

Introduction | 1

Over the past decade, increasing attention has been paid to environmental technology, reflecting demands for improvement in environmental quality, and recognition of the growing costs of treating waste and pollution, sometimes to meet stricter standards. Innovative or more cost-effective environmental technologies are being pursued on several fronts: improvements in add-on technologies to control pollution before it enters the environment; development of new or less costly technology to treat or clean up waste after it enters the environment; and development of cleaner technologies, or pollution prevention approaches, that produce less waste and pollution in the first place and are often more energy efficient than conventional control technologies. The need for specialized technologies to clean up hazardous or radioactive wastes resulting from nuclear weapons research and production also has been an impetus for research and development (R&D).

In response to such demands, federal funding for environmental technology research, development and demonstration (RD&D) has expanded. According to a Clinton Administration estimate, the federal government spent over \$3.5 billion in FY 1994 and about \$3 billion in FY 1993 on environmental technology RD&D. Because these are baseline figures, it is not clear how environmental technology RD&D spending would compare with spending in prior years. However, under the Clinton Administration, environmental technology has become a more prominent component of federal policy affecting technology development. The most recent Administration initiative—a national environmental technology strategy—was announced in April 1995.

Environmental protection is a crosscutting issue. Several different agencies, including the Department of Energy (DOE), the

2 | Environmental Technology: Analysis of Selected Federal R&D Programs

Department of Defense (DoD), the Environmental Protection Agency (EPA), and the Department of Commerce (DOC), have placed increased emphasis on environmental technology R&D. Involvement of these and other agencies generally falls into one or more broad categories:¹

1. *Developing technologies to help federal agencies comply with environmental requirements, or clean up and manage wastes at federal facilities.* Federal agencies now spend several billions of dollars each year on environmental compliance, cleanup, and waste management, especially for management of radioactive and hazardous wastes at DOE and DoD facilities. Estimates of future clean up and restoration costs at Federal Facilities using current technology extend into the hundreds of billions of dollars. Some funds are now directed to development of innovative or potentially less costly cleanup or restoration technologies, or potentially less costly compliance approaches such as pollution prevention.
2. *Encouraging development and diffusion of less costly and more effective environmental technologies for use by business, local governments, and consumers in abating and controlling pollution or waste.* Most environmental technologies are developed to meet government-imposed regulatory requirements. The direct costs of complying with U.S. pollution abatement and control requirements have been estimated at \$90 billion to \$120 billion per year. Effective, yet less costly, environmental technologies, might reduce future growth in this burden, while contributing to the social return from environmental investments.
3. *Encouraging development of environmentally preferable technologies—often called pollution prevention or cleaner technologies—for use by industry and consumers.* Many federal agencies undertake or support R&D in areas re-

lated to their mission, such as energy, transportation, agriculture, and mining. Efforts are underway to encourage these and other agencies to support R&D that could lead to innovations that are preferable from an environmental standpoint because they use less energy, produce less waste, and/or find productive use for by-products.

4. *Promoting U.S. exports of environmental technologies for their domestic economic benefits and to foster environmentally sustainable development throughout the world.*

Often a mixture of such efforts exists in an agency, or a given effort may apply to several of these purposes. For example, in some cases, innovative technologies developed for cleanup at federal sites may also be appropriate for private sector use, here and abroad. Table 1-1 shows environmental technology activities of selected federal agencies or entities.

With the expansion of federal environmental technology activities, questions about program coordination, potential for duplication of efforts, and priorities for allocation of limited federal R&D resources have become more prominent. While the Administration sought increased funding for some environmental technology programs in its proposed FY 1996 budget, rollback or, in some cases, zeroing out funding for some of these programs is proposed in several appropriations bills under consideration in the 104th Congress.

There are also sharp philosophical disagreements in Congress about the appropriate role for federal RD&D. For example, few would disagree in principle with use of federal R&D funds to develop specialized technologies that might lower the high costs of federal facility cleanup when those technologies are not available commercially. However, there is continuing debate about what priority to give to federal site cleanup, and what standards for cleanup should apply. For

¹The federal government also spends substantial sums to advance environmental science and understanding through development and deployment of technologies to monitor and model physical, chemical, and biological processes. R&D on such technologies, which include earth observation satellites and climate models, are sometimes included in estimates of environmental technology spending, but are not addressed in detail here.

TABLE 1-1: Key Federal Agencies with Environmental Technology RD&D Responsibilities

National Science and Technology Council

- Government-wide strategy development
- Coordination through:
 - Committee on Environment and Natural Resources
 - Committee on Civilian Industrial Technology
 - Working Group on Environmental Technology
 - Interagency Environmental Technologies Office
- Multiagency activities

Department of Energy

- Cleanup and restoration technologies for current and former DOE facilities
- Technologies for cleaner production, generation, and use of fossil energy
- Energy efficiency technologies for use in buildings, utilities, transportation, and industry
- Solar and renewable energy technologies
- Transfer of DOE-developed technologies to public and private sectors

Department of Defense

- Cleanup and restoration technologies for current and former DoD facilities
- Technologies to bring DoD facilities and operations into compliance with environmental laws
- Technologies to further internal steps to reduce compliance and operation costs through pollution prevention and energy efficiency
- Transfer of DoD-developed technologies to public and private sectors

Environmental Protection Agency

- Adaption of the regulatory system to lower barriers to technological innovation
- Encouragement of technology partnerships with public and private sectors
- Evaluation of innovative technologies for Superfund and some other purposes
- Media specific activities to support regulatory functions

Department of Commerce

- Encouragement of environmental technology exports
- Development of monitoring technologies to keep track of oceanic and atmospheric environmental conditions
- Measurement and reference standard technologies pertinent to the environment

National Aeronautics and Space Administration

- Technologies for global monitoring of environmental conditions
- Technologies for lowering the environmental impact of aircraft

Department of Interior

- Recycling technologies and environmentally preferable technologies and approaches to extract, process, and use nonfuel minerals
- Water conservation technologies

Department of Agriculture

- R&D in support of environmentally preferable ways to conduct agriculture and forestry, and to deal with the related wastes from these activities

SOURCE: Office of Technology Assessment, 1995.

example, cleanup standards might vary depending on the anticipated future land use on a site.

The most intense debate surrounds use of federal R&D funds to encourage development of environmentally preferable technologies for private sector use. Some view these government R&D efforts as an inappropriate manifestation of industrial policy, and are concerned about government

unwisely influencing technology choices that should be left to the private sector. Another criticism holds that these programs amount to corporate welfare. Others see environmental technology as a special case, especially when technologies are developed to comply with government regulations to achieve the societal objective of environmental protection. The issue is complex because

4 | Environmental Technology: Analysis of Selected Federal R&D Programs

the distinction between environmental technologies and advanced production technologies is often murky; some innovative technologies and process changes that are most desirable from an environmental standpoint may also be more productive or efficient than previously used technologies.

This report is intended to provide information helpful to Congress as it examines several issues surrounding environmental technology R&D programs. It is the first product in a broader Office of Technology Assessment (OTA) assessment, requested by the House Committee on Science and the Senate Committee on Environment and Public Works, on the development and diffusion of innovative environmental technology, scheduled for completion in the Spring of 1996.²

This paper responds to interest expressed by staff of the House Committee on Science for interim information about federal agency environmental technology programs. The paper discusses key federal environmental technology strategies, programs, and coordinating mechanisms. The primary focus is on direct federal support for research, development, and demonstration activities, as well as, to a lesser extent, programs that support

testing, evaluation, and verification of the performance of environmental technologies. The role, both positive and negative, that environmental regulations play in environmental technology innovation is discussed in other OTA work, and is not addressed in detail in this paper.³ Other federal programs affecting environmental technology, such as export promotion, also are not discussed in detail.⁴

The next chapter discusses the overall environmental technology RD&D spending by the federal government, and efforts to develop government-wide strategies and coordinating mechanisms. Subsequent chapters discuss key federal departments and agencies with major environmental technology R&D programs. These chapters are organized on a department-by-department or agency-by-agency basis. The list of programs covered is by no means comprehensive in terms of broader definitions of environmental technology. Not covered, for example, are mass transit, many technologies associated with land and other resource management, most nuclear waste management R&D, earth monitoring technologies, and climate modeling.

² The final report of the assessment will focus on public and private roles in providing environmental technical assistance.

³ See U.S. Congress Office of Technology Assessment, *Industry, Technology, and the Environment: Competitive Challenges and Business Opportunities*, OTA-ISC-586 (Washington, DC: U.S. Government Printing Office, January 1994). In addition, an OTA report on new approaches to environmental regulation is forthcoming this summer.

⁴ See *ibid* for fuller treatment of these aspects of environmental technology policy, and comparative information about public and private environmental technology research and development spending in the United States, Europe, and Japan.