assisting in the flow of information about the technology within the targeted environmental area, acting as "first users," and removing regulatory barriers to its implementation.

EPA Offices

OAR – Office of Air and Radiation
OPPTS – Office of Prevention, Pesticides and Toxic Substances
ORD – Office of Research and Development
OSWER – Office of Solid Waste and Emergency Response
OW – Office of Water

Descriptions of EPA's Environmental Technology Programs

1. **Science To Achieve Results (STAR):** The STAR Program is EPA's primary competitive grants program to fund extramural research in environmental science and engineering for universities and nonprofit organizations.

Areas on Technology Continuum:	**Research/Proof of Concept** Development (secondary focus)
Media Focus:	Focus areas chosen each year
Type of Support Provided:	Grants to universities and nonprofits
Funding:	$$[2]
Responsible Office:	ORD
Web Site:	www.epa.gov/ncer/grants

The STAR Program supports the research of investigators at universities and nonprofit organizations. Cutting-edge science and proof of concept-type projects are supported in research areas consistent with EPA's mission and vision. Past research has included a wide range of technology areas with focus on green chemistry and engineering. Current emphasis is on nanotechnology. Grants average about $350,000 for 3 years.

2. **Federal Technology Transfer Act (FTTA) Activities:** The FTTA allows for negotiated agreements between specific EPA offices or laboratories/centers and external organizations to undertake joint research projects, exchange materials, or license EPA developed technologies.

Areas on Technology Continuum:	**Research/Proof of Concept** **Development** **Demonstration** Diffusion/Utilization (secondary focus)
Media Focus:	All
Type of Support Provided:	Use of EPA facilities, equipment, and other in-kind services by public or private technology developers
Funding:	$$
Responsible Office:	ORD
Web Sites:	www.epa.gov/etop/crada/index.html www.epa.gov/osp/ftta.htm

The FTTA provides a mechanism for cooperative research and development partnerships. Through the FTTA program, federal agencies can conduct joint research with non-federal partners and protect intellectual property that may be developed. The alliance that is formed through the FTTA program supports and improves U.S. competitive positions worldwide, helps remove barriers to collaboration, and encourages cooperative research and development with the goal of commercialization. Cooperative research and development agreements (CRADAs) allow non-federal parties to collaborate on projects with the EPA and

[2] The funding levels in this document reflect Fiscal Year 2005 resources.

share in-kind resources. Non-federal parties can provide direct funds as well, but the Agency cannot. EPA also can license technologies developed within the Agency to external parties and accept royalties. Royalties are split between the EPA laboratory where the technology was developed and the inventor(s).

3. **ORD In-House Technology Research:** ORD conducts a vigorous and well-recognized research program in environmental technology. It includes R&D through technology transfer in monitoring, treatment, prevention, and cleaner technologies.

Area on Technology Continuum:	**Research/Proof of Concept** **Development** **Demonstration** **Verification** **Diffusion/Utilization**
Media Focus:	All media and cross-media
Type of Support Provided:	Bench research to full-scale demonstrations and technology transfer
Funding:	$$$
Responsible Office:	ORD

ORD utilizes a multidisciplinary in-house staff of scientists and engineers to conduct an applied research, development, and technology transfer program for new environmental technologies. Technologies of interest are determined largely by the critical needs of EPA program offices for understanding how current or emerging technology performs in a specific problem area, such as for mercury control and drinking water disinfection. ORD also responds to the need for new technology development for emerging issues where there is a gap in work performed by external research organizations and where ORD may provide a unique multimedia, multidisciplinary approach. A postdoctoral program is used to quickly engage new expertise if needed to supplement ORD staff. CRADAs may be used to collaboratively develop technology approaches with private-sector support for research from proof-of-concept to pilot-scale demonstration. Examples of this type of research are especially found in the green chemistry, green engineering, and pollution prevention tools development areas of the in-house research program.

4. **Small Business Innovation Research (SBIR):** EPA provides funding for technology development from proof of concept (Phase I) through commercial prototype (Phase II) using competitive solicitations for small businesses.

Areas on Technology Continuum:	**Research/Proof of Concept** **Development** Demonstration (secondary focus) Verification (limited to funding for ETV verification) Diffusion/Utilization (limited to funding for commercialization option)
Media Focus:	Focus areas chosen each year
Type of Support Provided:	Contracts to small businesses
Funding:	$$
Responsible Office:	ORD
Web Site:	www.epa.gov/ncer/sbir

In addition to awarding contracts averaging $295,000 for the core activities of proof of concept and prototype development, the SBIR program encourages further development leading to commercialization by offering additional funding of $70,000 to firms that have secured third-party financing for accelerating commercialization of the technology and up to $50,000 to support verification of technologies accepted into EPA's Environmental Technology Verification (ETV) Program. Areas of technology focus are chosen each year and can cover all environmental media.

5. **Clean Automotive Technology Program:** Under this program, EPA conducts innovative research in collaboration with the automotive industry to achieve ultra-low pollution emissions, increase fuel efficiency, and reduce greenhouse gases.

Areas on Technology Continuum:	**Research/Proof of Concept** **Development**
Media Focus:	Air
Type of Support Provided:	Researchers and facilities
Funding:	$$$
Responsible Office:	OAR
Web Site:	www.epa.gov/otaq/technology

By developing cost-effective technologies, the program encourages manufacturers to produce cleaner and more fuel-efficient vehicles. Also under the program, EPA is working with industrial partners to evaluate and develop the Agency's Clean Diesel Combustion (CDC) Technology, which refines several existing technologies into a unique engine design that is simultaneously clean, efficient, and cost effective. EPA partners with industry to maximize the viability of targeted technologies for commercial production through CRADAs. The research is conducted at EPA's National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan. The Clean Automotive Technology Program has four main focus areas: (1) hydraulic hybrid research, (2) engine research, (3) alternative fuels research, and (4) technical and analytical support.

6. **Water Nonpoint Source Grants Program:** EPA awards grants to state and tribal agencies to deal with nonpoint sources of water pollution.

Areas on Technology Continuum:	**Research/Proof of Concept** **Development** **Demonstration**
Media Focus:	Water
Type of Support Provided:	Grants or cooperative agreements
Funding:	$$$
Responsible Office:	OW
Web Sites:	www.epa.gov/owow/nps/cwact.html

Under the authority of Section 319(h) of the Clean Water Act (CWA), EPA makes grant funds available to state and tribal agencies to implement their approved nonpoint source management programs. These programs can contain components involving technical assistance, technology transfer, and demonstration projects. Each year, EPA awards Section 319(h) funds to states in accordance with a state-by-state allocation formula that the Agency has developed in consultation with the states.

7. **Small Drinking Water Systems and Capacity Development:** This program addresses issues affecting drinking water systems serving populations less than 3,300.

Areas on Technology Continuum:	**Research/Proof of Concept** **Development** **Utilization**
Media Focus:	Drinking water treatment
Type of Support Provided:	Research, information/technology transfer[3]
Funding:	$
Responsible Office:	OW
Web Site:	www.epa.gov/safewater/smallsys.html

The Safe Drinking Water Act (SDWA) authorizes EPA to make grants to institutions of higher learning to establish and operate small public water systems technology assistance centers (TACs). Together, the eight TACs and state and federal regulatory agencies work with small water systems (serving less than 10,000 population) to assist them in acquiring and maintaining the technical, managerial, and financial capacity needed to consistently provide safe drinking water and meet the public health protection goals of the SDWA. Resources available include, but are not limited to, onsite technical assistance, training for water systems operators and managers, technical assistance in conducting sanitary surveys and self-assessments, water treatment technology research and evaluation, computer training including database and Web page development and management, systems finances, and monitoring.

8. **Water Security:** Significant actions are underway to develop new security technologies to detect and monitor contaminants and prevent security breaches.

Areas on Technology Continuum:	**Development** **Verification** **Utilization**
Media Focus:	Water security
Type of Support Provided:	Verification, information/technology transfer[3]
Funding:	$$
Responsible Office:	ORD/OW
Web Site:	cfpub.epa.gov/safewater/watersecurity/index.cfm

EPA works with other federal agencies (e.g., the Centers for Disease Control and Prevention, the Federal Bureau of Investigation, and the Department of Defense) and water sector organizations (e.g., Water Environment Research Foundation) to improve information on technologies and conduct research for water sector security. ORD and OW developed the Water Security Research and Technical Support Action Plan, which was peer reviewed by the National Research Council. This publication presents results of collaborative efforts between EPA and other government agencies, the water industry, public health organizations, and the emergency response community to identify critical research and technical support needs for protecting drinking and wastewater infrastructures. The Water Security Division in OW is working with ORD to support verification of water security technologies.

[3] The activities of some of the information/education programs target earlier stages in the technology development continuum but because commercialization and/or utilization are the ultimate objective of these programs, they were mapped to the commercialization and/or utilization stage of the continuum.

9. **National Environmental Technology Competition (NETC):** The NETC Program was created to recognize and reward innovative and cost-effective technology solutions and to move them toward commercialization. It also emphasizes sustainable technologies and practices.

Areas on Technology Continuum:	**Demonstration** Diffusion/Utilization (secondary focus)
Media Focus:	All
Type of Support Provided:	Grants to universities
Funding:	$$
Responsible Office:	ORD
Web Site:	www.epa.gov/etop/netc/index.html

NETC's current focus is to provide small grants to teams of university students to compete in a national competition called "P3" (People, Prosperity, Planet). The teams develop sustainable technology designs for the developed and developing world over the academic year and exhibit them in a spring competition on the National Mall in Washington, DC. Winning teams receive additional funds to further develop and implement their designs. Sixty-six teams competed in 2005.

10. **Arsenic Treatment Technology Demonstration Program:** The purpose of the Arsenic Treatment Technology Demonstration Program is to evaluate cost-effective technologies to help small drinking water systems meet the new arsenic standard. One major aspect of the program was the initiation of the full-scale treatment demonstration program. Recognizing that the new arsenic rule can be an economic burden to small water systems, the demonstration program research was specifically geared toward establishing, testing, and demonstrating effective arsenic technologies that are low cost. The demonstrations are: (1) evaluating cost-effectiveness relative to existing technologies and gauge simplicity of operation, (2) evaluating the effectiveness of arsenic treatment technologies under varying water quality conditions, (3) comparing reliability, (4) documenting operation and maintenance needs, and (5) characterizing arsenic wastes (residuals) and evaluating management practices. The goal of the program is to provide information on arsenic treatment technologies to water systems, engineering firms, regulatory officials, and others impacted by the new arsenic standard.

Areas on Technology Continuum:	**Demonstration** **Verification** Utilization (secondary focus)
Media Focus:	Drinking water treatment
Type of Support Provided:	Full-scale demonstration and performance evaluation
Funding:	$$
Responsible Office:	ORD
Web Site:	www.epa.gov/ORD/NRMRL/arsenic

When the new arsenic drinking water standard was announced the Agency committed to provide an extensive research and technical assistance program to assist small communities in meeting the revised maximum contaminant limit of 10 µg/L. The centerpiece of the program is full-scale demonstration of commercial-ready arsenic treatment technologies at 40 selected water systems across the country. The treatment systems are being installed in 20 different states, and performance evaluation studies are conducted for a minimum of 1 year to determine the cost and performance of the systems. The average cost of each demonstration project that includes the cost of the full-scale treatment system and the performance evaluation study is $500,000.

11. **Superfund Innovative Technology Evaluation (SITE):** The SITE Demonstration Program offers a mechanism for conducting joint technology demonstration and evaluation projects at hazardous waste sites involving the private sector, EPA, and other state and federal agencies. The SITE Program is composed of a Demonstration Program and a Measurement and Monitoring Technologies Program.

Areas on Technology Continuum:	**Demonstration** **Verification**
Media Focus:	Hazardous waste treatment and monitoring technologies
Type of Support Provided:	Pilot and full-scale demonstration and performance reports
Funding:	$$
Responsible Office:	ORD
Web Site:	www.epa.gov/ORD/SITE

The SITE Program supports field tests of innovative hazardous waste treatment technologies at sites where few remedial alternatives exist, or existing methods are too costly. The SITE Measurement and Monitoring Technologies Program evaluates technologies for characterization and monitoring of toxic substances to provide more cost-effective methods for producing real-time data. SITE compiles data and reports on variables such as the performance of the technology, potential operating problems, capital and operating costs, and the applicability to other sites and waste types. The SITE program is responsible for preliminary treatability studies, test plan preparation, sampling, sample and data analysis, and the reporting of the demonstration results. All project participants (i.e., SITE Program, site/problem owner, and technology vendor) share in the project funding through financial and in-kind contributions.

12. **Technology Testing and Evaluation Program (TTEP):** TTEP's mission is to service the needs of water utility operators, building and facility managers, emergency responders, consequence managers, and regulators by providing reliable performance information from a trusted source.

Areas on Technology Continuum:	**Demonstration** **Verification** Diffusion/Utilization (secondary focus)
Media Focus:	Homeland security-related technologies, specifically detection, monitoring, treatment, and decontamination as applied to high hazard chemical, biological, and radiological contaminants
Type of Support Provided:	Technology testing and evaluation and performance reports
Funding:	$$
Responsible Office:	ORD
Web Site:	www.epa.gov/nhsrc/tte.htm

The TTEP process includes the use of chemical and biological warfare agents and field testing where appropriate. ETV test plans often are used after being modified to meet homeland security requirements. All testing is conducted following strict quality assurance (QA) procedures that are described in the test plan. The data are evaluated, and the performance results are included in individual summary reports and in side-by-side comparisons. TTEP provides high-quality test results obtained through rigorous testing. Technologies are tested using a wide range of performance characteristics, requirements, or specifications. The results are provided in user-oriented products that are intended for procurement and application decisions. These products can take the form of brief summary reports and side-by-side comparisons whenever possible.

13. **Technology Innovation Program (TIP):** The Office of Superfund Remediation and Technology Innovation's TIP provides information about characterization and treatment technologies for the hazardous waste remediation community. The program offers technology selection tools and describes programs, organizations, and publications for federal and state personnel, consulting engineers, technology developers and vendors, remediation contractors, researchers, community groups, and individual citizens.

Areas on Technology Continuum:	**Demonstration** **Diffusion/Utilization**
Media Focus:	Technologies addressing contamination of soil or groundwater
Type of Support Provided:	Funding and information/technology transfer[3]
Funding:	$$
Responsible Office:	OSWER
Web Site:	www.epa.gov/tio

The main goal of TIP is to assemble and disseminate information about treatment technologies through partnerships and initiatives such as the Federal Remediation Technologies Roundtable (www.frtr.gov), the State Coalition of Drycleaners (www.drycleancoalition.org), and the Remediation Technologies Development Forum (www.rtdf.org)—all promoting commercialization and utilization of remediation technologies. Through Measurement and Monitoring Technologies for the 21st Century (21M², www.cluin.org/programs/21m²), EPA supports field projects for first-time deployment of commercial-ready measurement techniques for contaminants in soil and groundwater. Funding for the 21M² demonstrations is about $270,000 per year. TIP also promotes numerous databases and provides a support area for vendors and developers (www.cluin.org/vendor).

14. **Environmental Technology Verification (ETV):** The ETV Program develops testing protocols and verifies the performance of innovative technologies with the potential to more efficiently and effectively protect human health and the environment.

Areas on Technology Continuum:	**Verification** Diffusion/Utilization (secondary focus)
Media Focus:	All environmental technologies except hazardous waste remediation
Type of Support Provided:	Verification testing and reports under consensus protocols
Funding:	$$
Responsible Office:	ORD
Web Site:	www.epa.gov/etv

The ETV Program provides independent performance verification data for commercial-ready technologies to help purchasers and permitters evaluate which technologies to select to solve environmental problems. The program has developed 82 consensus testing protocols for various technology categories through the efforts of 12 stakeholder groups and has completed 350 verification tests and reports for innovative air, water, and monitoring technologies. Both the protocols and test reports are posted on the ETV Web Site, which receives over 1.5 million hits a year. ETV testing protocols are used around the world to evaluate commercial-ready technologies. An average verification costs about $80,000, and ETV currently funds approximately 50% of the cost of the verification; the vendor and other partners fund the remaining 50%.

15. **Green Engineering Program:** Green Engineering is the design, commercialization, and use of processes and products that are feasible and economical while minimizing the generation of pollution at the source and risk to human health and the environment.

Areas on Technology Continuum:	Research/Proof of Concept (through the STAR and SBIR Programs) **Utilization**
Media Focus:	Pollution prevention technology
Type of Support Provided:	Information/technology transfer[3], education
Funding:	$$
Responsible Office:	OPPTS
Web Site:	www.epa.gov/opptintr/greenengineering

The goal of the Green Engineering Program is to "institutionalize" green thinking in the design, commercialization, and use of processes and products. One goal of the program is to introduce a "green" philosophy into engineering programs through the development of environmental information disseminated to the academic and industrial communities. EPA has partnered with the American Society of Engineering Education to develop green engineering educational materials to train the next generation of engineers. The materials have included a textbook, student handouts, instructor's guide, and case studies. The program also co-sponsors workshops to facilitate the exchange of green engineering information among practicing engineers and researchers. Both the SBIR Program and the STAR Program include green engineering in their research programs.

16. **Green Chemistry Program:** The Green Chemistry Program promotes innovative chemical technologies that reduce or eliminate the use or generation of hazardous substances in the design, manufacture, and use of chemical products.

Area on Technology Continuum:	Research (through the STAR Program) Proof of Concept (through the SBIR and STAR Programs) **Utilization**
Media Focus:	All
Type of Support Provided:	Information/technology transfer[3], recognition, education
Funding:	$
Responsible Office:	OPPTS
Web Site:	www.epa.gov/opptintr/greenchemistry

The Green Chemistry Program supports educational efforts, international activities, and conferences and meetings to encourage the commercialization/utilization of Green Chemistry. Activities include the Presidential Green Chemistry Challenge Award given annually to recognize innovative chemical technologies that accomplish pollution prevention and have broad application. An annual Green Chemistry and Engineering conference presents the latest research and commercial activities in green chemistry. Both the SBIR Program and the STAR Program include green chemistry in their research programs.

17. **Water Efficiency Market Enhancement Program:** By reaching out to organizations and fostering public-private partnerships, the Water Efficiency Market Enhancement Program hopes to promote the use of more water-efficient products and practices in businesses and homes across the country.

Areas on Technology Continuum:	**Diffusion/Utilization**
Media Focus:	Water
Type of Support Provided:	To be determined
Funding:	$$
Responsible Office:	OW
Web Site:	www.epa.gov/owm/water-efficiency/products_program.htm

Implementation of an effective Water Efficiency Market Enhancement Program could save billions of dollars in infrastructure costs, save consumers billions of dollars in water and energy costs, and help protect aquatic ecosystems. OW currently is examining options for program design that might include information dissemination and a product certification and labeling program. Extensive stakeholder input has been solicited, and a preliminary assessment of 41 products has been completed. A more detailed scoping of 14 products is now underway.

18. **Design for the Environment (DfE):** The DfE partnership projects promote the integration of cleaner, cheaper, and smarter solutions into everyday business practices.

Areas on Technology Continuum:	**Diffusion/Utilization**
Media Focus:	Technical tools and expertise in specific industry sectors
Type of Support Provided:	Information/technology transfer[3], partnership brokering
Funding:	$
Responsible Office:	OPPTS
Web Site:	www.epa.gov/opptintr/dfe

The DfE Program collaborates with a broad range of stakeholders that include manufacturers, trade groups, and environmental organizations, to achieve risk reduction by applying Office of Pollution Prevention and Toxics (OPPT) technical tools and expertise. DfE partners with a range of industry sectors (e.g., chemical manufacturers, chemical product formulators, the furniture industry, the electronics industry, and nail salons) to incorporate cleaner, innovative technologies into their business organizations (utilization). DfE partnerships protect human health and the environment by focusing on sectors with potential for the maximum reduction of release of chemicals of concern and sectors that could be most influenced by EPA's involvement.

19. **Clean Air Technology Center (CATC):** The CATC serves as a resource for all areas of emerging and existing air pollution prevention and control technologies and provides public access to data and information on their use, effectiveness, and cost. The CATC is comprised of the Reasonably Available Control Technology/Best Available Control Technology/ Lowest Achievable Emission Rate Clearinghouse (RBLC), the U.S. - Mexican Border Information Center on Air Pollution, and the Small Business Assistance Program.

Areas on Technology Continuum:	**Diffusion/Utilization**
Media Focus:	Air pollution and control technologies
Type of Support Provided:	Information/technology transfer[3]
Funding:	$
Responsible Office:	OAR
Web Site:	www.epa.gov/ttn/catc

The CATC provides the public with information on different facets of air pollution and control technologies, promoting commercialization and utilization of innovative environmental technologies.

20. **Voluntary Diesel Retrofit Program:** OAR's voluntary program designed to improve the emission performance of existing diesel vehicles and equipment. The program is building a market for clean diesel concepts by: (1) accelerating the delivery of ultra-low sulfur diesel (ULSD), (2) forging business partnerships and relationships, (3) evaluating technologies and supporting their use, and (4) investing EPA resources to accelerate market growth. In February 2005, EPA announced the award of 18 grants designed to demonstrate effective emissions reduction strategies for diesel fleets. Each demonstration project reduces the impacts of pollution on a population that is especially susceptible to the effects of diesel exhaust, including children, the elderly, and the chronically ill. The 18 grant recipients will use retrofit diesel vehicles and equipment with advanced technologies.

Areas on Technology Continuum:	**Diffusion/Utilization**
Media Focus:	Air
Type of Support Provided:	Funding, partnerships brokering, information/ technology transfer[3]
Funding:	$$
Responsible Office:	OAR
Web Site:	www.epa.gov/otaq/retrofit

EPA has a plan to significantly reduce pollution from new diesel engines. It is a two-step approach that first set new emission standards for diesel engines that took effect in 2004. In the second step, EPA will establish even more stringent emission standards for these engines beginning in 2007 in combination with ULSD fuel. Because new vehicles and engines are purchased gradually over time to replace older units, EPA has developed the Voluntary Diesel Retrofit Program to help make a difference in the immediate future. The program will address pollution from diesel construction equipment and heavy-duty vehicles that currently are on the road.

21. **SmartWay Transport Partnership:** EPA's SmartWay Transport Partnership is working to accelerate innovative emission reduction technology into the freight industry. Many technologies have the potential to reduce emissions (e.g., NOx and particulate matter) and improve fuel efficiency.

Area on Technology Continuum:	**Utilization**
Media Focus:	Air
Type of Support Provided:	Standards, information/technology transfer[3]
Funding:	$$
Responsible Office:	OAR
Web Site:	www.epa.gov/otaq/smartway/index.htm

Unnecessary idling at truck stops wastes about a billion gallons of fuel annually. Advanced truck stop electrification offers a feasible solution. Electrification refers to a technology that harnesses an electrical system to provide the truck operator with climate control, access to telecommunication (e.g., e-mail, Internet), and other needs, eliminating the need to idle the main engine. It can be a stand-alone system or it can include a combined on-board and off-board system. In October 2003, EPA and the Department of Transportation held the first national workshop on developing consistent truck stop electrification codes and electrical standards. Following this workshop, EPA published a Notice of Data Availability (NODA) in the *Federal Register* requesting comments and suggestions that would be used to better develop a national consensus.

22. **Center for Environmental Industry and Technology (CEIT):** EPA Region 1's CEIT provides access to resources, people, and programs for the environmental technology industry in New England and promotes the acceptance of innovative environmental technologies to solve the most significant environmental problems in New England.

Areas on Technology Continuum:	**Diffusion/Utilization**
Media Focus:	All media
Type of Support Provided:	Information/technology transfer[3], partnership brokering
Funding:	$
Responsible Office:	Region 1
Web Site:	www.epa.gov/ne/assistance/ceit

New England has a significant number of environmental technology developers. CEIT was established in 1993 to help these companies get their technologies into the marketplace. Over time, CEIT has developed a number of information services that cover the entire technology continuum. CEIT connects technology developers with funding sources as well as verification and demonstration opportunities through the CEIT Web Site. It also offers an advisory service to technology developers at any stage, and provides them with opportunities to market their technologies on CEIT's Web-based Innovative Technology Inventory and Virtual Trade Shows.

23. **Green Building Program Workgroup:** Green or sustainable building is the practice of creating healthier and more resource-efficient models of construction, renovation, operation, maintenance, and demolition.

Area on Technology Continuum:	**Utilization**
Media Focus:	Building technology
Type of Support Provided:	Information/technology transfer[3]
Funding:	$
Responsible Office:	OPPTS and OAR, current co-chairs
Web Site:	www.epa.gov/opptintr/greenbuilding

EPA provides information to homebuilders, businesses, and interested individuals on green building and promotes green building through programs such as Indoor Environments, Environmentally Preferable Purchasing, ENERGY STAR, and numerous others.

24. **ENERGY STAR:** ENERGY STAR is a government-backed program helping businesses and individuals protect the environment through the implementation of superior energy efficiency technology and procedures.

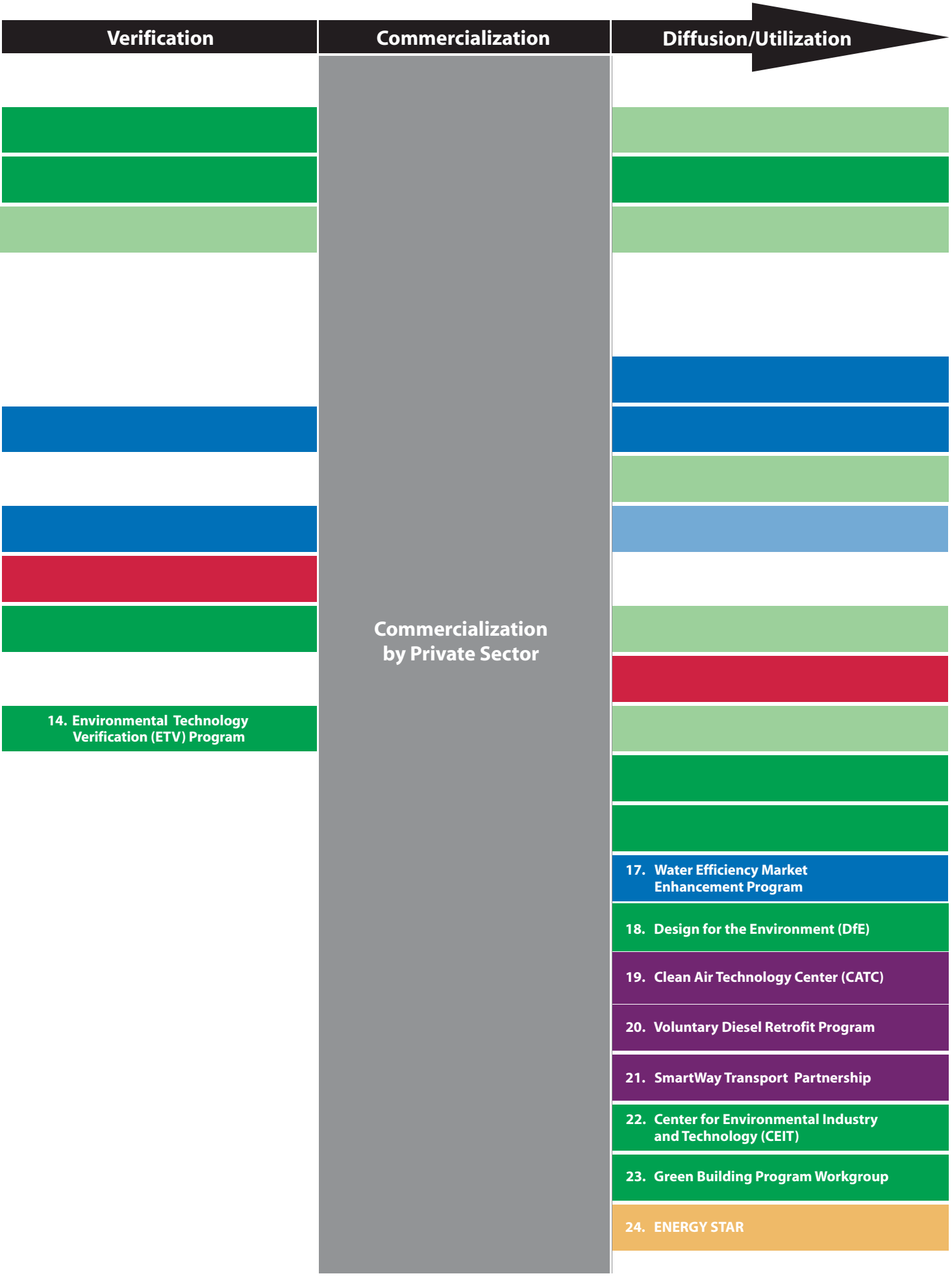
Area on Technology Continuum:	Utilization
Media Focus:	Energy conservation
Type of Support Provided:	Information/technology transfer[3]
Funding:	$$$
Responsible Office:	OAR
Web Site:	www.energystar.gov

The ENERGY STAR program works with companies to assist them in planning and implementing ENERGY STAR-qualified products that use less energy, save money, and help protect the environment. Businesses use the ENERGY STAR designation as a marketing tool to help promote the sale/use of their products.

Research/Proof of Concept	Development	Demonstration
1. Science To Achieve Results (STAR) Program		
2. Federal Technology Transfer Act (FTTA) Activities		
3. ORD In-House Technology Research		
4. Small Business Innovation Research (SBIR) Program		
5. Clean Automotive Technology Program		
6. Water Nonpoint Source Grants Program		
7. Small Drinking Water Systems and Capacity Development		
	8. Water Security	
		9. National Environmental Technology Competition (NETC)
		10. Arsenic Demonstration Program
		11. Superfund Innovative Technology Evaluation (SITE) Program
		12. Technology Testing and Evaluation Program (TTEP)
		13. Technology Innovation Program (TIP)

15. Green Engineering Program

16. Green Chemistry Program


Verification
Commercialization
Diffusion/Utilization
Commercialization by Private Sector
14. Environmental Technology Verification (ETV) Program
17. Water Efficiency Market Enhancement Program
18. Design for the Environment (DfE)
19. Clean Air Technology Center (CATC)
20. Voluntary Diesel Retrofit Program
21. SmartWay Transport Partnership
22. Center for Environmental Industry and Technology (CEIT)
23. Green Building Program Workgroup
24. ENERGY STAR