

Federal R&D Trends and Interagency Activities **2**

At least five federal departments and three independent agencies have important roles in environmental technology research and development (R&D). This chapter discusses overall estimates of federal agency environmental technology spending and the limitations of current data. It also discusses interagency coordination mechanisms and strategy development efforts.

FEDERAL FUNDING FOR ENVIRONMENTAL TECHNOLOGY

Meaningful estimates of federal R&D spending on environmental technology are difficult to develop. The main reason is that definitions of “environmental technology” vary, and applying definitions in practice often involves subjective judgments.¹ Also, several agencies and programs fund or conduct R&D; in some cases, a close examination of all projects funded under a

¹The Clinton Administration’s environmental technology strategy defines environmental technology as:

“technology that reduces human and ecological risks, enhances cost effectiveness, improves process efficiency, and creates products and processes that are environmentally beneficial or benign. The word ‘technology’ is intended to include hardware, software, systems, and services. Categories of environmental technology include those that avoid environmental harm, control existing problems, remediate or restore past damage, and monitor and assess the state of the environment.”

The definition is set forth in, National Science and Technology Council, *Bridge to A Sustainable Future: National Environmental Technology Strategy* (U.S. Government Printing Office, Washington, DC, April 1995), p. 3. On the difficulties in classifying environmental technologies, see U.S. Congress Office of Technology Assessment, *Industry, Technology, and the Environment*, OTA-1SC-586 (Washington, DC: U.S. Government Printing Office, January 1994), pp. 75-79.

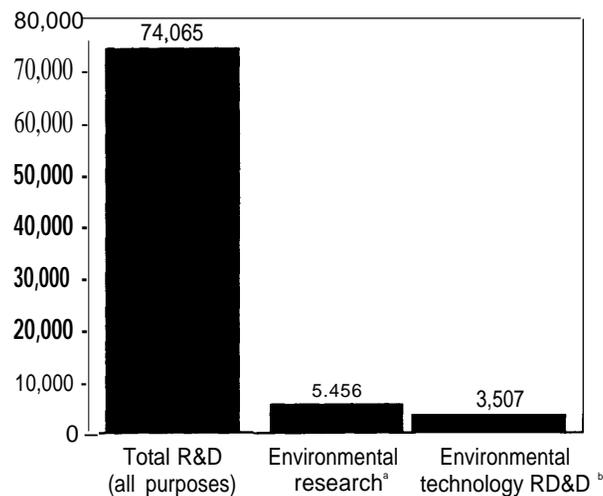
6 Environmental Technology: Analysis of Selected Federal R&D Programs

R&D program not ostensibly environmental in nature would reveal some environmental projects. While some efforts have been made to distinguish between focused projects—those undertaken primarily for environmental reasons—and projects for which environment is only a contributing objective, the border lines are often fuzzy.

A further complication is that federal environmental technology activities range across a spectrum, stretching from basic research, through applied research, technology development and demonstration, to technical assistance or other forms of help to end users. To develop an accurate picture of federal environmental technology R&D, analysts would need to conduct a crosscutting analysis of all potentially relevant projects using consistent definitions of environmental technology and a sharp delineation of countable activities.

A systematic estimation process, using consistent criteria and procedures government-wide, has yet to be implemented on a continuing basis. However, two interagency data collection efforts, both coordinated by the White House Office of Science and Technology Policy (OSTP) in 1994, do shed light on federal environmental technology R&D expenditures. One of the data collection efforts, conducted by a coordinating group called the Committee on Environment and Natural Resources (CENR), asked federal agencies with primary missions for environment and natural resources to report all of their environmental research activities (from basic scientific research through environmental technology development). The other data collection effort, referred to below as the TSF data because it was used in the Clinton Administration report, *Technology for a Sustainable Future (TSF): A Framework for Action*², was specifically aimed at identifying federal environmental technology expenditures. The two sets of data are not entirely comparable: however, they

FIGURE 2-1: Federal Agency Expenditures: All R&D, Environmental Research, and Environmental Technology R&D, FY 1994 (\$ millions)



^aEnvironmental research includes activities identified for the Committee on Environment and Natural Resources of the National Science and Technology Council, plus Department of Defense environmental technology spending.

^bEnvironmental technology RD&D derived from NSTC's *Technology for a Sustainable Future* report.

SOURCE: National Science Foundation, *Federal Funds for Research and Development: Fiscal Years 1992, 1993, and 1994, Volume 42*, NSF 94-328 (Arlington, VA: 1993), table C-2, pp. 33-35; and National Science and Technology Council, Committee on Environment and Natural Resources, unpublished tables, 1994

did provide government-wide estimates for the first time.³ (Figure 2-1 shows these estimates in comparison with the total for *all* federal R&D for all purposes in FY 1994).

The CENR estimated that federal agencies with primary missions for environment or natural resources spent more than \$5 billion on their environmental research and development in FY 1994. However, it is not clear how much of this was for environmental technology R&D. Moreover, the CENR data did not include the Department of Defense (DoD), which has major environmental

²National Science and Technology Council, *Technology for a Sustainable Future: A Framework for Action* (Washington, DC: U.S. Government Printing Office, 1994).

³Another round of data collection on environmental technologies is under consideration by the Clinton Administration.

TABLE 2-1: Clinton Administration Estimates of Federal Agency Environmental Technology Spending,^a FY 1994 (\$ millions)

| | DoD | DOE | EPA | NSF | DOC | NASA ^b | DOI | USDA | Other ^c | Total ^d |
|-----------------------------------|------------|--------------|------------|-----------|------------|-------------------|------------|------------|--------------------|--------------------|
| R&D | 206 | 1,059 | 56 | 34 | 190 | 791 | 116 | 251 | 41 | 2,745 |
| Demonstration | 176 | 506 | 38 | 0 | 18 | 0 | 18 | 2 | 5 | 762 |
| Subtotal | 382 | 1,565 | 94 | 34 | 208 | 791 | 134 | 253 | 46 | 3,507 |
| Scaleup | 60 | 3 | 11 | 0 | 0.5 | 0 | 1 | 1 | 0 | 77 |
| Commercialization | 66 | 13 | 8 | | 2 | 2 | 0.2 | 8 | 18 | 116 |
| Subtotal | 126 | 16 | 19 | 0 | 3 | 2 | 1 | 9 | 18 | 193 |
| Other | | | | | | | | | | |
| Education & training ⁴ | | 16 | 3 | 6 | 2 | 16 | 2 | 501 | 3 | 551 |
| Information dissemination | | 5 | 16 | | 8 | 10 | 3 | 1 | 1 | 43 |
| Market stimulation | | | 9 | | | 7 | 1 | | | 16 |
| Export promotion | | 3 | 7 | | | | | | | 11 |
| Foreign aid | 10 | | 0.2 | | 1 | | | | 160 | 170 |
| Subtotal | 14 | 24 | 35 | 6 | 11 | 33 | 6 | 502 | 164 | 791 |
| Total^d | 522 | 1,604 | 148 | 40 | 220 | 825 | 142 | 764 | 228 | 4,491 |

^a Estimates cited above may differ from other estimates for the same agencies in FY 1994 due to differences in methodologies, definitions, or programs covered in data collection. These estimates were finalized at the mid-point of the fiscal year; actual expenditures could differ from what was anticipated at the mid-point.

^b NASA figure includes instrumentation in aircraft and Earth orbiting spacecraft systems to monitor global environmental changes and also includes R&D for access to the Earth Observing Information System.

^c Includes the Department of Transportation, the National Institute of Environmental Health Sciences, Smithsonian Institution; Tennessee Valley Authority; and US Agency for International Development.

^d Figures may not add due to rounding.

Key: DOC=Department of Commerce; DoD=Department of Defense; DOE= Department of Energy; DOI=Department of interior, EPA= Environmental Protection Agency; NASA= National Aeronautics and Space Administration; NSF= National Science Foundation, USDA=U.S. Department of Agriculture

SOURCE: National Science and Technology Council, unpublished data, Apr. 6, 1994.

technology expenditures. Despite these limitations, the CENR effort produced detailed information about R&D projects for which environmental technology was the primary focus and projects for which environmental technology was a contributing objective.

The TSF estimates were specifically aimed at environmental technology. All the major federal agencies conducting environmental technology R&D, including the Department of Defense, responded. However, it is questionable whether some items reported through the TSF should be considered environmental technology.

Table 2-1 summarizes the TSF data. The TSF data suggests that anticipated federal spending for

all environmental technology-related activities was nearly \$4.5 billion in FY 1994. (The information was compiled at the mid-point of the fiscal year). Of the total, \$2.75 billion was for R&D; another \$762 million was expected to be spent for demonstration projects. Hence, the TSF total for environmental technology research, development, and demonstration (RD&D) was about \$3.5 billion in 1994. Another \$77 million was expected to be spent on scaleup, and an additional \$116 million was expected to be spent on commercialization; most of the scaleup and commercialization expenditures were incurred by the Department of Defense. (The remaining TSF funds were for activities related to education and training, market

8 Environmental Technology: Analysis of Selected Federal R&D Programs

BOX 2-1: Key Categories of Environmental Technology R&D

The Clinton Administration has identified four categories of environmental technology RD&D: pollution avoidance, remediation and restoration, pollution control, and monitoring and assessment. The proportions of federal RD&D that fall into each category is uncertain, due to definitional problems and possible under- or over-reporting in different categories. The high proportion attributed to monitoring and assessment technology, especially, is questionable. In the discussion below, OTA has relied on actual callout data produced through the interagency process for the *Technology for a Sustainable Future* (TSF) report, rather than the percentages specified in the TSF report.¹

Of the TSF estimate for RD&D, more than half—\$1.8 billion—was called pollution *avoidance technology*: a broad term encompassing pollution prevention², energy efficiency, water conservation, and technologies for recycling or recovery of energy waste streams, products or raw materials. Of the avoidance total, most was for energy efficiency and cleaner energy programs sponsored by the Department of Energy (DOE). Some DOE R&D is also for industrial waste minimization (roughly equivalent in DOE parlance to pollution prevention). Pollution prevention often reduces compliance costs relative to conventional control technologies. The Department of Defense (DoD) also conducts or supports substantial RD&D on pollution prevention—about \$130 million in FY 1994—as well as an additional \$50 million to scaleup processes. Much of this R&D, such as development of less polluting and nontoxic approaches for surface cleaning and degreasing, could reduce DoD costs for environmental compliance.

Remediation and restoration technology accounted for about \$537 million of the total—of which DOE and the Department of Defense accounted for a majority of the spending. RD&D for end of pipe *pollution control technology* amounted to about \$195 million, with DOE and DoD again the largest funders.

The TSF data also shows over \$1 billion in expenditures for *monitoring and assessment technology*. About three-fourths of this expenditure was for development of space, aircraft, and ground observational technology by the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) to track global environmental conditions. Whether those expenditures should be allocated to environmental technology is a matter of judgment. In this report, OTA does not consider these NASA and NOAA activities to be environmental technology expenditures.

SOURCE: Office of Technology Assessment 1995

¹The *Technology for a Sustainable Future* report presented pie charts specifying proportions of the total RD&D budget for environmental technology devoted to specific categories such as avoidance technologies. OTA has elected to use the callout data for clarity.

²Approaches that seek to prevent generation of pollution and waste in the first place.

stimulation, information, development assistance and export promotion; these activities are not discussed in detail in this report).⁴

The TSF classifies the RD&D and scaleup activities under four broad categories: pollution avoidance, remediation and restoration, control,

and monitoring and assessment. These categories are discussed in more detail in box 2-1.

As mentioned, estimates of environmental technology spending are a matter of definition. The very large TSF estimate of monitoring and assessment R&D (over \$1 billion) includes \$638

⁴The TSF data shows about \$800 million in these categories. Of these funds, the largest amount by far (\$501 million) was attributed to education and training funded by the U.S. Department of Agriculture (USDA). The TSF report does not explain why USDA would have such large expenditures for environmental technology education and training. In addition, about \$170 million, was expected to be spent on foreign aid related to environmental and energy efficiency technologies, primarily through the U.S. Agency for International Development.

TABLE 2-2: Environmental Technology RD&D Programs Covered In this Report^a

| Program | FY 1994 (\$ millions) |
|--|--------------------------|
| Department of Energy ^b | |
| Clean Coal Demonstration Program | \$222 |
| R&D pertinent to cleaner fossil fuels | 314 |
| Solar and Renewable Energies | 219 |
| Environmental Management Technology Development Program | 215 |
| Energy Efficiency | 334 ^c |
| Subtotal | 1304 |
| Department of Defense ^d | |
| Strategic Environmental R&D Program | 154 |
| Environmental Security Certification Program | — |
| Advanced Research Projects Agency | 68 ^e |
| Individual Services (total) | 178 |
| Subtotal | 400 |
| Other departments/agencies | |
| Environmental Protection Agency | 94 |
| Department of Commerce | 43 ^f |
| National Aeronautics and Space Administration | 153 ^f |
| Department of Health and Humann Services | 11 |
| Department of Interior | 44 |
| National Science Foundation (environmental technology R&D) | 34 |
| U.S. Department of Agriculture | 240 |
| Subtotal | 714 |
| Total | \$2,419 |

^aFunding estimates cited above may differ from other estimates for specific agencies in FY 1994 due to differences in methodologies, definitions, and jurisdictions covered in data collection.

^bFigures do not include activities carried out through the Office of Energy Research (such as global change research), the Office Of Assistant Secretary for Environment, Safety, and Health, the Bonneville Power Administration, and some other program.

^cFigure includes funding related to the Partnership for a New Generation Of Vehicles and for building technologies.

^dInformation provided by the Department of Defense.

^eFigure does not include \$10 million in appropriated but unreleased funds

^fFigure does not include monitoring and assessment technology.

SOURCE: Office of Technology Assessment, 1995; based on information provided by federal agencies, and data collected by the National Science and Technology Council

million for National Aeronautics and Space Administration (NASA) projects to track global environmental conditions, not emissions from factories or vehicles. But some other kinds of research that might lead to environmentally preferable technologies might well have been omitted.

OTA has been more selective in identifying programs to be covered in this report. As shown in table 2-2, federal spending for programs discussed

in subsequent chapters amounted to about \$2.4 billion in FY 1994. Most of this was for energy efficiency or cleaner energy technologies, followed by remediation technologies. Table 2-2 does not include NASA or National Oceanic and Atmospheric Administration (NOAA) programs to monitor global environmental trends—a significant difference with Clinton Administration estimates.⁵ Some other items that may have been

⁵For information about these NASA programs, see Office of Technology Assessment, *Global Change Research and NASA's Earth Observing System*, OTA-BP-ISC-122 (Washington, DC: U.S. Government Printing Office, November 1993).

identified as environmental technology in the TSF data, such as modeling related to global change research, also are not addressed here. Another contrast with TSF is that the DoD and DoE estimates in table 2-2 are reported on a program basis. The limitations of the program estimates in table 2-2 need to be understood. In the case of DOE, only major programs are covered in the table. Also, not all of the expenditures for programs listed in the table are for environmental technology R&D. Nevertheless, from the standpoint of policymaking, it would be useful for the data to be compiled on both a program basis and a project or activity basis (as some agencies did for the CENR). In the event that the executive branch again assembles data on crossagency environmental technology expenditures, it would be helpful if all agencies also reported expenditures on a program-by-program basis.

INTERAGENCY COORDINATION MECHANISMS AND STRATEGIES

Many different federal agencies have environmental technology responsibilities. The Department of Energy (DOE) and the DoD are the largest funders of environmental technology R&D. Numerous other agencies, including Environmental Protection Agency (EPA), the Department of Commerce, NASA, and the National Science Foundation (NSF) also support or conduct environmental technology R&D. Several environmental technology programs are multiagency efforts, although one agency may have lead responsibilities. For example, EPA is the lead for the Environmental Technology Initiative (ETI), but several other agencies receive ETI funding.⁶

Some federal technology programs that are not primarily environmental in nature also may on occasion fund projects that have such potential for large environmental benefits that they could be seen as environmental technology. For example, the Advanced Technology Program (ATP), a Department of Commerce program, is sponsoring R&D for development of more efficient refrigeration systems that would have the lowest achievable environmental impact. DoD's Technology Reinvestment Program (TRP) also has funded several projects or programs pertinent to environmental technology.⁷

In addition, informal alliances and partnerships among the agencies themselves and with other levels of government and/or the private sector have become common—leading some to refer to “virtual agencies” put together on a project-by-project basis to address environmental issues. The “virtual agency” concept also is being applied by federal laboratories as they conduct R&D on a cooperative basis with industry.

A commonly voiced criticism of federal environmental technology programs has been the absence of an overall strategic vision to guide agency actions. Recently, federal agencies have made efforts to develop environmental technology strategies, throughout the executive branch, and in several individual departments and agencies. The strategy development process resulted in the issuance of a national environmental technology strategy by the Clinton Administration in April 1995. (The strategy and the process that produced it are discussed in box 2-2.) In addition, several interagency coordinating mechanisms have also been set up to facilitate cooperation on environmental technology issues, both among the agen-

⁶ The program was funded at \$36 million in FY 1994, of which about \$15 million involved partnerships with other federal agencies. The FY 1995 budget is \$68 million; about \$17 million of this will go to fund a series of innovative technology projects in the National Action Plan for Global Climate Change. The Clinton Administration sought an increase in ETI funding for FY 96; however, a reduction or elimination of the program is being considered by Congress. (See, for example, H.R. 1814, as introduced on June 13, 1995). The ETI is described in more detail in the section on the Environmental Protection Agency.

⁷ Congress is considering FY 1996 funding cutbacks for both ATP and TRP.

BOX 2-2: Federal Environmental Technology Strategies

An ambitious effort to develop federal agency strategies for environmental technology, underway in the executive branch since at least 1993, culminated in the release by the Clinton Administration in April 1995 of a national environmental technology strategy, entitled *Bridge to a Sustainable Future*.¹

The interagency effort to develop this strategy was orchestrated through National Science and Technology Council (NSTC). In August 1994, NSTC issued a report, *Technology for a Sustainable Future*, which identified four areas for federal action related to development and diffusion of environmental technology:

1. Using research, development, and demonstration projects to facilitate a shift from control technologies and waste management to avoidance approaches and resource conservation throughout the technology life cycle.
2. Using regulatory and fiscal policies to stimulate the development of environmental technologies and work to expand their diffusion.
3. Using export promotion and aid policies to increase the U.S. share of the global market for environmental technologies,
4. Using partnerships, education and training, and information dissemination, in addition to regulatory drivers, to influence the market for environmental technologies.

To get input for the national environmental technology strategy, NSTC held about 30 workshops and met with stakeholders and interest groups across the country. One such meeting was a White House conference on environmental technology held in December 1994.²

Another interagency effort, undertaken by the Department of Commerce (DOC), the Department of Energy (DOE), and Environmental Protection Agency (EPA), articulated actions federal agencies could take to promote exports of U.S. environmental technologies. Called *Environmental Technologies Exports: Strategic Framework for U.S. Leadership*, the November 1993 document identifies 18 technical and financial actions the government could take.

In addition, some departments and agencies, including EPA, DOE, DOC, and the Department of Defense have issued or are in the process of issuing departmental or agency strategies or policies on environmental technology. In some cases, these strategies are part of broader efforts to more clearly define departmental missions and goals. (See subsequent chapters about specific agency activities for details).

SOURCE: Office of Technology Assessment, 1995

¹National Science and Technology Council, *Bridge to a Sustainable Future National Environmental Technology Strategy* (Washington, DC: U.S. Government Printing Office, April 1995).

²In addition, federal agencies have been working to identify specific R&D actions through a subgroup of two NSTC committees, called the Joint Subcommittee on Environmental Technologies (JSET). In December 1994, JSET issued a draft Strategy and Implementation Plan for Environmental Technologies for public comment. The draft identifies 12 environmental challenges, and federal agency actions that could be taken in the next five years that would contribute to meeting those challenges. The challenges are considered crosscutting, in the sense that several agencies and disciplines could be required to address them effectively. The draft is now being recast.

cies themselves and with the private sector. These mechanisms are discussed briefly below.

■ National Science and Technology Council (NSTC)

The Clinton Administration has sought to coordinate interagency activities and strategy development for environmental technology through the National Science and Technology Council. Set up in November 1993, NSTC is the highest level science and technology coordinating mechanism for federal agencies. It replaced the federal Coordinating Council on Science, Engineering, and Technology used by the Bush Administration. The Council, chaired by President Clinton, consists of the heads of major departments and agencies with responsibilities for science and technology; a key purpose of NSTC is to set goals for federal R&D funding. The Office of Science and Technology Policy assists NSTC.

Within NSTC, environmental technology responsibilities are carried out through two subgroups, the Committee on Environment and Natural Resources (R&D issues) and the Committee on Civilian Industrial Technology (environmental technology use by U.S. industry and exports of environmental technology). A Joint Subcommittee on Environmental Technology (JSET), formed to address areas of mutual interest between the two committees, has been working to help establish a federal agency R&D agenda for environmental technology. Increasingly, a working group on environmental technology with broader representation than these two committees has assumed JSET functions.

Several coordination and outreach activities are carried out under the overall NSTC framework, including:

Interagency Environmental Technologies Office (IETO): This working office within NSTC is intended to help achieve cooperation, coordination, and collaboration among the many federal committees, programs, and activities related to environmental technology. IETO was set up to facilitate collaboration by DoD, DOE, and other agencies on projects of mutual interest. IETO's

scope includes all environmental technology issues (remediation, restoration, pollution prevention, control and monitoring) and any federal agency involved in technology development can participate. (IETO depends on agency members for funds and personnel). IETO also serves as an information clearinghouse and focal point for collaboration with the private sector, the states, and local governments for advancing environmental technologies. An information system, called the Global Network for Environmental Technology (GNET), has been set up to facilitate this interaction.

The Rapid Commercialization Initiative (RCI): This interagency initiative, announced in December 1994, seeks to advance the commercialization of environmental technologies to further both environmental and economic objectives. Under this effort, which will be coordinated by IETO and the Department of Commerce, federal agencies will help technology sponsors find test or demonstration sites, support technology performance verifications, and work with states on expediting permitting procedures (such as interstate reciprocity) that could speed use of these technologies. The RCI will focus on technologies that respond to private sector, as well as public sector, needs. The RCI will rely on existing federal agency programs that support environmental technology demonstration, verification, and diffusion. For example, these agencies may seek to increase the availability of testing sites and experimental permits to make it easier for developers to bring their technologies to market more easily. It will also seek to verify the performance of innovative technologies so that regulators and potential clients can assess their efficacy.

Private Enterprise-Government Interaction Task Force (PEGI): PEGI conducts outreach to identify research interests common to both the private sector and government research organizations. It now functions as an interagency task group of NSTC's Committee on Environment and Natural Resources. It works to identify private sector R&D on environment and natural resources and to inform the private sector of related govern-

ment-sponsored R&D. To do this, PEGI holds periodic meetings and an annual public roundtable conference.

Comprised of representatives from nine federal agencies, PEGI does not have funding of its own, and must rely on its member agencies to plan and hold meetings. PEGI has helped form several partnerships with private entities, including one dealing with offshore petroleum platform use for scientific research and another in the bioremediation area. PEGI also is sponsoring a government-wide Private Sector Fellowship Program. Firms and associations can sponsor staff members to work with managers of various federal environmental programs as a way to foster interactions and collaborative efforts between industry and the federal government.

Other NSTC Programs: NSTC also has become a coordinating body for crosscutting R&D programs that involve several agencies. For example, the global change research program, although primarily an environmental research (not technology) activity, involves 11 federal agencies or departments. NASA accounts for half or more of the overall spending on global change research,

which exceeded \$2 billion in FY 1995.

Some other multiagency R&D programs that are coordinated through the NSTC also have a significant environmental content, such as the Partnership for a New Generation of Vehicles (PNGV).⁸ This partnership includes seven federal agencies (DOE, DoD, DOC, the Department of Transportation, NASA, NSF and EPA) and the U.S. Council for Automotive Research, which represents Chrysler, Ford, and General Motors. The federal agencies plan to commit an estimated \$246 million on PNGV in FY 1995.

In addition, several interagency working groups have been set up to address specific issues that may involve environmental technology. One of the longest standing of these is the federal Remediation Technologies Roundtable. The roundtable is composed of representatives from several federal agencies that meet semi-annually to discuss new technology for treatment and remediation of hazardous wastes, and sponsor publications about field demonstrations of innovative treatment technologies⁹ and access to data bases for cleanup technologies.¹⁰

⁸PNGV's has three primary goals: 1) to improve the productivity of U.S. manufacturing by upgrading U.S. manufacturing technology while reducing the environmental impacts and improving quality; 2) to pursue advances in vehicles that can lead to improvements in fuel efficiency and emissions of standard vehicle designs, while pursuing safety advances to maintain safety performance; and 3) to develop a vehicle to achieve up to three times the fuel efficiency of today's comparable family vehicle with an equivalent purchase price.

⁹*Synopses of Federal Demonstrations of Innovative Site Remediation Technologies*, Third Edition, EPA/542/B-93/009 (Washington, DC: U.S. Government Printing Office, October 1993).

¹⁰*Accessing Federal Data Bases for Contaminated Site Clean-up Technologies*, Second Edition, EPA/542/B-92/002 (Washington, DC: U.S. Government Printing Office, August 1992).