

3. Research and Development Spending for Energy End Use and Electricity

Overview

According to the Office of Management and Budget (OMB), the Federal Government spent \$34.5 billion on civilian research and development (R&D) in fiscal year 1999.³⁷ Outlays for energy R&D (as defined by OMB) accounted for 4 percent of civilian R&D expenditures. “Atomic energy general science” (consisting mainly of basic research conducted by the Department of Energy) accounted for an additional 7 percent of fiscal year 1999 civilian R&D outlays.³⁸

Research and development is in an ambiguous position as an energy subsidy, because of its indirect connection with future market outcomes.³⁹ Whereas the tax expenditures described in Chapter 2 benefit selected fuel producers, and programs such as LIHEAP benefit selected consumers, the beneficiaries of R&D spending are more diffuse. In principle, the product of R&D is knowledge, and the presumed users of the knowledge are typically manufacturers of energy-producing or consuming capital equipment. Future energy producers and consumers will benefit only if equipment manufacturers apply the knowledge gained to commercially successful products in the future.

Some observers argue that Federal Government R&D funding is a subsidy because it substitutes for private R&D.⁴⁰ If this view were applied specifically to the energy industries, it would imply that Federal R&D relieves capital equipment producers of a competitive requirement to invest in R&D, and that consequently costs (and, to some extent prices) of capital goods are lower than would otherwise be the case. The extent to which Government R&D substitutes for private R&D would be difficult to determine.

This chapter focuses on Federal R&D spending aimed at energy end use and electricity. Federal end-use R&D is generally aimed at innovations that use *less* energy, rather than more. Thus, to the extent that they constitute a subsidy, the programs subsidize technologies that improve energy efficiency rather than promoting consumption of a particular type of energy.⁴¹ Federal energy end-use R&D appropriations were estimated to be \$453.6 million in fiscal year 1999 (Table 4). About 45 percent of the money was spent on transportation-related energy R&D, concentrating on technologies that eventually could be instrumental in building vehicles that use alternative fuels, produce low or zero emissions of pollutants, or have higher fuel efficiencies.

³⁷Office of Management and Budget, *Budget of the United States Government FY 2000: Historical Tables* (Washington, DC, 1999), p. 159.

³⁸The general science funding is not included in the tables in this chapter or in the Executive Summary. This chapter focuses on applied energy research and development.

³⁹In addition to directly funded R&D, the Natural Gas Policy Act of 1978 mandated the creation of a private sector natural gas research and development agency, the Gas Research Institute (GRI). Because the funding for GRI is collected from the industry and not provided by the Government, it is not a subsidy. The Electric Power Research Institute (EPRI) performs similar research for the electric power industry. The funding for EPRI comes from organizations that elect to participate, not from the Government, and thus is not a subsidy.

⁴⁰P. Stoneman, *The Economic Analysis of Technology Policy* (London, UK: Oxford University Press, 1987), p. 203.

⁴¹Conservation programs are directed primarily at consumers of energy. End-use programs are oriented to the development and introduction of technologies for use in specific sectors.

This report does not include a category of R&D programs specifically aimed at electricity production or consumption. In practice, most of the programs related to electricity production are attributed to the form of fuel to be consumed (and hence included in the previous report),⁴² or attributed to an end-use category such as buildings, transportation, or industry (and included in this report), rather than to electricity as a separate category.

Research and Development Spending for Energy End Use and Conservation

U.S. Department of Energy (DOE) R&D programs aimed at conserving energy were funded at \$453.6 million in fiscal year 1999 (Table 4). The conservation programs target buildings, industries, and the transportation sector. In addition, other Federal agencies (particularly the National Aeronautics and Space Administration and the Department of Transportation) operate large R&D programs not aimed directly at energy consumption, but which may significantly affect energy consumption in the future. Figure 3 illustrates trends in conservation R&D spending.

Table 4. Federal Research and Development Subsidies for Energy End Use, Fiscal Years 1992 and 1999
(Million 1999 Dollars)

Category	Fiscal Year 1992		Fiscal Year 1999 Estimated
	Appropriations ^a	Expenditures ^b	
Building Technology, State and Community Programs	54.1	51.4 ^c	81.0 ^c
Industrial Sector	111.2	110.3	165.9
(Minus Advanced Turbine Systems) ^d	(^e)	(^e)	-33.0
Industrial Sector, Net	111.2	110.3	132.9
Transportation Sector	125.7	124.7	202.1
Unallocated	3.1	3.1	37.7
Federal Energy Management Program Adjustment ^f	NA	-4.6	NA
Total	294.1	284.9	453.6

^aAppropriations taken from the 1992 EIA report (see sources below), adjusted for inflation (14 percent).

^bExpenditures taken from the 1992 report, adjusted to reflect the revised definition of subsidy used in this report, revisions in appropriations after the 1992 EIA report was published, and changes in the definitions of end-use categories based on a reassessment of where programs should be assigned.

^cAdjustments were made to exclude expenditures for regulatory programs (codes and standards).

^dIncluded in EIA's September 1999 subsidy report.

^eIncluded in "Natural Gas R&D" in the fiscal year 1992 budget.

^fFEMP was included in the 1992 expenditures but is removed here because it is not considered a subsidy.

NA = not applicable.

Note: Totals may not equal sum of components due to independent rounding.

Sources: U.S. Department of Energy, *U.S. Department of Energy Fiscal Year 2000 Budget Request*, DOE/CR-0059 (Washington, DC, May 21, 1999); Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy Markets 1999: Primary Energy*, SR/OIAF/99-03 (Washington, DC, September 1999); and Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, SR/EMEU/92-02 (Washington, DC, November 1992). U.S. Department of Energy, Office of Building Technologies and State and Community Programs, e-mail from Gale Kabat (February 28, 2000).

⁴²Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy Markets 1999: Primary Energy*, SR/OIAF/99-03 (Washington, DC, September 1999).

Building Technology, State and Community Programs (BTS)

The mission of the DOE building technology R&D program is to develop, promote, and integrate energy practices and technologies to make buildings more efficient and affordable and communities more livable. The Building Research and Standards program accelerates the introduction of highly efficient building technologies and practices through R&D and increases minimum energy efficiency of buildings and equipment through appliance standards, building codes, and guidelines. Building technology R&D (non-grant) programs complement DOE grant programs that help to deploy energy-efficient technologies and increase consumer awareness of their benefits and costs. The appropriation in fiscal year 1999 was \$96.2 million. The funding level included \$15.3 million for regulatory expenditures that are not considered subsidies in this report. The regulatory funding included \$6.5 million for lighting and appliance standards, \$7.7 million for training and assistance for State energy codes, and \$1.1 million for residential and commercial building energy codes. Therefore, the adjusted funding level for fiscal year 1999 is \$81.0 million.

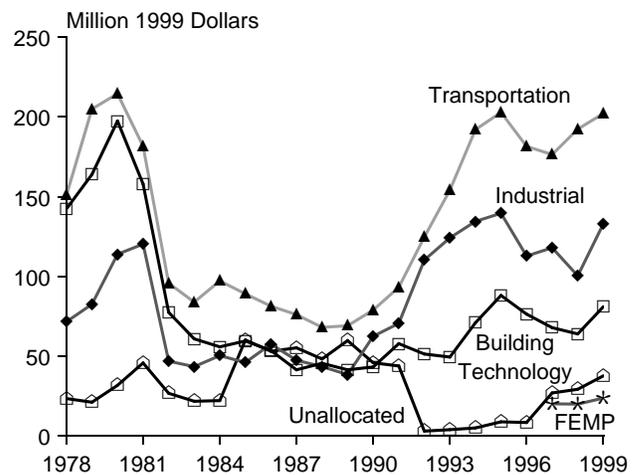
Federal Energy Management Program

The Federal Energy Management Program (FEMP) was established in 1974 to provide direction, guidance, and assistance to Federal agencies in planning and implementing energy management programs.⁴³ The mission of FEMP is to reduce the cost of Government by advancing energy and water efficiency, promoting renewables, and managing utility costs. Section 543 of the National Energy Conservation Policy Act, as amended by the Energy Policy Act of 1992 (EPACT), requires each agency to achieve: a 10-percent reduction in energy consumption in its Federal buildings by fiscal year 1995, when measured against a fiscal year 1985 baseline on a Btu-per-gross-square-foot basis; and a 20-percent reduction in Btu per gross square foot by fiscal year 2000. In addition, Executive Order 12902, issued in 1994, required Federal agencies to achieve a 30-percent reduction by fiscal year 2005.

Executive Order 13123, "Greening the Government Through Efficient Energy Management" supersedes Executive Order 12902. Executive Order 13123 encourages effective energy management in the Federal Government and builds on work begun under EPACT and previous Executive Orders. The program was funded at \$23.8 million in fiscal year 1999. Expenditures for FEMP are not included in Table 4, because the funds are invested by the Federal Government to reduce energy consumption in its own facilities, and only public benefits accrue from those investments.

⁴³FEMP was initially included in end-use programs for budget purposes. Separate accounting for FEMP began in 1997. Details are provided in Appendix C of this report.

Figure 3. Principal Appropriations for U.S. Department of Energy Research and Development on Energy End Use, Fiscal Years 1978-1999



Notes: Industrial sector R&D appropriations exclude funding for Advanced Turbine Systems. Funding for the Federal Energy Management Program (FEMP) is included in this figure because it is included as a line item in the DOE energy conservation R&D appropriations. It is not considered a subsidy. Before 1997, FEMP expenditures were included in other end-use programs. Building technology appropriations exclude codes and standards funding for fiscal years 1992-1999.

Source: U.S. Department of Energy, Office of the Chief Financial Officer, "Budget Authority History Table by Appropriation" (Washington, DC, 1998); U.S. Department of Energy Fiscal Year 1999 Budget Request, DOE/CR-0050 (Washington, DC, February 1998); and U.S. Department of Energy Fiscal Year 2000 Budget Request, DOE/CR-0059 (Washington, DC, May 21, 1999).

Industrial Sector

The mission of DOE's Office of Industrial Technologies (OIT) is to improve the energy efficiency, environmental performance, and productivity of energy-intensive industries by developing and delivering advanced science and technology options that will lower raw material and energy use per unit of output, improve labor and capital productivity, and reduce generation of wastes and pollutants. OIT's R&D portfolio concentrates on cooperative projects with nine of the major process and extraction industries in the industrial sector. These industries, referred to as Industries of the Future (IOF) include forest products, steel, aluminum, metal casting, glass, chemicals, petroleum, mining, and agriculture.

In addition, the OIT portfolio includes crosscutting R&D efforts on technology needs, which have been identified in "technology roadmaps" across multiple industries and form technology bases from which more industry-specific developments can derive. The crosscutting activities also include technical information and outreach programs, demonstrations, training, and tool development to assist industry in evaluating and adopting new energy-efficient and pollution-preventing technologies and techniques. The industrial R&D program was funded at \$132.9 million in fiscal year 1999 (excluding \$33 million for the Advanced Turbine Systems program, which was included as a primary energy subsidy in the September 1999 EIA report).⁴⁴

Transportation Sector

U.S. Department of Energy

The DOE transportation sector R&D program funds activities directed at improving vehicle technology, fuel utilization, technology deployment, materials technologies, and related management and planning activities. The mission of the program is to support the development of advanced transportation vehicles and fuels that will reduce energy demand, particularly for petroleum; reduce criteria pollutant emissions; and reduce greenhouse gas emissions. The transportation R&D program includes support to the Partnership for a New Generation of Vehicles (PNGV), which involves major U.S. vehicle manufacturers and multiple Federal agencies. The goal is to develop a mid-size family sedan with a fuel economy of up to 80 miles per gallon by 2004 without sacrificing comfort or safety. Research for the PNGV is directed at fuel cells, advanced direct-injection engines, exhaust systems, advanced batteries, and electronic power controllers. The funding level for these programs was \$202.1 million in fiscal year 1999, of which \$128.1 million was allocated to the PNGV program.

Other U.S. Government Agencies

Other Departments also have extensive transportation R&D programs, notably the National Aeronautics and Space Administration and the Department of Transportation. As this report excludes transportation expenditures because they are not specifically targeted to energy,⁴⁵ they are not discussed here.⁴⁶

⁴⁴Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy Markets 1999: Primary Energy*, SR/OIAF/99-03 (Washington, DC, September 1999), p. 33.

⁴⁵See Chapter 1 for additional discussion of subsidies.

Utility

In the early 1990s, R&D on utility conservation was directed to promoting “integrated resource planning”—the concept that utilities should plan their investment programs on the basis of the full costs of energy services provided, from the customer’s light bulb to the coal mine’s reclamation cost, rather than focusing simply on electricity production and supply. The DOE program was aimed both at promoting integrated resource planning and at developing analytical tools (such as fuel cycle cost analysis) intended to help utilities undertake integrated resource planning. Funding for the program was discontinued in fiscal year 1996. Expenditures for this program are included under Advanced Turbine Systems in the 1992 estimates presented in Table 25 of this report (see Chapter 5) and are included in the “Electric Utility” category for 1992 in Table 8 of the September 1999 EIA report, *Federal Financial Interventions and Subsidies in Energy Markets 1999: Primary Energy*.

Unallocated

Unallocated includes funds for policy and management of R&D programs. It includes management activities at DOE headquarters, the Golden (Colorado) Field Office, and regional support offices. It also supports technical and economic studies and scientific evaluations of issues related to crosscutting program activities. Increases in funding relative to 1992 levels reflect revisions in the categorization of the activities, which in prior years were included in the programs themselves but in the current budget are explicitly accounted for. The funding level for fiscal year 1999 was \$37.7 million.

⁴⁶The National Aeronautic and Space Administration allocated \$768.9 million in fiscal year 1999 to Aeronautical Research & Technology and \$5 million for “Global Observations to Benefit the Environment.” See National Aeronautics and Space Administration Budget Summary. The Federal Aviation Administration requested \$55 million for systems security research and \$35 million for research in aircraft structures and materials in fiscal year 1999. The Federal Highway Administration requested \$496 million for R&D in 1999, including \$250 million for intelligent transportation systems. The Coast Guard received \$12 million in fiscal year 1999 for technologies, materials, and human factors R&D. There are additional R&D programs requested by the National Highway Traffic Safety Administration (\$53 million) for safety systems and data collection in fiscal year 1999. The Federal Transit Administration requested \$44 million in fiscal year 1999 for methods and technologies for accessibility, hybrid electric buses, fuel cells, and battery-powered propulsion systems. The Federal Railroad Administration spending request for fiscal year 1999 included \$21 million for safety-related R&D. An additional \$4 million was requested for R&D by the Research and Special Programs Administration. See U.S. Department of Transportation, Office of the Secretary, *Budget in Brief—FY 1999 and FY 2000 Budget in Brief*.