SR/OIAF/99-03

Federal Financial Interventions and Subsidies in Energy Markets 1999: Primary Energy

September 1999

Energy Information Administration
Office of Integrated Analysis and Forecasting
U.S. Department of Energy
Washington, DC 20585

Preface

The analysis in this report was undertaken at the request of the Office of Policy, U.S. Department of Energy. In its request, the Office of Policy asked the Energy Information Administration (EIA) to update the 1992 EIA report on Federal energy subsidies, including any additions or deletions of Federal subsidies based on Administration and Congressional action since the 1992 report was written, and to provide an estimate of the size of each current subsidy. Subsidies to be included are those through which a government or public body provides a financial benefit. The subsidy must be specific; for example, depreciation schedules that can be used in non-energy sectors as well as energy sectors are not included in the definition of a subsidy for this study. This report is to focus on subsidies covering primary energy only; a subsequent report will be requested, covering end-use energy and electricity. The assumptions for the study were noted in a letter provided by the Office of Policy on May 20, 1999. A second letter from the Office of Policy clarified the assumptions further, focusing the analysis of subsidies on goods rather than services. Both letters are provided in Appendix E.

The legislation that established EIA in 1977 vested the organization with an element of statutory independence. It is EIA's responsibility to provide timely, high-quality information and to perform objective, credible analyses in support of the deliberations of policymakers. EIA prepared this Service Report upon special request, using the assumptions specified by the requestor.

This report was prepared by the staff of EIA's Office of Integrated Analysis and Forecasting. General questions about the report may be directed to Mary J. Hutzler (202/586-2222, mhutzler@eia.doe.gov), Director of the Office of Integrated Analysis and Forecasting, or to Arthur Rypinski (202/586-8425, arthur.rypinski@eia.doe.gov). Specific questions about the report may be directed to the following analysts:

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Purpose

In May 1999, the Office of Policy, U.S. Department of Energy (DOE), asked the Energy Information Administration (EIA) to prepare an update of EIA's 1992 Service Report on Federal energy subsidies,[1] using a more specific definition of "subsidies" provided by the Office of Policy. In its letter of request, the Office of Policy asked the EIA to examine Federal programs that provided a "specific financial benefit" covering "primary energy only."[2]

Federal energy subsidies take three principal forms:

- **Direct Payments to Producers or Consumers.** These are Federal programs that directly affect the energy industry and for which the Federal Government provides a direct financial benefit. Currently, three energy programs provide direct payments to producers or consumers. Two of them focus on energy end use, and are excluded from this study. The third program is the Renewable Energy Production Incentive.

- **Tax Expenditures.** Tax expenditures are provisions in the tax code that reduce the tax liability of firms or individuals who take specified actions that affect energy production, consumption, or conservation in ways deemed to be in the public interest.

- **Research and Development.** R&D expenditures do not directly affect current energy production and prices, but if successful they could affect future production and prices. An example of the impact of Federal energy R&D is the important role that Federal R&D spending has had in the development of the U.S. commercial nuclear power industry.

In addition to the principal types of programs described above, there are Federal programs that may act as subsidies but for which the existence or impact of the subsidy is uncertain. These programs are represented by the excess liabilities of trust funds, such as the Black Lung Disability Fund. Although trust funds are discussed in this report, no specific estimate of their subsidy element is presented because of the difficulty of estimating the potential future liability to the Federal Government.

The size, scope, and market effects of energy subsidies depend primarily on the definitions and methods used to measure their impacts.[3] In economics, the term "subsidy" is used to define a specific program in which the Government makes direct payments to producers or consumers to defray a portion of the cost of producing or consuming some product. The application of this definition to real-world programs, however, can be much more complex.

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[1]Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, SR/EMEU/92-02 (Washington, DC, November 1992).

[2]The Office of Policy has indicated that it intends to request a second study that will cover energy end use and electricity.

[3]Appendix A reviews various energy subsidy reports.

This report measures subsidies based on the cost of the programs to the Federal budget. This approach has the advantage of being relatively easy to measure using available information. However, Federal budget estimates generally overstate both the economic costs and the market impacts of specific programs. Programs that offer small subsidies for products for which there are huge existing markets tend to function mostly as transfer programs; that is, their market impacts are negligible, and for the most part they simply redistribute funds from one part of the economy to another, with the Government acting as the intermediary. More often, Federal energy subsidies offer relatively large payments to producers using specific energy technologies that otherwise would be uneconomical. In these cases, the effects on the larger markets are small, but the impacts on the use of particular technologies may be significant. Finally, while subsidy programs are legislated because they are presumed to produce some social benefit that exceeds the expected cost of the program, no attempt is made in this report to measure the social benefits that may accrue from the programs reviewed.

Federal Government intervention in energy industries has generally declined over the past two decades. Price controls for domestic oil and natural gas production were largely eliminated by the mid-1980s. The Tax Reform Act of 1986 reduced or eliminated many tax expenditures, several of which figured prominently in earlier studies. The Energy Policy Act of 1992 (EPACT), while introducing incentives for renewable energy and alternative transportation fuels, set the stage for the eventual privatization of DOE's uranium enrichment activities. The implications of the EPACT provisions were not incorporated in EIA's 1992 subsidy report, because their date of enactment followed that analysis.

Summary of Results

Federal subsidies for primary energy are estimated to be $4.0 billion in fiscal year 1999, down about $1 billion (1999 dollars) from fiscal year 1992 (Table ES1 and Figure ES1). Direct expenditures from the Renewable Energy Production Incentive are estimated to be $4 million in fiscal year 1999, as compared with direct expenditures of $82 million (1999 dollars) for synthetic fuel in the 1992 report. Tax expenditures related to primary energy total $1.7 billion (1999 dollars), with another $0.7 billion for the ethanol exemption from Federal excise taxes. EIA's 1992 report showed greater tax expenditures ($2.2 billion in 1999 dollars) but lower Federal excise taxes ($0.5 billion). In 1999, the two largest items are the alternative fuels production tax credit, largely used to develop coalbed methane and tight sands ($1.0 billion), and the percentage depletion allowance for the oil, gas, and coal industries. Tax deferrals on enhanced oil recovery are the third largest expenditure.

Federal R&D appropriations related to energy markets (excluding basic research) are estimated at a total of about $1.6 billion in fiscal year 1999–down from $2.0 billion in 1992 (in 1999 dollars). Federal spending on coal and nuclear power research has declined substantially since 1992. The decrease in nuclear energy R&D expenditures has resulted largely from declines in spending directed at treatment and storage of nuclear waste and the decommissioning of obsolete nuclear power plants. The fiscal year 1999 budget includes about $0.6 billion for "nuclear" R&D, most of which is related to nuclear waste disposal and cleanup of nuclear research facilities. Less than $0.1 billion is budgeted for research on new nuclear plants. Coal R&D expenditures have also declined, as a result of cuts in spending on clean coal technologies.

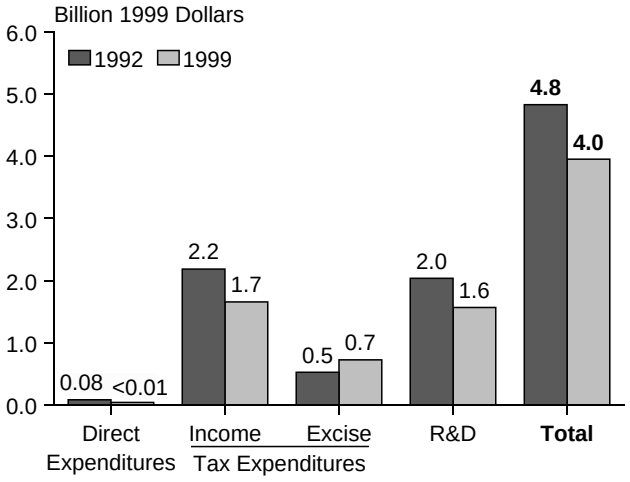
Table ES1. Summary of Primary Energy Subsidy Elements in Federal Programs by Fuel and Program Type on a Budget Outlay Basis, Fiscal Year 1999
(Million 1999 Dollars)

Fuel	Type of Subsidy				Total
	Direct Expenditures	Tax Expenditures		Research and Development	
		Income	Excise		
Oil	0	263	0	49	**312**
Gas	0	1,048	0	115	**1,163**
Coal	0	85	0	404	**489**
Oil, Gas, and Coal Combined[a]	0	205	0	0	**205**
Nuclear	0	0	0	640	**640**
Renewables	4	15	[b]725	327	**1,071**
Electricity	0	40	0	[c]33	**73**
Total	**4**	**1,656**	**725**	**1,567**	**3,953**

[a]The category Oil, Gas, and Coal Combined includes expenditures that were not allocated to any one of the three individual fuels.
[b]Alcohol fuels excise tax.
[c]Electricity research and development is advanced turbine technology. Other generation technology research and development is distributed by fuel.
Sources: Most information drawn from Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2000* (Washington, DC, February 1999).

The total value of Federal subsidies to oil, natural gas, coal, and nuclear power is estimated to be $2.8 billion in 1999 (Table ES1), compared with wholesale spending of $127 billion (1999 dollars)[4] in 1998 for purchases of those fuels and total retail expenditures of $363 billion (1999 dollars) in 1995.[5] Although the value of energy subsidies is low relative to total energy expenditures, some forms of energy receive subsidies that are substantial relative to the value of the fuels. Of the primary fossil fuels, natural gas benefits the most from Federal subsidies in 1999–a total of $1.2 billion, almost all of which comes from a tax credit on the production of alternative fuels, primarily gas from coalbed methane and tight sands. Although no production data are available for natural gas from tight sands, coalbed methane accounted for 6 percent of all natural gas production in 1997. The $1.0 billion alternative fuel credit in 1999 can be compared with natural gas sales valued at $39 billion (1999 dollars) at the wholesale level in 1998 and $79 billion (1999 dollars) at the retail level in 1995. A subsidy amount of $4 billion or $5 billion is, in

Figure ES1. Summary of Primary Energy Subsidy Elements in Federal Programs by Program Type on a Budget Outlay Basis, 1992 and 1999



Source: Tables 1 and 2 in this report.

[4]Wholesale expenditures do not include nuclear fuel.
[5]The 1995 data on retail expenditures for energy are the latest available.

general, too small to have a significant effect on the overall level of energy prices and consumption in the United States; however, the subsidy programs described in this report are, in most cases, targeted at narrow segments of the energy industry (e.g., ethanol production for blending into gasoline and natural gas production from coalbed methane and tight sands).

Appendix A reviews different subsidy reports in the literature. A number of those reports have produced larger estimates of subsidies than this report due to the inclusion of regulation, defense, transportation, and/or tax expenditures that are not specific to energy.

1. Introduction

Background

In May 1999 the Acting Director of the Office of Policy, U.S. Department of Energy (DOE), requested that the Energy Information Administration (EIA) "undertake a service report that updates EIA's 1992 report on Federal Energy Subsidies and begins an examination of the energy market impact of these subsidies. The report will serve as a building block to promote understanding regarding the level and composition of direct market interventions which may affect the use of energy or the composition of energy supply, and how these interventions have changed since the 1992 report." The Office of Policy also specified that the subsidy must be specific, cover primary energy only, and provide a financial benefit. The Office of Policy has indicated that a second report, covering end-use energy and electricity, will also be requested.

The 1992 EIA report[1] was issued at the request of the Congress following the congressional mandate requiring that, within available funds, EIA produce a one-time study defining direct and indirect Federal energy subsidies, methods of valuation of such subsidies, and a survey of existing subsidies, as well as an analysis of actions and costs necessary to produce a periodic report.[2] The present report differs from the 1992 report in that it focuses on subsidies that clearly affect "goods" rather than "services."

There is no universally accepted definition of what constitutes a subsidy. Typically, a subsidy is defined as a transfer of economic resources by a government to the buyer or seller of a good or service that has the effect of reducing the price paid, increasing the price received, or reducing the cost of production of the good or service. The net effect of such a subsidy is to stimulate the production or consumption of a commodity over what it would otherwise have been.[3] The transfer of resources from the government entity must be contingent in some way on the actual production or consumption of the subsidized good or service by the recipient.

Public interest in energy subsidies arises in part from concerns that they may affect competition between energy and non-energy investments or between different forms of energy. Concerns also arise when subsidies lead to higher prices or taxes, either direct or indirect. For example, some argue that investments in energy efficiency, conservation, and renewable energy are hindered by Federal subsidies to more conventional forms of energy.[4] Past studies of subsidies have been motivated by concern that Federal intervention in energy markets "tilts the playing field."[5] Most Federal Government policies have the potential to affect energy markets. Policies supporting economic stability or economic growth have energy market consequences, as do those that support highway development or affordable

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[1]Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, SR/EMEU/92-02 (Washington, DC, November 1992).

[2]U.S. House of Representatives, *Appropriations Committee Report: Department of Interior and Related Agencies Appropriation Bill*, Report 102-116 (June 19, 1991), p. 115.

[3]See C. Shoup, *Public Finance* (Chicago, IL: Aldine Publishing Company, 1969), p. 145.

[4]Amory Lovins, in "Four Revolutions in Electric Efficiency," *Contemporary Policy Issues*, Vol. VIII (July 1990), p. 123, states: "[E]lectricity is about eleven times as heavily subsidized as direct fuels (as of 1984) . . . ."

[5]For example, this argument is made by H.R. Heede et al., in *The Hidden Costs of Energy* (Washington, DC: Center for Renewable Resources, October 1985).

housing. The energy impacts of such policies are incidental to their primary purpose, however, and they are not examined here.

This report describes the current status of U.S. Government energy policies affecting various energy sources and uses. The focus is on Government programs that have the effect of increasing or reducing costs and prices in energy markets through direct financial commitments. The report does not seek to make policy recommendations nor to evaluate the effectiveness of existing policy, and it covers only those energy subsidies that meet the strictly defined criteria cited by DOE's Office of Policy. This chapter describes the types of subsidies covered and the methods used to estimate their value. The overall results are summarized and compared with the results of the 1992 EIA study.

Scope of the Report

Federal Energy Subsidies Quantified in This Analysis

Direct Subsidies

Energy subsidies may be either "direct" or "indirect." Direct subsidies include (a) payments from the Government directly to producers or consumers and (b) tax expenditures. Tax expenditures are provisions in the tax code that reduce the Federal tax liability of qualifying firms or individuals who have undertaken particular actions. Energy-related examples include tax credits for certain kinds of activity (e.g., drilling coalbed methane wells) or favorable treatment of capital recovery (e.g., percentage depletion for independent oil producers). When such payments or tax expenditures are made exclusively to recipients engaged in energy production or consumption, they are considered direct energy subsidies.

Indirect Subsidies

There are also many indirect subsidies, which consist of Federal Government actions that do not involve direct payments to producers or consumers. Indirect energy subsidies consist of other forms of Federal financial commitment that affect the cost of consumption or production of some form of energy. Indirect subsidies include provision of energy or energy services at below-market prices; loans or loan guarantees; insurance services; research and development activities and expenditures; and the unreimbursed provision by the U.S. Government of environmental, safety, or regulatory services. Only one type of indirect subsidy—funding for research and development—is quantified in this report.

The budgetary cost of Government-funded research and development (R&D) is easy to measure. Determining the extent to which Government energy R&D is a subsidy is more problematic. Although R&D funding often consists of direct payments to producers or consumers, the payments are not tied to the actual production or consumption of energy in the present and, thus, do not fall within the definition of direct energy subsidies. Federal funding for energy R&D may, however, act as a subsidy to the extent that it substitutes for private R&D expenditures that would have been made in the absence of Government outlays. Because Government-funded R&D programs, if successful, will affect future energy prices and costs, they are considered to be indirect energy subsidies.

Other Subsidies Discussed in This Analysis: Excess Liabilities of Trust Funds

When the Federal Government assumes actual or potential liabilities of private-sector industries, the funds needed to cover the liability may be collected through a levy on the industry. If the expected present value of the cost of the

liability assumed by the Government exceeds the present value of the levy on the industry, it is considered to be an indirect subsidy.

Historically, there have been a class of future liabilities characterized by large, but uncertain, future costs for such actions as remediating leaking underground storage tanks, cleaning up oil spills, shutting down retired nuclear power plants, or paying health benefits for coal miners with black lung disease. Policymakers have feared that if private firms were assigned liability for these future costs, they might fail to make adequate current provision today, and then evade the costs in the future through bankruptcy. Alternatively, there might be health or environmental liabilities for which no current responsible party could be identified.

The public policy response to this situation has taken two forms:

- The Government assigns liability to private firms, but requires them to make payments into public or private trust funds to assure that funds will be available to meet future liabilities.
- The Government assumes legal responsibility for the liability, but levies an excise tax on the products of the industry deemed responsible and accrues the monies into a public trust fund, which is dedicated to meeting future liabilities.

In the former case, there is no subsidy, inasmuch as the liability remains with the private sector. In the latter case, however, if the Federal Government collects taxes that are insufficient to meet the liability assumed on behalf of the private sector, there may be an element of subsidy in the arrangement because the value of the tax is less than the cost of the liability. Analysis of such trust funds for actuarial sufficiency is beyond the scope of this study. This report lists and describes trust funds that can be considered to have a subsidy component and provides an overall estimate of the size of each fund, but it does not attempt to quantify the subsidy component.

Energy Subsidies Not Included

Because this report focuses exclusively on subsidies that involve direct intervention in markets for primary energy sources, U.S. Government activities of a regulatory nature and activities involving non-internalized externalities are excluded from the analysis, as are failures by the Federal Government to intervene when an externality is unknown or unidentified. State and local government programs are excluded by definition. Also excluded are programs that cover end-use energy and electricity, which will be addressed in a later report.

Studies of energy subsidies have varied widely in purpose, scope, definition, and methods of estimation (see Appendix A). For instance, because the U.S. Government raises and spends vast sums of money on transportation infrastructure projects, studies that view transportation spending as an energy subsidy tend to have larger estimates of subsidies than those that do not. Similarly, because the Government spends large sums of money on defense, studies that view military spending—whether directed toward the Persian Gulf or elsewhere—as energy subsidies also tend to produce considerably larger estimates than those that do not.

There are other ways in which the scope of energy subsidies can be broadened. For instance, one study completed in the mid-1980s concluded that subsidies to the U.S. electricity industry amounted to $80 billion per year because of the U.S. regulatory practice of pricing electricity at average rather than marginal cost.[6] Another study estimated

[6]M. Kosmo, *Money to Burn? The High Costs of Energy Subsidies* (Washington, DC: World Resources Institute, 1987).

subsidies to U.S. motor gasoline producers alone at $84 billion per year, based on the inclusion of such costs as defense-related expenditures and energy-related health care costs.[7]

It is clear that Federal Government intervention in energy industries generally has declined over the past two decades. Price controls for domestic oil and natural gas production were largely eliminated by the mid-1980s. The Tax Reform Act of 1986 reduced or eliminated many tax expenditures, several of which figured prominently in earlier studies. The Energy Policy Act of 1992, while introducing incentives for renewable energy and alternative transportation fuels, set the stage for the eventual privatization of the DOE's uranium enrichment activities.

Past studies addressing the question of energy subsidies identify a host of programs with potentially significant effects on energy prices and uses. Although the specific quantitative findings of earlier studies are of limited current interest, given the manner in which energy policy has evolved, they illustrate the following tendencies:

- At any point in time, large variations in estimates of subsidy values are possible (both for specific programs and in total), depending on the array of programs included when the valuation methodology is developed.
- The potential for variations can be greatly compounded, depending on the methodology used in calculating the subsidy value attributed to each program.

Measuring the Cost of Subsidies

Measuring the cost of subsidies presents a number of difficult problems. Direct subsidies and many indirect subsidies can involve payment or receipts of money dispensed or collected by the Government and accounted for in Federal budget documents. On the other hand, the costs or benefits of many indirect subsidies are not reflected in budget documents but rather in the financial accounts of affected energy consumers and producers. This report attempts to measure subsidies using, to the greatest extent possible, Federal Government outlays and/or near equivalents, including the outlay equivalent value of tax expenditures.

The costs of a subsidy to the Government may differ from the benefits that accrue to the recipients. Administrative costs drive a "wedge" between costs and benefits. Subsidies can also take forms that are costly to the Government but provide smaller benefits to recipients. A more common phenomenon is that a Federal program will incur costs to produce social benefits that are difficult, and controversial, to value in monetary terms. This report focuses only on the costs of subsidies. The concept of cost becomes more difficult to apply to indirect subsidies, however. Consequently, this analysis uses fiscal measures of cost primarily for programs implemented through Federal outlays, tax expenditures, or excise taxes.

The valuation of benefits is much more difficult than that of spending. First, for a variety of reasons discussed later in this report, it is difficult to know what value consumers place on the benefits that subsidies provide. Second, determining such matters as the net present value of the subsidy, the incidence of its benefit, and how it affects production and consumption choices at the margin would add further complications.

[7]J.B. Wahl, *Oil Slickers: How Petroleum Benefits at the Taxpayer's Expense* (Washington, DC: Institute for Local Self-Reliance, 1996), web site www.ilsr.org.

Main Findings

The intent of this study is to identify Federal Government programs that intentionally seek to influence the allocation and pricing of primary energy resources. Where possible, a quantitative assessment of costs is presented. Given the definitions used, it is estimated that direct Federal energy subsidies—nearly all of which are tax expenditures—total about $2.4 billion in fiscal year 1999 (Table 1). EIA's 1992 report, by comparison, estimated direct subsidies in 1992 equivalent to $2.8 billion in 1999 dollars (Table 2 and Figure 1). Income tax expenditures related to primary energy in 1999 total $1.7 billion on an outlay equivalent basis, along with another $0.7 billion for the ethanol exemption from Federal excise taxes. EIA's 1992 report showed higher income tax expenditures ($2.2 billion in 1999 dollars) but slightly lower Federal excise tax expenditures ($0.5 billion). In 1999, the largest single energy-related tax expenditures are the alternative fuels production tax credit, largely used to develop nonconventional natural gas, and the percentage depletion allowance for the oil, gas, and coal industries. Tax deferrals on enhanced oil recovery are the third largest expenditure. Table 3 indicates just how small the value of all primary energy subsidies, both direct and indirect, is relative to total energy spending. In 1995, consumers spent $363.4 billion (1999 dollars) on end-use energy from oil, natural gas, coal, and nuclear power. Primary energy subsidies are about 1 percent of that figure.

Federal energy-related R&D appropriations unrelated to basic research are estimated at a total of about $1.6 billion in fiscal year 1999—down from $2.0 billion in 1992 (in 1999 dollars). Federal spending on coal and nuclear power research has declined substantially since 1992. The decrease in nuclear energy R&D expenditures has resulted largely from declines in spending directed at treatment and storage of nuclear waste and in R&D for the decommissioning of obsolete nuclear power plants. Coal R&D expenditures have declined as a result of cuts in spending on clean coal technologies.

Basic research accounts for $2.8 billion of DOE's energy R&D appropriations in 1999, compared with $4.2 billion in 1992 (in 1999 dollars). Basic research expenditures include Government funding for fusion research and the superconducting supercollider, which represent subsidies for the development of scientific knowledge in general, rather than for energy in particular. They are not treated as direct energy subsidies in this analysis and do not appear in Tables 1 and 2.

Energy trust funds are Federal funds earmarked for a particular public purpose, financed by excise taxes or similar levies on energy commodities—particularly, gasoline and coal. Total energy-related trust fund tax receipts were $2.2 billion in fiscal year 1999. Trust funds are not included as direct subsidies and thus do not appear in Tables 1 and 2. The largest trust funds are the Nuclear Waste Fund and the Black Lung Disability Fund, each funded at $600 million.

The estimated total value of 1999 Federal subsidies to oil, natural gas, and coal is $2.2 billion (Table 1), compared with wholesale purchases in 1998 valued at $126.9 billion (1999 dollars) and end-use expenditures of $363.4 billion (1999 dollars) for purchases of those fuels in 1995 (Table 3). Although the value of energy subsidies is low relative to total energy expenditures, some forms of energy receive subsidies that are substantial relative to the value of the fuels. Of the primary fossil fuels, natural gas has benefitted most from Federal subsidies in 1999—a total of $1.2 billion, almost all of which comes from a tax credit on the production of alternative fuels, primarily gas from tight sands and coalbed methane. Although no production data are available on natural gas production from tight sands, coalbed methane accounted for 6 percent of all natural gas production in 1997. The $1.2 billion alternative fuel credit in 1999 can be compared with natural gas sales valued at $39 billion (1999 dollars) at the wholesale level in 1998 and $79 billion (1999 dollars) at the retail level in 1995 (Table 3).

Table 1. Summary of Primary Energy Subsidy Elements in Federal Programs by Fuel and Program Type on a Budget Outlay Basis, Fiscal Year 1999
(Million 1999 Dollars)

Fuel	Type of Subsidy				Total
	Direct Expenditures	Tax Expenditures		Research and Development	
		Income	Excise		
Oil	0	263	0	49	**312**
Gas	0	1,048	0	115	**1,163**
Coal	0	85	0	404	**489**
Oil, Gas, and Coal Combined[a]	0	205	0	0	**205**
Nuclear	0	0	0	640	**640**
Renewables	4	15	[b]725	327	**1,071**
Electricity	0	40	0	[c]33	**73**
Total	**4**	**1,656**	**725**	**1,567**	**3,953**

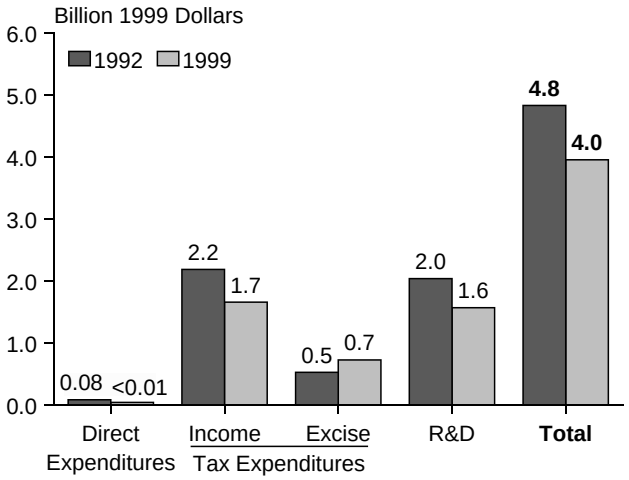
[a]The category Oil, Gas, and Coal Combined includes expenditures that were not allocated to any one of the three individual fuels.
[b]Alcohol fuels excise tax.
[c]Electricity research and development is for advanced turbine technology. Other generation technology research and development is distributed by fuel.
Sources: Most information drawn from Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2000* (Washington, DC, February 1999). See also the subsequent chapters of this report.

Table 2. Summary of Primary Energy Subsidy Elements in Federal Programs by Fuel and Program Type on a Budget Outlay Basis, Fiscal Year 1992
(Million 1999 Dollars)

Fuel	Type of Subsidy				Total
	Direct Expenditures	Tax Expenditures		Research and Development	
		Income	Excise		
Oil	0	451	0	80	**531**
Gas	0	1,215	0	29	**1,244**
Coal	82	354	0	629	**1,065**
Nuclear	0	0	0	1,015	**1,015**
Renewables	0	91	[a]525	278	**894**
Electricity	0	74	0	[b]5	**79**
Total	**82**	**2,185**	**525**	**2,037**	**4,829**

[a]Alcohol fuels excise tax.
[b]Electricity research and development is for advanced turbine technology. Other generation technology research and development is distributed by fuel.
Note: Totals may not equal sum of components due to independent rounding.
Source: Most information drawn from Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1993* (Washington, DC, February 1992).

Figure 1. Summary of Primary Energy Subsidy Elements in Federal Programs by Program Type on a Budget Outlay Basis, 1992 and 1999



Source: Tables 1 and 2.

Table 3. Estimated Quantity and Value of U.S. Energy Consumption by Fuel

Energy Use	Oil	Natural Gas	Coal	Nuclear	Biomass, Solar, Wind, and Geothermal	Total
1998 U.S. Consumption (Quadrillion Btu)	36.57	21.84	21.62	7.16	3.48	**90.67**
1998 Average Wholesale Price (1998 Dollars per Million Btu)	[a]1.88	[b]1.78	[c]0.83	NA	NA	**NM**
1998 Total Fuel Expenditures (Million 1999 Dollars)	69,455	39,272	18,128	NA	NA	**126,855**
1995 End-Use Energy Expenditures (Million 1999 Dollars)	252,033	78,690	28,559	4,102	NA	**363,384**

[a]First purchase price.
[b]Wellhead price.
[c]Value of coal produced at free-on-board mines.
NA = not available. NM = not meaningful.
Source: Energy Information Administration, *Annual Energy Review 1998*, DOE/EIA-0384(98) (Washington, DC, August 1999).

Comparisons With the 1992 EIA Report

This report differs in many ways from EIA's 1992 report on Federal energy subsidies, which was broader in scope. Table 4 compares the Federal primary energy market interventions included as subsidies in this report with the same categories of subsidies from the 1992 report. The estimated values of primary energy subsidies in the two reports are compared in Table 4 after conversion of the 1992 estimates to 1999 dollars. The comparison indicates that the total monetary value of Federal interventions in primary energy markets has fallen from $4.8 billion (1999 dollars) in 1992 to $4.0 billion in 1999.

An obvious difference between the results in this report and those from the 1992 EIA report is that a number of Federal programs have been eliminated over the past 8 years, while others have been created. For instance, the Energy Policy Act of 1992, while introducing tax incentives for renewable energy and alternative transportation fuels, also set the stage for the eventual privatization of DOE's uranium enrichment activities. The Enhanced Oil Recovery Credit was not included in the 1992 report, because the credit, which resulted from the Omnibus Budget Reconciliation Act of 1980, was not reported in the Federal budget until 1994. Subsidies for synthetic fuels were included in the 1992 report but have since been terminated. The Renewable Energy Production Incentive has been added since 1992 as a direct expenditure subsidy. Expensing of Tertiary Injectants, included in 1992, is not included in this report because its value is below the Treasury Department's *de minimis* reporting level (roughly $5 million). Finally, three R&D programs have been terminated since the 1992 report: the Interagency National Acid Precipitation Assessment Program, Shale Oil Research and Development, and U.S. Geological Survey Energy Research and Development.

Organization of the Report

In addition to this introductory chapter, this report contains three chapters. Chapter 2 reports on programs listed in the Federal budget, using budget computations as the valuation method for energy-related tax expenditures. Chapter 3 evaluates energy-related R&D expenditures, and Chapter 4 discusses energy excise taxes and trust funds.

The report also includes five appendixes. Appendix A reviews a number of other studies of Federal energy subsidies. Appendix B presents information, in the form of Fact Sheets, on a range of Federal programs that were considered candidates for inclusion in this report. Appendix C contains tabular listings of Federal appropriations for energy R&D overall and specifically for nuclear power, fossil fuels, renewable energy, and energy conservation. Appendix D provides a bibliography, and Appendix E contains the letters from DOE's Office of Policy setting out the assumptions and definitions used for the study.

Table 4. Comparison of Estimates of Federal Financial Interventions and Subsidies in Primary Energy Markets: Values for Corresponding Categories From the 1992 and 1999 EIA Reports

Subsidy Category	1992 Estimate (Million 1992 Dollars)	1992 Estimate (Million 1999 Dollars)	1999 Estimate (Million 1999 Dollars)
Direct Expenditures			
Renewable Energy Production Incentive	NI	NI	4
Synthetic Fuel Subsidies	72	82	[a]NI
Subtotal (Direct Expenditures)	*72*	*82*	*4*
Tax Expenditures			
Capital Gains Treatment of Royalties in Coal	10	11	85
Expensing of Exploration and Development Costs	-55	-63	-90
Exception From Passive Loss Limitation for Working Interests in Oil and Gas Properties	100	114	35
Enhanced Oil Recovery	[b]NI	[b]NI	245
Expensing of Tertiary Injectants	20	23	NI
Alternative Fuel Production Credit	670	764	1,030
New Technology Credit	65	74	40
Alcohol Fuel Credit	80	91	15
Excess of Percentage Over Cost Depletion	1,025	1,170	295
Subtotal (Income Taxes)	*1,915*	*2,185*	*1,656*
Excise Taxes	460	525	725
Subtotal (Tax Expenditures)	*2,375*	*2,710*	*2,381*
Research and Development			
Nuclear Power			
New Nuclear Plants	122	139	30
Waste/Fuel/Safety	620	707	467
Unallocated	148	169	143
Subtotal (Nuclear Power)	*890*	*1,015*	*640*
Coal			
Preparation/Mining	81	93	[c]NI
Coal Conversion	51	58	[d]NI
Power Generation	148	168	[e]NI
Clean Coal Technology Program	415	474	183
Interagency National Acid Precipitation Assessment Program	31	35	[a]NI
Advanced Clean Efficient Power Systems	NI	NI	[f]88
Advanced Clean Fuels	NI	NI	[g]16
Advanced Research and Technology Development	NI	NI	[h]20
Unallocated	79	90	97
Subtotal (Coal)	*804*	*918*	*404*
Other Fossil Energy			
Oil	51	59	49
Natural Gas	13	14	115
Shale Oil	6	7	[a]NI
U.S. Geological Survey Energy Research and Development	26	30	[a]NI
Subtotal (Other Fossil Energy)	*96*	*109*	*164*
Renewable Energy			
Photovoltaic/Wind/Other Solar	137	156	134
Biomass	21	24	96
Geothermal	27	31	29
Hydroelectric	1	1	3
Electricity Technologies	38	43	44
Unallocated	19	22	22
Subtotal (Renewable Energy)	*244*	*278*	*327*
Electricity			
Advanced Turbine Systems	5	5	33
Subtotal (Research and Development)	*2,039*	*2,326*	*1,567*
Clean Coal Technology Adjustment[i]	253	289	—
Subtotal (Research and Development, Including Clean Coal Technology)	*1,786*	*2,037*	*1,567*
Total	**4,233**	**4,829**	**3,953**

NI - not included. [a]Program terminated. [b]Not reported in the Federal budget until 1994. [c]Reclassified as Advanced Research and Technology Development. [d]Reclassified as Advanced Clean Fuels. [e]Reclassified as Advanced Clean and Efficient Power Systems. [f]Replaces Power Generation category from 1992 EIA report. [g]Replaces Coal Conversion category from 1992 EIA report. [h]Replaces Preparation/Mining category from 1992 EIA report. [i]Value of appropriations from 1992 EIA report (1992) and value of outlays from this report (1999).

Sources: This report and Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, SR/EMEU/92-02 (Washington, DC, November 1992).

2. Tax Expenditures

Overview

This chapter discusses Federal programs directly affecting the energy industry through which the Federal Government provides a direct financial benefit to energy producers or consumers and receipt of the benefit is directly linked to primary energy production and consumption. In the succeeding chapters, programs are examined in which linkage to energy production and consumption is less direct. The type of Federal program considered in this chapter consists mainly of Federal Government tax expenditures. Energy tax expenditures are broadly defined as provisions of the tax code that permit special, beneficial tax treatment to taxpayers who produce, consume, or save energy in ways that are judged to be in the public interest. In addition, this chapter also includes one "direct expenditure" energy subsidy, the Renewable Energy Production Incentive (REPI). Direct expenditures are payments made by the Federal Government to particular energy producers or consumers because they are economically disadvantaged or have undertaken to produce or consume energy in a way that has desirable social consequences. The size of the REPI subsidy is relatively small, however, at $4 million in 1999.

Tax expenditures and direct expenditures do not involve large sums of money in comparison with the Federal civilian budget or the value of U.S. energy consumption. Tax expenditures, largely aimed at energy production, are modest, totaling some $2.4 billion in outlay equivalent in fiscal year 1999. Tax expenditures are concentrated: the largest single item is $1.0 billion for the Section 29 tax credit for alternative energy sources. Although the legislation permits the credit for a large array of possible energy sources, almost all the $1.0 billion in tax expenditures for this legislation is claimed for natural gas production. The other large item in this account is the excise tax exemption for ethanol, with an outlay equivalent value of $0.7 billion—less than 1 percent of the $138 billion value of retail gasoline sales in 1998 but still a significant subsidy for ethanol.

Definitions

Tax expenditures are reductions in Government revenues resulting from preferential tax treatment for particular taxpayers. They are termed "tax expenditures" because their objectives could also be reached by direct expenditure of Government funds. In this report, the term "tax expenditures" is applied to preferential tax treatment provided by Federal income tax laws, as requested in the study definition. All but one of the tax expenditure provisions reviewed in this chapter include Federal income taxes that are applied preferentially to energy. The exception is the partial exemption from Federal energy excise taxes that benefits alcohol fuels.[8]

Many tax expenditure programs are functionally equivalent to direct expenditure programs. The basis for selecting one or the other approach to provide benefits to taxpayers is not always clear. Several factors may be considered

[8]Excise taxes are reviewed in Chapter 4. Because the partial exemption of alcohol fuels from excise taxes on transportation fuels is closely related to energy tax expenditures, it is reviewed in this chapter.

during the selection process. The decision as to which approach to use in a subsidy program depends on the specific characteristics of each program.[9]

The economic basis, or justification, that is frequently asserted for adopting tax expenditures differs with the particular type of tax expenditure program. The typical justification for tax expenditures that relate to capital recovery is to bring tax depreciation into closer conformity with actual economic change in the market value of the asset. Examples of differential capital cost recovery for energy tax purposes that have used this rationale include immediate expensing of intangible drilling costs and percentage depletion.[10] Intangible drilling costs were asserted by producers to be conventional operating expenses that therefore should be expensed. A key element of this assertion is that intangible drilling costs lack any salvage value. Granting accelerated writeoffs for investment improves the present value of after-tax profits and encourages additional mineral exploration and development.[11] The use of percentage depletion rather than cost depletion has a similar consequence.[12] A second justification for tax expenditures is to stimulate the production of goods thought to provide benefits that are not sufficiently valued in the market. An example is the Alternative Fuel Production Credit, which encourages increased production of energy from nonconventional sources, with the goal of reducing reliance on petroleum imports.

Tax expenditures exist when actual tax treatment for particular kinds of taxpayers deviates from standard tax treatment. There is disagreement as to what constitutes standard treatment, both in principle and in practice. As a result, lists of tax expenditure items and associated values can and do differ. With minor modification, the list and values used in this report are those prepared by the U.S. Department of Treasury and reported by the Office of Management and Budget (OMB) in the U.S. Government's annual budget.[13] The OMB does not include preferential energy excise tax expenditures, which are included here, within its formulation of tax expenditures.[14] The status of the tax expenditure provisions covered in this report extends only through fiscal year 1999, although an OMB forecast is presented for subsequent years through 2004.

Generally, tax expenditures are both tax benefits to preferred taxpayers and revenue losses to the Federal Government. This distinction creates two alternative means of measuring the effects of tax expenditures: revenue losses and outlay equivalents. Revenue losses are defined as revenue foregone by Treasury. The benefits or losses can also be expressed as outlay equivalents, which are the amounts taxpayers would have to be paid in order to derive the same after-tax income obtained under the revenue loss approach. Outlay equivalents will exceed revenue losses whenever outlays add to the taxable income of those who benefit from the tax expenditure program. For example, producers pay no tax on the tax credit they receive for producing alternative fuels, and their net income increases by the full amount of the credit. The direct budget outlay required to produce the same increase in net

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[9]Some of the factors related to the two approaches are discussed in M. Feldstein, "A Contribution to the Theory of Tax Expenditures: The Case of Charitable Giving," in H.J. Aaron and M.J. Boskin, eds., *The Economics of Taxation* (Washington, DC: The Brookings Institution, 1980), pp. 99-122.

[10]Intangible drilling costs are defined as oil and gas well drilling expenses that do not have salvage value and are "incident to and necessary for the production of oil and gas." Typical intangible costs—well logging, labor, fuels, and site preparation expenses—usually account for about 70 percent of the cost of drilling wells. A textbook discussion of intangible drilling costs can be found in R.A. Gallun and J.W. Stevenson, *Fundamentals of Oil and Gas Accounting*, 2nd edition (Tulsa, OK: PennWell Books, 1988), pp. 224-227.

[11]Although accelerated writeoffs have no effect on the value of after-tax profits, they allow profits to be realized earlier and give companies the opportunity to take advantage of intertemporal interest rate effects.

[12]Each tax expenditure category, including those that relate to intangible drilling costs and percentage depletion, is discussed later in the report and in detail in the Fact Sheets in Appendix B.

[13]Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2000* (Washington, DC, 1999), and earlier editions. Treasury's compilation of tax expenditures is limited to special exceptions in the Federal income tax code that serve specific programs listed in the budget, such as energy, health, and defense.

[14]The basic rationale against including preferential energy excise taxes in formulations of tax expenditures is that excise taxes lack a basic structure against which deviations (preferences) can be measured. See P.R. McDaniel and S.S. Surrey, "Tax Expenditures: How To Identify Them; How To Control Them," *Tax Notes* (May 24, 1982), p. 610.

income would be greater than the credit, because the outlay would be subject to income tax—as typically occurs when tax expenditures take the form of tax deferrals. Tax deferrals are essentially loans, such as those implicit when exploration and development costs are expensed (or immediately charged against income), and do not directly affect taxable income.

This report presents both revenue losses and outlay equivalents. The outlay equivalent approach makes it easier to compare tax expenditure subsidies with other types of subsidies, which usually are reported on an outlay basis. The effects of interactions among tax preferences on the aggregate value of energy tax expenditures are reported by the Treasury Department only on an outlay equivalent basis.

Aggregate Federal tax expenditures measured in terms of outlay equivalent have grown relatively quickly over the past 10 years, to approximately $664 billion in 1999 from $482 billion in 1992, in 1999 dollars (Table 5). The Commerce and Housing Credit program has consistently accounted for more than one-quarter of tax expenditures since at least 1983.[15] Tax expenditures for that program, together with those for Income Security[16] and Health and Medicare,[17] annually account for about two-thirds of total Federal tax expenditures. Energy currently accounts for only $2 billion, or 0.3 percent of all tax expenditures.

Types of Tax Expenditures and Their Measurement

Four major types of energy-related tax expenditures can be identified (Tables 6 and 7): tax credits, measures that reduce taxable income, preferential tax rates, and tax deferrals. They differ substantially in terms of dollar value:

- Tax credits are currently the most valuable type of tax expenditure. The credits, which apply to items such as investment in alternative fuel production, enhanced oil recovery, new technology, and alcohol fuels, are valued at $1,015 million in fiscal year 1999 on a revenue loss basis (Table 6) or $1,330 million on an outlay equivalent basis (Table 7). The $1,030 million Alternative Fuel Production Credit is the largest energy-related tax credit in 1999 on an outlay equivalent basis.
- The sole income-reducing measure—excess of percentage over cost depletion—has the second greatest value, totaling $260 million in 1999 on a revenue loss basis or $295 million on an outlay equivalent basis.
- Preferential tax rates, the third most valuable form of energy tax expenditures, are expected to amount to $65 million in fiscal year 1999 on a revenue loss basis or $85 million on an outlay equivalent basis. This type of tax expenditure is the only one that involves a lowering of the corporate tax rate.
- The least valuable group of tax expenditures is tax deferrals. Tax deferrals originate when tax laws and regulations allow income earned in one period to be reported and taxed in a later period or allow acceleration of the deduction of expenses. When deferred, taxes are reported as positive tax expenditures (that is, as a loss in Government revenue). When repaid, they are reflected as a negative tax expenditure (that is, as a gain in Government revenues). In fiscal year 1999, net energy tax deferrals were estimated to be a negative $35 million on a revenue loss basis or a negative $55 million on an outlay equivalent basis. The tax deferrals covered here originate from expensing certain energy exploration and development costs, and from the exception from the passive loss limitation for working interests in oil and gas properties.

[15]The Commerce and Housing income tax credit provides incentives to encourage business investment. It allows capital gains to be taxed at a lower rate than other income.
[16]The Income Security tax credit provision benefits certain classes of retirement savings.
[17]The Health and Medicare tax allows employers to exclude contributions for health insurance from taxable income.

Table 5. Estimated Outlay Equivalent of Federal Tax Expenditures by Program, Selected Fiscal Years, 1992 and 1999
(Billion 1999 Dollars)

Program	1992	1999
Commerce and Housing Credit	180	210
Income Security	105	145
Health	66	109
General Purpose Fiscal Assistance	46	68
Education, Training, etc.	29	74
Social Security	26	23
International Affairs	10	15
National Resources and Environment	3	2
General Science, Space and Technology	4	3
National Defense	3	2
Community and Regional Development	3	2
Veterans Benefits and Services	2	3
Energy[a]	2	2
Interest	1	1
Agriculture	1	1
Transportation	*	2
Total Before Program Interactions	**482**	**664**

*Less than $0.5 billion.
[a]Does not include the outlay equivalent of any preferential energy excise taxes.
Notes: The values shown for any given program are after interactions among components of the program but before interactions between programs. Technically, the program values are not additive because of their high degree of interaction. Actual totals with program interactions are not available but would probably differ substantially from those shown. Sum of components may not equal total due to independent rounding. All data have been rounded to the nearest billion.
Sources: Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1993* (Washington, DC, 1992), and earlier issues; and Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999), and earlier issues.

Table 6 also shows the only energy tax expenditure covered in this chapter that does not originate from the income tax system—the alcohol fuels excise tax preference. Its expected fiscal year 1999 value is $725 million, both on a revenue loss basis and on an outlay equivalent basis. Each type of energy tax expenditure is discussed in the following section. Additional details are provided in the fact sheets in Appendix B.

Individual Energy Tax Expenditures

Energy tax expenditures are among the smallest tax expenditures that correspond to specific budget programs (Table 5). In fiscal year 1999, when preferential energy excise taxes are included, they amounted to about $2.0 billion on a revenue loss basis (Table 6) or $2.4 billion on an outlay equivalent basis (Table 7).[18] Most of the energy tax expenditures and preferential energy excise taxes are accounted for by only a few provisions, but those provisions are important in terms of their effects. They apply principally to oil and gas and, to a lesser extent, to alcohol for motor fuels and to coal. Alternative forms of energy benefit to only a small degree. Solar, wind, biomass, and geothermal energy facilities are beneficiaries of the New Technology Credit.

[18]The tax expenditures in these tables are net of the effects of the Alternative Minimum Tax.

Table 6. Estimated Revenue Losses from Federal Energy Tax Expenditures by Type of Expenditure and Form of Energy, Fiscal Year 1999
(Million 1999 Dollars)

Tax Expenditures	Oil	Natural Gas	Coal	Oil, Gas, and Coal Combined	Alcohol[a]	Other Energy	Certain Energy Facilities	Total
Preferential Tax Rates								
Capital Gains Treatment of Royalties on Coal	0	0	65	0	0	0	0	**65**
Tax Deferrals								
Expensing of Exploration and Development Costs	NA	NA	NA	-70	0	[b]0	0	**-70**
Exception from Passive Loss Limitation for Working Interests in Oil and Gas Properties	[c]18	[c]18	0	0	0	0	0	**35**
Tax Credits								
Enhanced Oil Recovery Credit	160	0	0	0	0	0	0	**160**
Alternative Fuel Production Credit	[d]0	[e]810	0	0	0	[f]0	0	**810**
New Technology Credit	0	0	0	0	0	0	[g]30	**30**
Alcohol Fuel Credit[h]	0	0	0	0	15	0	0	**15**
Income-Reducing Measure								
Excess of Percentage Over Cost Depletion	NA	NA	NA	260	0	[b]0	0	**260**
Total Before Component Interactions	**178**	**828**	**65**	**190**	**15**	**0**	**30**	**1,305**
Alcohol Fuels Excise Tax	0	0	0	0	725	0	0	**725**

[a]Alcohol for use as motor fuel.
[b]There may be small values for uranium, oil shale, and geothermal. Any such values are included in the value for coal.
[c]Derived by allocating an aggregate value for oil and natural gas equally between the two forms of energy. The total value for oil and gas combined was $35 million.
[d]There may be small values for oil produced from shale and tar sands. Any such values are included in the value for natural gas.
[e]Although the tax expenditure provision applies to oil, natural gas, solids, and steam produced from other than conventional sources, the $810 million income tax credit is estimated to be almost entirely for nonconventional natural gas.
[f]There may be small values for synthetic fuels produced from coal, fuel from qualified processed wood, and steam from solid agricultural byproducts. Any such values are included in the value for natural gas.
[g]Solar, wind, biomass, and geothermal energy facilities.
[h]In addition to the income tax expenditures in the table, there is a gasoline excise tax preference which amounted to an estimated $725 million in fiscal year 1999.
NA = Not available.
Source: Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999).

The most valuable Federal tax expenditure for energy is the Alternative Fuel Production Credit, which has been most effective in stimulating the production of nonconventional natural gas. The credit is available for production sold before January 1, 2003, for qualifying properties drilled after December 31, 1979, and before January 1, 1993.[19] The second-largest energy-related tax expenditure in 1999 resulted from the use of percentage depletion rather than cost depletion for mineral resources. Under percentage depletion, a specified percentage of gross income from a mineral resource property is deductible for tax purposes. Under cost depletion, the value of the deduction is limited to the amortization of the investment value committed to the depleting resource. Percentage depletion benefits principally oil and gas producers but also producers of other natural resources, particularly coal.

[19]The credit was extended to production from biomass and liquid, gaseous, or solid synthetic fuels produced before January 1, 1997, and production through January 1, 2008. These fuels are relatively minor recipients of the Alternative Fuel Production Credit.

Table 7. Estimated Outlay Equivalent of Federal Energy Tax Expenditures by Type of Expenditure and Form of Energy, Fiscal Year 1999
(Million Dollars)

Tax Expenditures	Oil	Natural Gas	Coal	Oil, Gas, and Coal Combined	Alcohol[a]	Other Energy	Certain Energy Facilities	Total
Preferential Tax Rates								
Capital Gains Treatment of Royalties on Coal	0	0	85	0	NA	0	0	**85**
Tax Deferrals								
Expensing of Exploration and Development Costs	NA	NA	NA	-90	0	[b]0	0	**-90**
Exception from Passive Loss Limitation for Working Interests in Oil and Gas Properties	[c]18	[c]18	0	0	0	0	0	**35**
Tax Credits								
Enhanced Oil Recovery Credit	245	NA	NA	0	0	0	0	**245**
Alternative Fuel Production Credit	[d]0	[e]1,030	0	0	0	[f]0	0	**1,030**
New Technology Credit	0	0	0	0	0	0	[g]40	**40**
Alcohol Fuel Credit[h]	0	0	0	0	15	0	0	**15**
Income-Reducing Measure								
Excess of Percentage Over Cost Depletion	NA	NA	NA	295	0	[b]0	0	**295**
Total Before Component Interactions	**263**	**1,048**	**85**	**205**	**15**	**0**	**40**	**1,656**
Alcohol Fuels Excise Tax	0	0	0	0	725	0	0	**725**

[a]Alcohol for use as motor fuel.
[b]There may be small values for uranium, oil shale, and geothermal. Any such values are included in the value for coal.
[c]Derived by allocating an aggregate value for oil and natural gas equally between the two forms of energy. The total value for oil and gas combined was $35 million.
[d]There may be small values for oil produced from shale and tar sands. Any such values are included in the value for natural gas.
[e]Although the tax expenditure provision applies to oil, natural gas, solids, and steam produced from other than conventional sources, the $1,030 million income tax credit is estimated to be almost entirely for nonconventional natural gas.
[f]There may be small values for synthetic fuels produced from coal, fuel from qualified processed wood, and steam from solid agricultural byproducts. Any such values are included in the value for natural gas.
[g]Solar, wind, biomass, and geothermal energy facilities.
[h]In addition to the income tax expenditures in the table, there is a gasoline excise tax preference which amounted to an estimated $725 million in fiscal year 1999.
NA = Not available.
Source: Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999).

In 1969, the percentage depletion rate for oil and gas was reduced; and, beginning in 1975, integrated oil and gas producers were prohibited from using percentage depletion altogether. The rate that applied to the remaining oil and gas producers, the "independents," was further reduced between 1981 and 1984. Since EIA's 1992 *Federal Energy Subsidies* report was written, the Alternative Fuel Production Credit has supplanted the use of percentage depletion as the largest energy-related Federal tax expenditure program, primarily because the oil and gas wells eligible for the percentage depletion credit had to have been drilled between 1980 and 1992, leading to a surge in subsequent sales (and tax expenditures) in the early to mid-1990s. The value of the percentage depletion tax expenditure has dropped primarily as a result of weak U.S. oil and gas prices since the mid-1980s.

Preferential Tax Rates

Only one type of energy tax expenditure involving preferential tax rate treatment is currently operative. It applies to royalty income derived from certain coal operations. The royalty income of individual owners of coal leases is taxed at the lower individual capital gains tax rate of 28 percent rather than at the higher regular individual top tax rate of 39.6 percent, if the owners so choose. Corporate owners have the same option, but because the corporate income and corporate capital gains tax rates are both 35 percent, the option is of little or no advantage to them. Individuals and corporations opting for the capital gains tax rate cannot also use the percentage depletion tax expenditure provision discussed below. In practice, the percentage depletion provision is generally more beneficial, particularly for corporations. The small preferential rate tax expenditure (revenue loss) for coal of $65 million in Table 6 (and its $85 million outlay equivalent in Table 7) benefits only individual owners at present.

Tax Deferrals

Tax deferrals generate tax expenditures that have a unique feature, in that they can be negative. Tax deferrals can be viewed as interest-free loans by the Government to taxpayers. These temporary revenue losses are recorded as positively valued tax expenditures. When the loans are repaid they are treated as negative tax expenditures.[20] In any given year the measured net value of newly made loans and loans repaid can therefore be either positive or negative. Actual subsidies associated with tax deferrals can never be negative, however, because interest-free loans always benefit the recipient. The value of the subsidy in any given year can be viewed as the amount that can be earned by investing the loans that are outstanding in that year. Two tax deferral types of energy tax expenditures exist: the expensing of exploration and development expenditures and the exception from the passive loss limitation for working interests in oil and gas properties.

Exploration and Development Expenditures

Tax law allows energy producers, principally oil and gas producers, to expense certain exploration and development (E&D) expenditures rather than capitalizing them and cost-depleting them over time. The most important of these expenditures consist of intangible drilling costs (IDCs) associated with oil and gas investments. IDCs are costs incurred in developing and drilling oil, gas, and geothermal wells up to the point of production.[21] Major (or integrated) oil companies can expense 70 percent of their IDCs for successful domestic wells and 100 percent for unsuccessful domestic wells.[22] The remaining 30 percent must be amortized over 5 years. Independent (or nonintegrated) oil producers can expense 100 percent of their IDCs for all domestic wells. Producers of other fuel minerals can also expense certain E&D expenditures. For example, coal producers can expense 70 percent of their surface stripping and other selected expenditures. The remainder must be amortized over 5 years.

The value of the E&D tax expenditure provision applied to oil, gas, and coal is an estimated negative $70 million in fiscal year 1999 (Table 6) or a negative $90 million in outlay equivalent (Table 7). The negative value represents a gain in Government revenue rather than a loss. The gain represents, in effect, a repayment of the principal on a Government loan (or prior tax deferral).

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[20]Technically, this is referred to either as a reversal or a turnaround of deferred taxes, depending on whether the emphasis is on all loans or individual loans.

[21]IDCs include costs such as labor, fuels, and site preparation. They exclude the cost of acquiring the property itself, as well as costs such as pipelines and other tangible facilities to control and transport the oil and gas produced.

[22]A major oil company is one that has integrated operations from exploration and development through refining or distribution to end users.

The value of the E&D tax expenditure provision is small by historical standards. Before 1986, positive tax expenditures occasionally exceeded $1 billion per year. The recent small values reflect reductions in the extent to which IDCs can be expensed, due to tax reform, and the adverse effects on petroleum investment resulting from the collapse of oil prices in 1986 and the relatively low oil and gas prices after that time.

The value of the subsidy associated with the expensing of E&D costs cannot be estimated precisely. By one measure, the subsidy is equal to the total interest charges the taxpayer would have had to pay to borrow the funds, which depends on the interest rate at which the taxpayer would borrow and the period of deferral. Since 1987, in all years but one, the value of expensing oil and gas development costs has been negative, meaning, on balance, that there has been no subsidy during the period.

The provision that allows the expensing of E&D costs for oil, gas, and other fuels increases the return on investment in those resources and adds to other E&D incentives. Domestic crude oil and natural gas production is greater than it otherwise would be, and capital is diverted from other productive activities. Also, all IDCs that are incurred outside the United States must be capitalized, thus providing a disincentive for foreign oil and gas exploration. The deferral particularly benefits the development of coal mines rather than the exploration efforts that precede development.[23] Additionally, on a per-dollar-of-investment basis, the expensing provision benefits mines with high capital costs and low variable costs (such as deep underground mines in the East) to a greater degree than those with a less capital-intensive ratio (such as strip mines in the West).

Title XIX of the Energy Policy Act of 1992 increased the future value of these provisions for independent oil and gas producers by limiting the extent to which intangible drilling costs are treated as tax preference items for purposes of computing the Alternative Minimum Tax. This provision will reduce the Alternative Minimum Tax liability of independent producers.

Passive Loss Limitation

The second tax deferral is an exemption from passive loss limitations for working interests in oil and gas properties.[24] The exemption allows owners of working interests to offset their losses from passive activities against active income. Under normal rules, passive losses remaining after being netted against passive incomes can only be carried over to future period passive incomes. The passive loss limitation provision and the oil and gas exception to it apply principally to partnerships and individuals rather than corporations.

The value of this tax expenditure in fiscal year 1999 is an estimated $35 million (Table 6). The value of the subsidy does not equal the value of the tax expenditure for the same reason cited above: the expenditure is equivalent to a loan, and the subsidy is equivalent to the gross interest that the loan earned, or could have earned, for the taxpayer. The value of the subsidy in fiscal year 1999 is equal to the interest not only on the net new loans of $35 million for that year but also to the interest on the cumulative net new loans in prior years.

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[23]Mine development expenses can be written off immediately. Typically, exploration costs can also be written off immediately, but the benefits of the early writeoff are nullified if the mines become profitable. See National Research Council, *Energy Taxation: An Analysis of Selected Taxes*, DOE/EIA-0201/14, prepared for the Energy Information Administration (Washington, DC, September 1980), pp. 78-79.

[24]A working interest is an interest in a mineral property that entitles the owner to explore, develop, and operate a property. The owner of the working interest bears the costs of exploration, development, and operation of the property and any liabilities arising from those activities. In return, the owner is entitled to a share of the mineral production from the property or to a share of the proceeds.

The impact of the subsidy may be greater than its small value for 1999 suggests. One reason for the small subsidy value is that the subsidy generally applies only to the noncorporate and closely related segments of the industry, and the level of funds obtained by independents through limited partnerships in recent years has been low.[25]

Tax Credits

The four energy tax credit expenditure provisions are the Enhanced Oil Recovery Credit, Alternative Fuel Production Credit, Alcohol Fuel Credit, and New Technology Credit. The credits have one common feature: they apply to unconventional forms of energy or means of producing energy.

Enhanced Oil Recovery Credit

Section 43 of the Internal Revenue Code provides taxpayers an enhanced oil recovery (EOR) credit equal to 15 percent of their qualified EOR costs. Section 43 was a part of the Omnibus Budget Reconciliation Act of 1990, which made several changes to capital cost recovery methods. The Section 43 credit is phased out if oil prices rise above a certain level, i.e., $28 per barrel (in 1991 dollars).[26]

The value of this tax expenditure is estimated at $160 million for fiscal year 1999 or $245 million in terms of outlay equivalent (Tables 6 and 7). The subsidy prolongs the lives of some wells, thus increasing the total volume of hydrocarbons recovered from those wells. In order to be eligible for the credit, the taxpayer must employ certain tertiary recovery methods,[27] such as miscible fluid replacement, steam drive injection, microemulsion, *in situ* combustion, polymer-augmented water flooding, cyclic steam injection, alkaline flooding, carbonated water flooding, and immiscible carbon dioxide replacement. EIA's *Annual Energy Outlook 1999* estimated that EOR contributed 580,000 barrels per day to U.S. oil production in 1997.[28]

Alternative Fuel Production Credit

This tax credit provision applies to the production of alternative (or nonconventional) fuels. It is the largest energy tax credit and stems from Section 29 of the Internal Revenue Code. Section 29 was established by the Windfall Profits Tax of 1980 (see box on page 20). At the end of fiscal year 1999, the qualifying fuels had to be produced from specified wells drilled or certain facilities placed in service between January 1, 1980, and December 31, 1992, and sold through the year 2002.

The credit is reduced if other subsidies are used.[29] The current value of the credit is an estimated $810 million for fiscal year 1999 and $1,030 million in terms of its outlay equivalent (Tables 6 and 7), making the Alternative Fuel Production Credit the largest energy-related tax expenditure. Its value has doubled since 1992, when EIA's previous energy subsidy report was produced.

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[25]The passive loss rules generally apply to individuals, trusts, estates, personal service corporations, and closely held corporations.

[26]The Section 43 tax credit is phased out when the average unregulated wellhead price per barrel of crude oil exceeds $28 in inflation-adjusted dollars. In 1999 dollars this value was $32.83, after adjusting for inflation using the 1992 GDP inflator (GDP92 = 1.00). Source: Joint Committee on Taxation.

[27]Tertiary injectants can also be expensed under Section 193 of the U.S. tax code. The value of this tax expenditure fell beneath the U.S. Treasury's *de minimis* amount ($5 million) over fiscal years 1999-2004 and thus was not reported.

[28]Energy Information Administration, *Annual Energy Outlook 1999*, DOE/EIA-0383(99) (Washington, DC, December 1998), Table A15.

[29]The credit is offset by any benefits received from energy investment credits, tax-exempt financing, and benefits received from Government grants.

Article 29: The Alternative Fuel Production Credit

The Alternative Fuel Production Credit (Section 29 of the Internal Revenue Code) was established by the Windfall Profit Tax of 1980 and became operational in the same year. Section 29 was designed to encourage the production of domestic energy from certain nonconventional sources and to reduce the Nation's dependence on energy imports. The credit applies to qualified fuels from wells drilled or facilities placed in service between January 1, 1980, and December 31, 1992. Production from qualifying wells can receive the credit on volumes produced through December 31, 2002; thus, the Section 29 credit affects the industry for 10 years after the qualifying deadline. The qualified fuels are:

- Oil produced from shale and tar sands
- Gas from geopressurized brine, Devonian shale, coal seams, tight formations, and biomass
- Liquid, gaseous, or solid synthetic fuels produced from coal
- Fuel from qualified processed formations or biomass
- Steam from agricultural products.

The principal changes that have occurred since 1980 have been to extend the time limits by which wells or facilities must be placed in service and fuels sold in order to be eligible for the credit. The initial time limit for qualification was December 31, 1989, but the deadline has been extended twice by subsequent legislation. In 1989, legislation allowed a 1-year extension of the time limits. The Omnibus Budget Reconciliation Act of 1990 provided an additional 2-year extension. The 1990 act also eased the qualifying requirements for gas produced from tight sands after 1990.[a,b]

The tax credit for nonconventional fuels is $3 per barrel of oil equivalent produced. (All prices as well as the credit are specified in 1979 dollars, but for actual use they are indexed for inflation relative to that base. Conversion factors are used to convert the various fuels into their crude oil equivalent for purposes of calculating the credit.) The credit is fully effective when the price of crude oil is $23.50 per barrel or less and phases out gradually as the price rises to $29.50 per barrel.[c] The credit is reduced if certain other energy subsidies, such as government grants and tax-exempt financing, are used.

The tax credit appears to have had a substantial impact on the production of alternative fuels. Initially, it stimulated the development of nonconventional gas wells, but the early rates of growth were not sustained through the mid-1990s, as the 1992 deadline slipped further into the past. According to one study, in 1992, just before the deadline when newly drilled wells would no longer be eligible for the tax credit, 78 percent of gas wells completed were drilled for the exploitation of gas in coal seams, tight sands, and shale oil.[d] The following year, their share had fallen to 61 percent. Although tight gas formations volumetrically account for the greatest share of U.S. nonconventional energy production, coalbed methane production has been affected most by the credit in recent years.[e] Coalbed methane recovery totaled only 91 billion cubic feet in 1989 out of total U.S. gas production of 17 trillion cubic feet. By 1994 it had risen to 1.0 trillion cubic feet, or 5 percent of U.S. production. Since then, growth in coalbed methane recovery has been less dramatic. Its share of the market reached 6 percent in 1997, which is the latest year for which production data are available. The majority of production takes place in Colorado, New Mexico, and the Black Warrior Basin of Alabama.

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[a]Section 29 was retained when the Windfall Profits Act was repealed in the late 1980s.

[b]Other changes under the 1990 Act included extending the credit as it applies to production from biomass and liquid, gaseous, or solid synthetic fuels produced from coal. The extension is allowed for facilities placed in service before 1997 and in production through 2007. These fuels are relatively minor recipients of the alternative fuel production credit. The credit no longer applies to fuel from qualified processed formations or biomass or steam from agricultural products.

[c]The actual conversion formula is: $3 - (($3 * (reference price - $23.50) / $6). For reference, the $3 credit and range of $23.50 to $29.50 in 1979 dollars are the equivalent in 1999 dollars of a $6.20 credit based on a range from $48.55 to $60.95. The GDP deflator was used to convert 1979 dollars to 1999 dollars.

[d]V.A. Kuuskraa and S.H. Stevens, "How Unconventional Gas Prospers Without Tax Incentives, *Oil and Gas Journal* (December 11, 1995).

[e]Production data for tight formation gas are difficult to compile, because it is often difficult to distinguish between tight formation gas and conventional gas being produced from the same field.

Investment Credit for New Technology

This credit formerly included a wide variety of items, but now it is limited to investment in solar and geothermal energy facilities. The Energy Tax Act of 1978 established a 10-percent investment tax credit for solar photovoltaic projects, as well as a 15-percent energy tax credit added to an existing 10-percent investment tax credit for solar thermal and wind generation facilities. The Tax Reform Act of 1986 eliminated the 10-percent investment tax credit and extended the energy tax credit to 1988, but it reduced that credit from 15 percent to 10 percent and eliminated wind as a candidate for any credits. The business tax credit was extended on a year-to-year basis until 1992, when passage of the Energy Policy Act of 1992 made the 10-percent business credit for solar (photovoltaic and thermal) and geothermal permanent. The Energy Policy Act of 1992 also provided a credit of 1.5 cents per kilowatthour for electricity produced from renewable resources such as wind and biomass.[30] The latter credit expired in July 1999.

The Investment Credit for New Technology, also known as the Investment (Business) Energy Tax Credit, is valued at $30 million for fiscal year 1999 ($40 million in terms of outlay equivalent) (Tables 6 and 7). Anyone who invests in or purchases a qualified solar,[31] wind, biomass, or geothermal energy property can take the credits, which are intended to encourage the production and consumption of energy generated by those facilities. Production costs have declined over time but still exceed those for conventional fuel.[32] Present levels of nonhydroelectric renewable energy production are small despite the subsidies.

Production Credit for Alcohol Fuels

The Production Credit for Alcohol Fuels is the only income tax expenditure for which there is also a preferential excise tax, in the form of an exemption. Motor fuels containing at least 10 percent alcohol are exempt from 6.0 cents of the per-gallon Federal excise tax on gasoline, diesel fuel, and other motor fuels. The income tax credit is 60 cents per gallon for alcohol used as a motor fuel and can be taken in lieu of the excise tax exemption. (For ethanol-based alcohol fuels, the excise tax exemption is 5.4 cents, and the credit equals 54 cents per gallon.) The income tax credit is granted to producers of alcohol fuels, defined as distributors who blend the alcohol and motor fuels. The credit may differ from 60 cents, depending on the proof of the alcohol. A new Federal income tax credit of an extra 10 cents per gallon is also available to eligible small producers of ethanol.[33]

The alcohol fuels income tax credit was not used to any significant degree until 1999, and in fiscal year 1999 it amounts to only $15 million (Tables 6 and 7), a value that could reflect the initial use of the new “small producers of ethanol” credit. Blenders generally use the excise tax exemption rather than the income tax credit, because the excise tax exemption provides them with an immediate cash flow. The subsidy they receive from this exemption in fiscal year 1999 is estimated at $725 million.

The alcohol fuels income tax expenditure and preferential excise tax programs affect not only the motor fuels industry but other industries and the environment as well. The alcohol fuels industry can exist for motor fuel

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[30]The tax expenditure “New Technology Credit” is an aggregation of the investment tax credit for solar and geothermal energy coupled with the renewable resource production tax credit directed at wind and biomass energy. These values are not reported separately in U.S. budget documents. The U.S. Treasury does not disaggregate these items separately as tax expenditures. They provided estimates of the production tax credit for wind and investment tax credit for solar and geothermal for 1999 to 2004. See the fact sheet “New Technology Credit: Investment Energy Tax Credit” in Appendix B.

[31]Solar property eligible for the investment credit uses solar energy to generate electricity or to heat or cool.

[32]Energy Information Administration, *Renewable Energy Annual 1998: Issues and Trends*, DOE/EIA-0628(98) (Washington, DC, March 1999), p. 7.

[33]An eligible small producer of ethanol generally is a person who, at all times during a year, has a productive capacity for alcohol not in excess of 30 million gallons.

purposes only with the aid of Government subsidies, because the price of alcohol fuels otherwise would not be competitive with gasoline or other alternatives. Because of the subsidies, gasoline/ethanol blends account for somewhat less than one-tenth of U.S. motor fuel consumption and production.[34] The result is a small (less than 1 percent) reduction in the volume of gasoline required to meet the demand for motor fuels and a probably negligible reduction in the prices of gasoline and other petroleum products relative to those that would otherwise prevail. Corn prices are higher, because nearly all U.S. ethanol is made from corn.[35]

Income-Reducing Measure

The Percentage Depletion Allowance is the only energy-related tax expenditure that reduces taxable income. Independent oil and gas producers and royalty owners, and all producers and royalty owners of certain other natural resources, including mineral fuels, may take percentage depletion deductions rather than cost depletion deductions to recover their capital investments.[36] Under cost depletion, the annual deduction is equal to the reduction in the remaining value of the resource that results from the current year's additional production.[37] Under percentage depletion, taxpayers deduct a percentage of gross income[38] from resource production at rates of 10 percent for coal, 15 percent for oil, gas, and oil shale, and 22 percent for uranium. Two special provisions also apply to oil and gas. First, percentage depletion for independent producers[39] and royalty owners is limited to 1,000 barrels oil equivalent per day. Second, for oil and gas wells with marginal production and wells whose production is substantially heavy oil, the 15-percent rate is increased by 1 percentage point for each dollar that the average wellhead price of domestically produced crude oil is below $20 a barrel.[40] The maximum increase allowed is 10 percentage points. Marginal production eligible for the higher rate has a prior claim on the 1,000-barrel-per-day limitation.

The percentage depletion deductions based on gross income are subject to net income limitations. The annual deduction for oil and gas is limited to 100 percent of net income from the property, and for other mineral fuels the deduction is limited to 50 percent. Geothermal production is eligible for percentage depletion at 65 percent of net income. Because percentage depletion is based on gross income rather than on the cost of the underlying assets, the resulting allowances generally will exceed the actual acquisition and development costs for the property from which the resource is extracted.

In fiscal year 1999, the reduction in tax revenue totals $260 million for oil, gas, and coal (Table 6). (Small reductions for uranium, oil shale, and geothermal energy are included in the values for coal.) The outlay equivalent of these revenue losses is greater, at $295 million (Table 7).

Percentage depletion will continue to provide incentives for resource development in the future. The incentives result in part from differences in the net income limitations and differences in production and distribution costs. However,

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[34]Ethanol is an alcohol that, when blended with gasoline, provides an effective fuel additive. Gasohol commonly is a blend of 10 percent ethanol and 90 percent gasoline.

[35]One study has estimated that approximately 7 percent of the U.S. corn crop was used for ethanol production in 1997, and that the subsidy raised corn prices by 45 cents per bushel. See M. Evans, *The Economic Impact of the Demand for Ethanol* (Lombard, IL: Midwestern Governors' Conference, February 1997).

[36]The excess depletion allowance is classified as a deduction because it permanently reduces income tax expense. If it merely deferred the expense it would be classified as a tax deferral.

[37]Specifically, the annual deduction is equal to the unrecovered cost of acquisition and development of the resource times the proportion of the resource removed during that year.

[38]Gross income amounts to oil and gas revenues, less transportation costs to the point of sale and any allocable lease bonus payments.

[39]For purposes of percentage depletion, an independent producer is defined, in general, as one who does not retail petroleum or petroleum products or refine crude oil. However, if the aggregate retail sales of the oil, natural gas, and products do not exceed $5 million per year, and if refinery runs do not exceed 50,000 barrels a day on any day during a tax year, the producer still is classified as an independent.

[40]Generally, for purposes of this provision, a marginal well property is one that produces a daily average of 15 barrels of oil equivalent or less per producing well over the course of a calendar year. Marginal wells include stripper wells.

the many constraints imposed on the use of percentage depletion for oil and gas since 1975, including the use of percentage depletion by only independent producers and royalty owners and then only up to 1,000 barrels per day, have and will continue to limit that tax expenditure provision to small-scale oil and gas operations. Independent producers would not generally engage in large offshore operations or in areas such as the North Slope even with the advantage of the depletion allowance. Nevertheless, they will continue to enjoy after-tax profits and royalties that are greater than they would be in the absence of percentage depletion.

The Alternative Minimum Tax Provision of the Energy Policy Act of 1992 reduced the tax burden on oil and gas producers and royalty holders by repealing, for them, excess percentage depletion tax adjustment for oil and gas for taxable years beginning after December 31, 1992. Excess preferences were preferences added back to the regular tax base in calculating income tax liabilities under the Alternative Minimum Tax System.[41] The Alternative Minimum Tax System has been in effect since 1986. Its purpose is to ensure that all individuals or business entities that benefit from certain exemptions within the tax code pay at least a minimum amount of tax. One effect of the tax, initially, was to reduce the value of percentage depletion.

Coal, uranium, oil shale, and geothermal operations will continue to be affected differentially by the percentage depletion provision. The differential effect reflects in large part the different depletion rates for the sources of energy as well as different net income limitations. As a practical matter, coal is the only energy industry, other than oil and gas, of any consequence with respect to percentage depletion, because the other industries operate at very low levels.

Department of Energy Renewable Energy Production Incentives

The Renewable Energy Production Incentive (REPI) program is part of an integrated strategy in the Energy Policy Act of 1992 to promote increases in the generation and utilization of electricity from renewable sources and to advance renewable energy technologies. The program provides financial incentive payments for electricity produced and sold by new qualifying renewable energy generation facilities. Qualified generation sources receive a payment of about $0.015 per kilowatthour, except that the amount of money is capped by a budgetary allocation. If the available funds are insufficient to cover the full production incentive payments, partial payments are made on a *pro rata* basis. Actual appropriations were $2.00 million for fiscal year 1997, $2.95 million for fiscal year 1998, and $4.00 million for fiscal year 1999.

[41]Energy Information Administration, *Performance Profiles of Major Energy Producers 1992*, DOE/EIA-0206(92) (Washington, DC, January 1994), p. 17.

Unreported Tax Expenditures

The reporting of tax expenditures was mandated by the Congressional Budget Act of 1974 (Public Law 93-344). The Budget of the U.S. Government defines tax expenditures as "revenue losses due to preferential provisions of the Federal tax laws, such as special exclusions, exemptions, deductions, credits, deferrals, or tax rates." Although the concept of what constitutes a tax expenditure is clear, the determination of what exactly is a preferential provision is subject to interpretation. In preparing this section on energy-related tax expenditures, the Energy Information Administration relied entirely on the definitions of tax expenditures presented in Office of Management and Budget (OMB) documents.

Expenditures below the U.S. Treasury *de minimis* amount ($5 million) are not reported in standard OMB budget documents and therefore are not included in this report. A case in point is the tax expenditure resulting from deepwater royalty relief in the outer continental shelf. To date, these expenditures have fallen well below the $5 million cutoff. The Outer Continental Deep Water Royalty Relief Act was signed into law on November 28, 1995.[a] The Act provides incentives for oil and gas production in the deep waters of the Gulf of Mexico by eliminating certain royalties on deepwater leases. "Specifically, it mandates volumes of royalty-free production from fields in water depths exceeding 200 meters, both for new leases . . . and for existing leases."[b] The program is administered by the U.S. Department of Interior's Minerals Management Service. As of August 1999, four requests had been granted for deepwater tax relief.[c] To date, the value of royalty reductions has been relatively small: $1.5 million in 1998 and $1.1 million in 1999 through April.[d]

This report does not address quantitatively recently passed energy legislation whose budgetary impact has not yet been assessed by the OMB for the current fiscal year (1999) or for future years. A case in point is the Emergency Oil and Gas Guaranteed Loan Program Act (Public Law 106-51), signed into law on August 17, 1999, which provides $500 million in loan guarantees to independent producers who have experienced layoffs, production losses, or financial losses since January 1, 1997.

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[a]The Outer Continental Deep Water Royalty Relief Act was included as an amendment to the Alaska Power Administration Sale Act legislation (S. 395).

[b]U.S. Department of Interior, Minerals Management Service, web site www.gomr.mms.gov/homep/whatsnew/newsreal/980115.html.

[c]U.S. Department of Interior, Minerals Management Service, Gulf of Mexico Offshore Region Office.

[d]U.S. Department of Interior, Minerals Management Service, Gulf of Mexico Offshore Region Office.

3. Federal Energy Research and Development

The Federal Government's role in financing large-scale civilian R&D dates from the early 1950s. The principal landmarks were President Eisenhower's decision to commercialize nuclear energy in the wake of his "Atoms for Peace" speech in 1953 and the furor following the launch of the Soviet Sputnik satellite in 1956. Figure 2 shows trends in U.S. Government R&D outlays since 1950, in constant 1999 dollars. Current expenditures exceed $70 billion, 57 percent of which is defense-related. In the 1980s, total Government R&D spending rose by about 40 percent. The increase resulted primarily from increased emphasis on defense R&D. In the late 1980s, spending on health research also increased in relative importance. In the fiscal year 1999 budget, health R&D exceeds all other categories of R&D except national defense. Since the 1980s, energy R&D expenditures have declined. Current appropriations for energy R&D total about $1.6 billion, about 5 percent of all civilian Government-funded R&D.

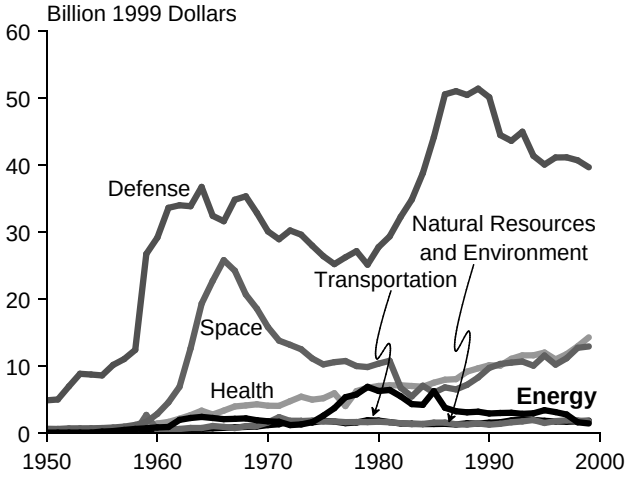
Overview of Federal Energy Research and Development

Research and Development Defined

Federal energy-related R&D can be described as falling into three classes: basic research, research that seeks to develop new energy technologies, and research that seeks to improve existing technologies.

- **Basic Research.** The potential beneficiaries of basic research could be considered to be the population of the United States or the world as a whole. Basic research includes research projects designed to pursue the advancement of scientific knowledge and the understanding of phenomena rather than specific applications.
- **Research To Develop New Technologies.** The efforts in this context involve attempts to discover new scientific knowledge that can have commercial application. Although the end objective of the research is known, the research task is difficult and uncertain.
- **Research To Improve Existing Technologies.** These efforts emphasize the use of scientific knowledge to design and test new processes that may have substantial technical and cost uncertainties. The immediate beneficiaries are generally well defined: current producers and consumers of particular fuels or operators, and customers of the technology being improved.

Figure 2. Federal Research and Development Outlays by Program, Fiscal Years 1950-1999



Note: Budget figures for Transportation, Natural Resources and Environment, and Agriculture are similar and thus difficult to distinguish graphically. Agriculture data are not shown in this graph.

Source: Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2000* (Washington, DC, February 1999), Historical Tables, pp. 160-165.

Energy Research and Development as a Subsidy

It is easier to measure energy R&D spending than to it characterize from a subsidy perspective. R&D spending is intended to create useful knowledge that benefits society. Thus, all Federal R&D spending could, in a general way, be considered a subsidy to knowledge; however, the extent to which specific R&D programs actually affect energy markets is more difficult to ascertain.

The results of research are inherently uncertain. Many programs will advance knowledge across a range of energy and non-energy applications, rather than in the context of a particular fuel or form of consumption. Further, the knowledge obtained may be negative, in the sense that the research may only reveal technical or economic dead ends to be avoided in the future.[42] Thus, only a portion of Federal energy R&D is likely to achieve results (in the form of changes in energy costs or consumption) that can be attributed specifically to a particular R&D program. Moreover, to the extent that there are attributable results, they are likely to be measurable only years after the funded research effort is initiated.

Federal R&D is intended to support research that the private sector would not undertake. It is not supposed to substitute for private-sector R&D. However, the creation of a Government-funded R&D program could, under some circumstances, displace private-sector R&D. In that case, the Federal program would not produce any net new knowledge but simply reduce private costs. It is impossible, however, to know with certainty what private-sector firms would have done in the (hypothetical) absence of a Federal program. In general, the less "basic" the R&D program and the more focused on near-term commercialization, the greater the risk that the program will be a substitute for private-sector R&D.

There are no means to determine conclusively whether or not particular Federal energy R&D projects are substitutes or complements for private-sector activities. Moreover, because research is risky, with failure an inherent part of the process, the effectiveness of Federal R&D cannot easily be assessed. This report makes no judgments on either of these issues. Rather, it surveys the current composition of Federal R&D spending and provides a degree of historical perspective on the changing composition of Federal energy R&D efforts.

There is another issue that is specific to U.S. energy R&D programs: much U.S. energy R&D is aimed not at producing fuels *per se* but at developing fuel-consuming capital equipment (particularly power generation technologies). Such projects may be more properly viewed as a subsidy to capital equipment manufacturers than to fuel producers or consumers. Although, in principle, all successful power generation R&D benefits electricity consumers, the effects on fuel producers are more ambiguous. Because they are energy-saving technologies, the new technologies will only benefit producers if they help to expand the market for their fuel. Thus, if one seeks to understand the effects, rather than the intent, of R&D spending, the success of the programs must be evaluated, noting that expenditures will necessarily occur long before technology adoption, and considering the competitive consequences of any new technologies introduced.

Finally, much of the expenditure that is formally defined as "energy research and development" in the U.S. Government's budget accounts is not directly expended on energy research or development. Some of the funds are expended for environmental restoration and waste management for energy (particularly nuclear) research facilities,

[42]Several studies suggest that the return on Federal R&D investment is much lower than the return on private-sector R&D, implying relatively high failure rates. See N. Terlecyyj, *Effects of R&D on the Productivity Growth of Industries: An Exploratory Study* (Washington, DC: National Planning Association, 1974), and Z. Griliches, "Returns to R&D in the Private Sector," in J. Kendrick and B. Vaccara (eds.), *New Developments in Productivity Measurement and Analysis*, NBER Studies in Income and Wealth No. 44 (Chicago, IL: University of Chicago Press, 1980), pp. 419-454. This result need not be surprising, as the Federal Government's research portfolio may be much riskier than that chosen by the private sector.

or on R&D on environmental restoration and waste management, or on overhead or difficult-to-allocate functions. Such spending may not have a material impact on current or future energy markets.

Energy Research and Development Trends

Table 8 allocates Federal energy R&D by energy type and function. Currently, nearly two-thirds of Federal energy R&D ($2.8 billion) is allocated to basic research. DOE's largest single basic research program is the General Science Program, funded at $1.6 billion in fiscal year 1999. Basic research is difficult to characterize as an energy subsidy, however, because it cannot be allocated between energy and non-energy benefits, or among forms of energy. Therefore, the balance of this chapter focuses on applied energy R&D.

Table 8 lists both "estimated" and "actual" research and development appropriations for fiscal year 1992. The estimated appropriations are drawn from the Department of Energy's fiscal year 1993 budget proposal, prepared in early 1992, which showed appropriations by budget account for the previous fiscal year.[43] The estimated appropriations were used in EIA's 1992 subsidy report. The actual appropriations are drawn from the Office of the Chief Financial Officer's Appropriation History Tables, prepared in early 1997, which show final appropriations by budget account.

The differences between the two columns have multiple causes. The Department transfers (with the approval of Congress) unspent monies from one account to another. This may take place well after the end of a fiscal year if the Department has multi-year spending authority for a particular account. The largest difference between the two columns is due to a large reprogramming of funds for fusion research. There have also been several changes of classification. For example, the account "Biological and Environmental Research" has been transferred from "Environment, Safety, and Health" to "General Science." In addition, minor errors in the original 1992 report have been corrected in the final appropriations column. For example, some of the expenditures on wind in the "Wind, Photovoltaic, and Other Solar" category were interchanged with biomass expenditures in the 1992 report.

Applied R&D is aimed primarily at improving existing technology. Appropriations for applied energy R&D were about $1.5 billion in fiscal year 1999. Of that amount, more than half is allocated to nuclear activities. Within the range of nuclear projects, most of the money is spent on environmental management rather than R&D *per se*. For coal, the bulk of spending supports development of clean coal technologies. Solar, photovoltaic, and wind energy absorb the major share of renewable energy research funds ($134 million out of a total of $327 million). Expenditures shown as "unallocated" in Table 8 are administrative and miscellaneous programs associated with R&D. For example, unallocated expenditures for nuclear R&D ($143 million) in fiscal year 1999 include program termination costs and program direction. For renewable energy programs, they include program direction and funding for the National Renewable Energy Laboratory ($22 million in fiscal year 1999). The unallocated appropriation for basic energy research ($49.8 million in fiscal year 1999) funds personnel in a variety of research centers and provides support services and other related expenses.

[43]U.S. Department of Energy, *United States Department of Energy Posture Statement and Fiscal Year 1993 Budget Overview* (Washington, DC, February 1992).

Table 8. Federal Funding for Energy-Related Research and Development by Program, Fiscal Years 1992 and 1999
(Million 1999 Dollars)

Category	Fiscal Year 1992 Appropriation (Estimated)[a]	Fiscal Year 1992 Appropriation (Final)	Fiscal Year 1999 Appropriation
Basic Research			
Basic Energy Research			
General Science	1,672.8	2,059.3	1,624.2
General Energy Science	1,004.1	999.4	821.8
Environment, Safety, and Health	585.3	161.6	47.4
Unallocated	47.4	68.8	49.8
Fusion Energy Sciences	872.5	379.1	222.6
Total Basic Research Appropriations	**4,182.1**	**3,668.1**	**2,765.9**
Applied Research and Development			
Nuclear Power			
New Nuclear Plants (Nuclear Energy Research Initiative)	139.2	221.2	30.0
Waste/Fuel/Safety (Environmental Management)	707.1	754.6	466.6
Unallocated (Termination Costs)	168.6	155.9	143.0
Total	*1,014.9*	*1,131.7*	*639.6*
Coal			
Advanced Clean Efficient Power Systems	168.3	166.4	87.7
Advanced Clean Fuels	57.8	57.1	15.5
Advanced Research and Technology Development	92.8	91.8	19.9
Interagency National Acid Precipitation Assessment Program[b]	35.4	35.4	([c])
Unallocated	90.0	121.1	97.1
Total	*444.3*	*471.7*	*220.2*
Other Fossil Energy			
Oil	58.6	57.8	48.6
Shale Oil	6.5	6.7	0.0
Natural Gas	14.4	14.2	115.2
U.S. Geological Survey Energy Research and Development[b]	29.7	29.7	([c])
Total	*109.2*	*108.3*	*163.8*
Renewable Energy			
Wind, Photovoltaic, and Other Solar	156.3	135.9	133.9
Biofuels and Biomass	24.4	44.5	95.5
Geothermal	31.0	30.7	28.5
Hydroelectric	1.2	1.2	3.3
Electricity Technologies	43.4	42.9	44.1
Unallocated	21.6	20.6	22.0
Total	*277.9*	*275.8*	*327.2*
Electric Utility (Advanced Turbine Systems)[d]	5.4	5.4	33.0
Total Applied Research and Development Appropriations	**1,851.7**	**1,992.9**	**1,383.8**
Clean Coal Outlays	184.8	151.7	183.0
Total Applied Research and Development, Including Clean Coal	**2,036.5**	**2,144.6**	**1,566.8**

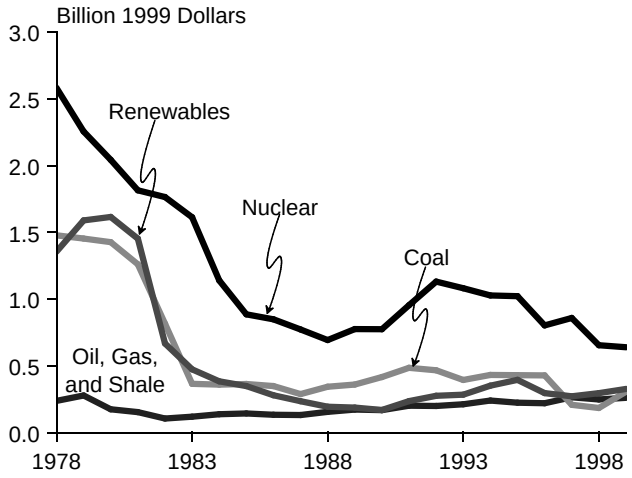
[a]As published in the 1992 EIA report.
[b]Assumed no change between estimated and actual fiscal year 1992 appropriations.
[c]Program terminated.
[d]Included in "end use" in the 1992 EIA report.

Sources: U.S. Department of Energy, *U.S. Department of Energy Fiscal Year 2000 Congressional Budget Request*, DOE/CR-0059 (Washington, DC, May 21, 1999); and Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, SR/EMEU/92-02 (Washington, DC, November 1992), p. 43.

Figure 3 illustrates trends in Federal applied energy R&D appropriations from fiscal year 1978 through fiscal year 1998. There were sharp reductions in energy R&D appropriations during the early 1980s, followed by modest growth after 1992. R&D spending by fuel type is dominated by nuclear power R&D, although coal R&D appropriations were boosted in the late 1980s by the advent of the Clean Coal Technology Program, and renewable energy appropriations have risen somewhat since 1990. Federal R&D spending related to oil and gas is budgeted at $164 million in fiscal year 1999.

Another recent trend in Federal R&D is a tendency for Congress to mandate research on particular projects. Title XIII of the Energy Policy Act of 1992 wrote much of DOE's coal R&D program into law and added some new areas of research, mandating R&D on coal-fired diesel engines, nonfuel coal use, coalbed methane, metallurgical coal development, coal gasification, coal liquefaction, low-rank coal use, and magnetohydrodynamic power generation. There are similar detailed provisions throughout the law for research on other energy sources, including nuclear power, end use, and renewable energy.

Figure 3. Federal Energy Research and Development Appropriations by Program, Fiscal Years 1978-1999



Note: GDP deflator used to convert nominal dollars to constant dollars.

Sources: 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).

Energy Research and Development Programs

Nuclear Power

Figure 4 illustrates trends in DOE's nuclear power R&D programs. DOE received an appropriation of $640 million for nuclear R&D in fiscal year 1999, but the majority of the funds ($466.6 million) are allocated to the cleanup of contaminated nuclear energy and research sites. About two-thirds of the cleanup funds are being used for site closures, and the balance is slated for site and project completion.

Non-Defense Environmental Safety and Health

A substantial portion of Government-funded nuclear R&D is for managing and addressing the environmental legacy resulting from nuclear energy and research activities. The goal is to clean up as many contaminated sites as possible by 2006. For fiscal year 1999, more than one-half of non-defense environmental, safety, and health funds are allocated for site closures.

Nuclear Safety Research

In addition to DOE's nuclear R&D program, the U.S. Nuclear Regulatory Commission (NRC) will also spend $53 million (about 11 percent of its budget) on nuclear safety R&D in fiscal year 1999. NRC responsibilities include regulation of commercial nuclear power reactors; non-power research, test, and training reactors; fuel cycle facilities; medical, academic, and industrial uses of nuclear materials; and the transport, storage and disposal of nuclear materials and waste. The NRC's operations (including R&D) are fully funded by a fee levied on the operation of nuclear power plants. Hence, NRC safety research cannot be considered as a subsidy to the nuclear power industry.

Improving Existing Power Plants and Enhancing Nuclear Power

The Nuclear Energy Research Initiative provides funds for R&D at universities, national laboratories, and industry to advance nuclear power technology. It includes proliferation-resistant reactor and fuel technologies, high-performance, high-efficiency reactor technology, advanced nuclear fuels, and new technologies for the minimization and management of nuclear waste. The fiscal year 1999 appropriation for this program is $19 million, out of the $30 million for new or improved nuclear power plants.

Unallocated Expenditures

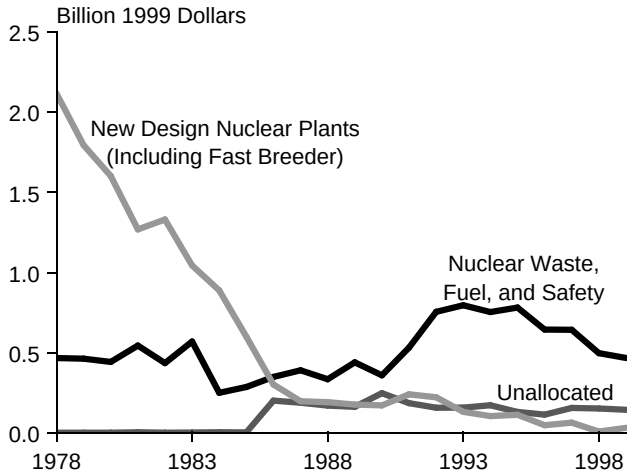
Unallocated expenditures cover a range of difficult-to-categorize nuclear R&D accounts totaling $143 million in fiscal year 1999 appropriations. The largest single item in this category is termination costs for the Fast Flux Test Facility, a 400-megawatt sodium-cooled research reactor that was shut down in 1992, and the deactivation of an experimental breeder reactor. Termination costs ($95 million out of the $143 million in this category) cover removal of spent fuel and maintenance of the safeguards and security infrastructure for the facilities.

Coal

Coal-related programs in DOE's Office of Fossil Energy include R&D on coal power systems, coal-derived fuels, and advanced R&D, as well as a Clean Coal Technology Demonstration Program. Total fiscal year 1999 appropriations for the R&D program were $220.2 million (Figure 5). The coal R&D program is focused on three goals: higher efficiency and cleaner power generation; improved emission control systems; and the development of economically competitive technologies for the production of alternative transportation fuels and chemicals.

Coal R&D is an integrated program consisting of Advanced Clean/Efficient Power Systems, Advanced Clean Fuels Research, and Advanced Research and Technology Development. The program is focused toward the *Vision 21* concept, aimed at doubling the existing power plant efficiency with the flexibility to produce high-value products from coal and other fuels while achieving near-zero pollution and reducing energy costs.

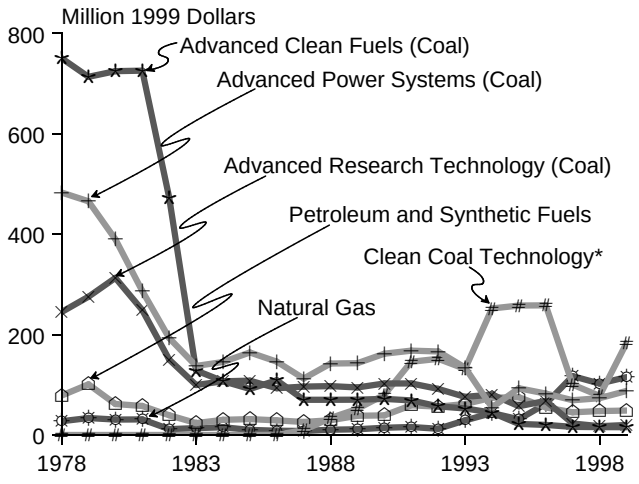
Figure 4. Federal Nuclear-Related Research and Development Appropriations by Program, Fiscal Years 1978-1999



Note: GDP deflator used to convert nominal dollars to constant dollars.

Sources: 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).

Figure 5. Principal Research and Development Appropriations for Fossil Energy, Fiscal Years 1978-1999



*Outlays.

Note: GDP deflator used to convert nominal dollars to constant dollars.

Sources: 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).

Advanced Clean/Efficient Power Systems Research and Development concentrates on a set of building-block technologies for *Vision 21* that will yield the clean coal power generation systems of the future. The Advanced Clean Fuels Research Program will conduct activities to develop clean methods to produce coal-derived liquid fuels. This research consists of coal preparation, direct and indirect liquefaction, and research on chemical storage agents for hydrogen and molecular modeling of carbon structures. Advanced Research and Technology Development includes both long-range research on coal-related systems and crosscutting R&D on fossil energy, including projects in support of *Vision 21*.

The Clean Coal Technology Program (CCT) occupies an anomalous position in the taxonomy of this report: it has some of the characteristics of R&D but in other respects more closely resembles a direct expenditure program. The program was authorized under the Clean Coal Technology Reserve provision of Public Law 98-473, enacted on October 12, 1984. Initial appropriations were made in Public Law 99-190 enacted on December 19, 1985. Congress has appropriated a Federal budget of $2.3 billion over the duration of the CCT program. For the 40 completed and active projects, industry participants have contributed $3.7 billion. By law, DOE's contribution cannot exceed 50 percent of the total cost of any project. With all projects selected and all the necessary funding appropriated, the outlays for CCT depend largely on the pace of the remaining projects that require final funding allocations for construction and operation. The application categories for the projects are environmental control devices, advanced electric power generation, coal processing for clean fuels, and industrial applications.

Table 9 lists approved Clean Coal projects by application category. The amounts shown in Table 9 are multi-year project costs, including funds that have already been spent and funds not yet obligated. Currently, of the 40 projects in the program, 23 have completed test operations and have either been concluded, moved into commercially funded operations, or are in the final stages of reporting results to DOE; 7 projects are in design, permitting, and other pre-construction activities; 1 project is in construction; and 9 projects are in operation, generating test data.

In fiscal year 2000, only two projects are expected to have outstanding obligation commitments: the Clean Energy Demonstration Project (an integrated gasification combined cycle project now planned for southern Illinois) and the CPICOR combined steelmaking and generation project planned for Geneva, Utah. DOE's current projections are that neither of these two projects will require funding allotments from previous appropriations in fiscal year 2000, and consequently $246 million can be deferred into future years.

The Federal budget treatment of the CCT program is complex. As noted above, the Congress has appropriated some $2.3 billion of multi-year money for the program, with which DOE has been able to make multi-year commitments to private-sector participants. During the early years of the program, however, outlays generally were much lower than appropriations. In recent years, no new money has been appropriated for the program, but DOE has continued to spend the money previously appropriated. Some of the money appropriated in prior years has been deobligated, producing, in effect, negative current appropriations for the program (-$40 million in fiscal year 1999). Outlays are therefore a better measure of the current fiscal consequences of the CCT program than are appropriations. (For most R&D accounts, most of the time, appropriations and expenditures are more or less consistent.) DOE clean coal outlays were $185 million in fiscal year 1992 and $183 million in fiscal year 1999. Termination of the CCT, after completion of projects now underway, is part of the President's realignment plan for the Department of Energy. The Administration's policy calls for limiting the program to existing domestic projects already under contract.

Table 9. DOE Clean Coal Technology Project Costs by Application Category

Application Category	Number of Projects	Total Costs (Million Dollars)	DOE Contribution (Million Dollars)	DOE Share of Costs (Percent)
Advanced Electric Power Generation	19	3,159.9	1,224.1	39
Environmental Control Devices	11	704.9	295.2	42
Coal Processing for Clean Fuels	5	519.2	230.0	44
Industrial Applications	5	1,287.5	192.1	15
Total	**40**	**5,671.5**	**1,941.4**	**34**

Source: U.S. Department of Energy, *Clean Coal Technology Demonstration Program: Program Update 1998* (Washington, DC, March 1999), pp. ES-5 and 3-1.

Oil and Natural Gas

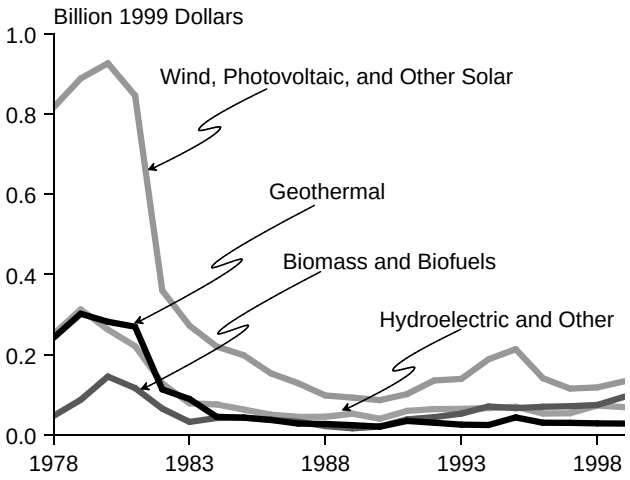
DOE's oil research efforts are funded at $48.6 million in fiscal year 1999, with an emphasis on new technologies that can improve exploration, drilling, reservoir characterization, and extraction. The Natural Gas Program received $115.2 million in fiscal year 1999 for natural gas research and fuel cells. Two new efforts include new diagnostic techniques to locate methane hydrates and engineering assessments to determine the best locations and approaches for revitalizing stripper wells in gas fields.

Renewable Energy

DOE's renewable energy R&D program is large in relationship to the size of the current renewable energy industry, but its purpose is to help expand that industry. Figure 6 illustrates the distribution of R&D expenditures across renewable technologies. The largest single item is the category "Wind / Photovoltaic / Other Solar," funded at $134 million in fiscal year 1999. Within this category, the largest program is for photovoltaics, at $72.2 million in fiscal year 1999. Most of the funds are for fundamental and applied research. The remainder will be used in competitive procurements for cost-shared projects with U.S. utilities and the photovoltaics industry. The research is concentrated on manufacturing process technologies, establishing utility applications of photovoltaic systems, and developing products that can be integrated into buildings.

Solar thermal systems are funded at $17 million per year. The funds are designed to provide technology options for concentrating solar power, including distributed dish / engine systems, on a cost-sharing basis. Research on molten-salt thermal storage technology is also funded through the cost-shared program, with the goal of developing advanced manufacturing techniques and high-temperature components to reduce overall system costs.

Figure 6. Federal Renewable Energy Research and Development Appropriations, Fiscal Years 1978-1999



Note: GDP deflator used to convert nominal dollars to constant dollars.

Sources: 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).

The funding for wind systems is $34.8 million, with a goal of generating electricity at a cost of 2.5 cents per kilowatthour by 2002 at wind speeds averaging 15 miles per hour. The program works directly with industry in technology development and verification projects in order to achieve commercial application.

Funding for geothermal energy R&D is $28.5 million in fiscal year 1999. The focus is on locating geothermal reservoirs, reducing exploration and drilling costs in a hard rock environment, developing production techniques, improving reliability, and reducing operating costs.

Two other renewable energy R&D programs are aimed at improving the efficiency of electricity supply and storage systems. Storage systems include high-temperature superconductivity and energy storage technologies. The majority of the funding is for superconducting wires, with the goal of increasing electric system capacity and improving efficiency in motors and generators.

Advanced Turbine Systems

DOE energy end use, efficiency, and energy conservation R&D programs are excluded from this report by definition. The program that remains is the “electric utility” category, which primarily funds research on advanced turbine systems, fueled primarily by natural gas in the near term, but with hydrogen, alcohol, and petroleum fuels as possible alternatives under some circumstances. This program was included here since the other generation technologies were assigned to their primary fuels. Fiscal year 1999 funding for this program is $33 million.

4. Trust Funds and Energy Excise Taxes

Excise taxes to fund highways, waterways, airports, and other infrastructure projects have a long history. Energy-related excise taxes and associated trust funds have become increasingly common over the past two decades as a mechanism for internalizing some of the social costs of energy production and consumption. Trust funds have two components: in the first part, the Federal Government imposes a tax on a particular industry; in the second part, the Federal Government assumes responsibility for some liability, often related to the environment, safety, or health. In some cases, responsibility for the liability may formerly have rested with the industry but, because of its poor definition under pre-existing law, has been shifted to the Federal Government. While the amount of the tax is known, the amount and timing of the liability assumed by the Federal Government has yet to be determined through experience. Most established trust funds currently run a surplus. The Black Lung Disability Trust Fund is in deficit, however, and will require Federal appropriations, in addition to current excise tax collections, to maintain its solvency.

The ultimate cost of storing high-level nuclear waste, or reclaiming abandoned, leaking underground oil storage tanks cannot be known with precision. Unlike the older transportation-oriented trust fund programs, the costs may be realized far in the future. Thus, evaluating the full costs of trust fund programs raises complex questions about the actuarial sufficiency of the excise taxes and their accompanying trust funds. This report does not attempt to address that issue, instead describing the principal energy excise taxes and trust funds and reporting on tax collections, trust fund accruals, and outlays from trust funds on a cash basis.

Energy excise tax and fee collections in fiscal year 1999 were approximately $2.2 billion (Table 10). The collections were earmarked for a variety of energy-related trust funds. The largest share of energy excise tax collections

Table 10. Estimated Excise Tax Receipts, Fiscal Year 1999
(Million Dollars)

Fund	Amount
Excise Taxes Dedicated to Environmental Trust Funds or Designated Funds	
Leaking Underground Storage Tank Trust Fund: Gasoline and Other Motor Fuels	212
Oil Spill Liability Trust Fund: Crude Oil[a]	0
Pipeline Safety	29
Aquatic Resources Trust Fund: Motorboat Gasoline and Other Fuels	205
Abandoned Mine Reclamation Fund	305
Nuclear Waste Fund	642
Uranium Enrichment Decontamination and Decommissioning Fund	171
Excise Taxes Dedicated to Health-Related Trust Funds	
Black Lung Disability Trust Fund	638
Total Collections	**2,202**

[a]The Oil Spill Liability Trust Fund excise tax expired after December 31, 1994.

Source: Office of Management and Budget, *Budget of the United States Government, Appendix 2000* (Washington, DC, 1999). Also earlier editions.

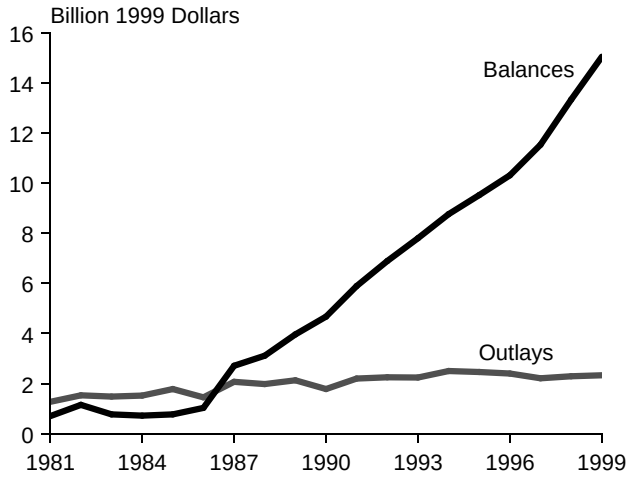
($1.4 billion) serves to fund a variety of programs that address environmental and safety problems associated with the production and distribution of petroleum and coal. In addition, approximately $642 million in user fees is collected annually from nuclear power producers to fund the development, acquisition, and operation of nuclear waste disposal facilities,[44] and $171 million is collected for the decontamination and decommissioning of uranium enrichment facilities.

Energy Trust Funds

In recent years, the trust fund concept has been extended to address a variety of safety and environmental concerns (Table 11). Over the past decade, the balances and outlays from many of these energy-related trust funds have grown several-fold (Figures 7 and 8).

Taxes and fees to finance energy-related trust funds are designed to impose costs on energy producers that formerly escaped valuation in the marketplace. They include health risks to production workers or damage to the environment from land damage accidents or waste disposal. Growth in the use of trust funds to finance programs related to environment, safety, and health can be traced in part to a shift to the use of market-based incentives to address these problems. Tying trust fund collections to products and activities responsible for damages is intended to cause their prices to reflect the costs of programs for remediation and prevention and thus more closely reflect the real costs (including social costs) of energy use and production.

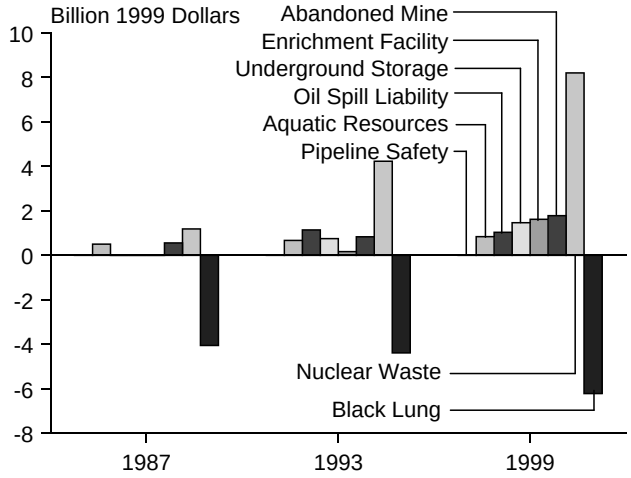
Figure 7. Total Outlays and End-of-Year Balances for Energy-Related Environmental Trust Funds, Fiscal Years 1981-1999



Note: Balance total excludes values for the Black Lung Program, which is in substantial deficit.

Source: Office of Management and Budget, *Budget of the United States Government* (various issues).

Figure 8. Energy-Related Environmental Trust Funds, End-of-Year Balances, Fiscal Years 1987, 1993, and 1999



Source: Office of Management and Budget, *Budget of the United States Government* (various issues).

[44]The nuclear waste fee payments are projected to decline gradually from current levels (estimated at $642 million in fiscal year 1999), reflecting a reduction in electricity generation from nuclear plants.

Table 11. Energy-Related Federal and Trust Funds, Fiscal Year 1999
(Million Dollars)

Fund	Beginning Balance	Collections	Other Receipts (Net)	Outlays	Ending Balance	Composition of Receipts	Sources of Receipts
Coal							
Abandoned Mine Reclamation	1,644	305	83	247	1,785	305	Per-ton fee on U.S. coal mine production
						83	Interest on balance and late payments
Black Lung Disability	-5,837	638	2	1,021	-6,218	638	Excise tax on mined coal
						2	Miscellaneous receipts
Nuclear							
Nuclear Waste Fund	7,237	642	507	185	8,201	642	Fees paid by nuclear powered electric utilities
						507	Interest on Investments
Uranium Enrichment Decontamination and Decommissioning	1,272	171	474	223	1,694	171	Assessment
						474	Interest and general fund payment
Petroleum							
Leaking Underground Storage	1,255	212	66	67	1,466	212	0.1 cent-per-gallon fuel tax
						66	Interest
Oil Spill Liability	1,076	0	137	178	1,035	0	Tax expired after December 31, 1994
						137	Interest on balance and other income
Pipeline Safety Fund	18	29	5	36	16	29	User fees collected from pipeline operators
						5	Other collections
Aquatic Resources[a]	753	205	253	372	839	205	Motorboat fuel tax
						253	Equipment taxes and interest
Total	**7,418**	**2,202**	**1,527**	**2,329**	**8,818**		

[a]Includes amounts for boat safety, coastal wetlands projects, and sport fish restoration.

Source: Office of Management and Budget, *Budget of the United States Government, Appendix 2000* (Washington, DC, 1999). Also earlier editions.

Coal-Related Trust Funds

The oldest energy-related trust funds involve coal mine operations. The Abandoned Mine Reclamation Fund is designed to assure that mine operations pay for remedies to the problems that stem from mine closure when the liable firms cannot be located or no longer exist. The problems include risks of mine subsidence, acid drainage, erosion, and despoliation of scenery. Fees of 35 cents per ton on surface coal, 15 cents per ton on coal mined underground, and 10 cents per ton on lignite are collected from mining operations. The first of these fees were paid in fiscal year 1978.

The Black Lung Disability Fund, established by the Black Lung Benefits Revenue Act of 1977, is directed toward work-related disabilities of underground miners. Long-term inhalation of coal mine dust can cause irreversible damage to miners' lungs, although current mine operating practice greatly reduces the risk to miners. The fund was established to compensate for black lung disabilities of miners for whom mine employment terminated before 1970 or for which no mine operation could be assigned liability. The tax on coal from underground mines is the lower of $1.10 a ton or 4.4 percent of the sales price. The tax on coal from surface mines is the lower of 55 cents a ton or 4.4 percent of the sales price. Coal is taxed at the 4.4-percent rate if the selling price is less than $25 a ton for underground coal or less than $12.50 ton for surface coal. The tax does not apply to sales of lignite coal or imported coal. As of 1998 the fund was inadequately supported by coal excise taxes, and substantial allocations from general revenues will be necessary to continue the program (Table 11).[45]

Nuclear Waste Fund

Concerns about the safety, health, and environmental effects of the disposal of nuclear wastes and controversies associated with the siting of nuclear waste disposal facilities led to the assumption of leadership by the Federal Government in developing appropriate facilities. Current efforts are directed primarily at studying the feasibility of a working site at Yucca Mountain in a desert region of Nevada. Since the establishment of the Nuclear Waste Fund in the early 1980s, collections from nuclear utilities have greatly exceeded outlays, resulting in a trust fund balance in excess of $7 billion (nominal dollars) at the end of fiscal year 1998.[46,47] The $507 million of interest income projected to be earned on trust fund balances in fiscal year 1999 exceeds the $185 million in outlays.

Uranium Enrichment Facility Decontamination and Decommissioning

The Uranium Enrichment Decontamination and Decommissioning Fund was established by the Energy Policy Act of 1992 to carry out environmental management responsibilities at the Nation's three gaseous diffusion plants. The gaseous diffusion plants are located in the East Tennessee Technology Park in Tennessee, at the Portsmouth site in Ohio, and at the Paducah site in Kentucky. The fund is also used to reimburse licensees operating uranium or thorium processing sites for the costs of environmental cleanup at those sites, subject to a site-specific reimbursement limit. The fiscal year 1999 funding for reimbursing licensees was $30 million. The balance in the fund at the start of fiscal year 1999 was estimated to be approximately $1.3 billion.

The fund addresses the cleanup liabilities at the three gaseous diffusion plants that are attributable to historical DOE operations supporting the production of nuclear weapons and commercial nuclear fuel. The future operations of the enrichment facilities will be managed by the commercial entity, the United States Enrichment Corporation (USEC).

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[45]The potential liabilities from under-accrued trust funds can be large. Annual outlays from general revenues to supplement the Black Lung Disability Trust Fund are $362 million in fiscal year 1999. The Black Lung Trust Fund is in deficit because, in the past, benefits paid out exceeded tax receipts credited to it. Under present law, the trust fund owes interest on past borrowings. Under Part B of Title IV of the Federal Coal Mine Health and Safety Act of 1969, as amended, the Federal Government also assumed responsibility (without offsetting excise taxes) for payments to disabled coal miners whose claims were filed before July 1, 1973. This program, administered by the Social Security Administration, has outlays of $560 million in fiscal year 1999. Source: Office of Management and Budget, *Budget of the United States Government, Appendix 2000* (Washington, DC, 1999), p. 1095.

[46]The Department of Energy is required to evaluate periodically the adequacy of the Nuclear Waste Fund fee. A recent assessment report concludes that: "The U.S. Department of Energy (DOE), referred to as the Department, finds that the current 1.0 mill ($0.001) per kilowatt-hour fee charged on generators of spent nuclear fuel (SNF) is adequate, and recommends that the fee not be changed. "U.S. Department of Energy, Office of Civilian Radioactive Waste Management, *Nuclear Waste Fund Fee Adequacy: An Assessment*, DOE/RW-0509 (Washington, DC, December 1998).

[47]Other independent cost estimates state that program cost escalation and a potentially greater number of early retirements may necessitate a significantly higher fee (ranging from 2.6 to 4.5 mills per kilowatthour) to fund the program fully. See B. Biewald and D. White, *Stranded Nuclear Waste* (Cambridge, MA: Synapse Energy Economics, Inc., 1999).

Ultimate cleanup of facilities leased from DOE by the USEC will commence when operations are completed and leases are terminated. The fund includes contributions from annual budget appropriations and contributions from commercial utilities based on historical enrichment services, measured in separative work units.[48]

Petroleum Trust Funds

Petroleum trust funds are directed toward past and potential environmental damages and safety problems arising from the storage and transport of petroleum and other hydrocarbons. Their funding is directly tied to per-unit taxes and user fees on the related products or activities. These programs are clear examples of a shift of Federal efforts, both to reflect the costs of environmental and safety problems in the prices of associated products and to provide funding for remedial and preventive programs.

In terms of fund balances and revenue collections, the largest of the petroleum-related programs is the Leaking Underground Storage Tank Trust Fund (Table 11 and Figure 8). The fund is financed by a 0.1-cent-per-gallon tax on motor fuels, which is estimated to total $212 million in fiscal year 1999. Programs supported by the fund are directed toward enforcement and cleanup of releases from leaking underground petroleum storage tanks. On an annual basis, expenditures have been small relative to collections. In general, the person or firm owning a storage tank has been made responsible for upgrading and repair of leaking tanks and remediation of environment consequences. The trust fund is intended to finance remediation of sites where the responsible party cannot be found or cannot pay.[49]

The Oil Spill Liability Trust Fund was financed by a 5-cents-per-barrel tax on oil either produced domestically or imported. The fund finances the oil pollution prevention and cleanup efforts of various Federal agencies, including the Coast Guard, the Minerals Management Service, and the Environmental Protection Agency. The Oil Spill Liability Trust Fund excise tax expired after December 31, 1994.

The smallest of the energy-related trust funds is the Pipeline Safety Fund, with fiscal year 1999 outlays of $36 million. Pipeline safety programs of the States are the major recipients of funds. Revenues for the fund come from user fees collected from pipeline operators.

The Aquatic Resources Trust Fund supports boating safety, coastal wetlands projects, and sport fish restoration. Primary funding derives from a motorboat fuel tax, which is estimated to total $205 million in 1999.

Off-Budget Trust Funds

In addition to the trust funds listed in the Federal budget, the Federal Government can also require firms to establish their own trust funds. The most prominent example of such an "off-budget" trust fund is the Nuclear Regulatory Commission (NRC) rulemaking on the decommissioning of nuclear power plants.[50] Decommissioning consists of dismantling the plant, disposing of the radioactive waste, and site cleanup.

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[48]A separative work unit is the standard measure of enrichment services.

[49]In most cases, there will be an identifiable responsible party, and the cost will be borne by the industry. A 1991 research report estimates that remediation of underground storage tanks will cost $32 billion to $67 billion (1990 dollars); however, that estimate does not distinguish between private requirements and Federal requirements. See M. Russell, E.W. Colglazier, and M.R. English, *Hazardous Waste Remediation: The Task Ahead* (Knoxville, TN: Waste Management Research and Education Institute, December 1991), pp. A-3.26–A-3.30.

[50]See M. Pasqualetti and G. Rothwell, "Nuclear Decommissioning Economics: Estimates, Regulation, Experience and Uncertainties," *The Energy Journal*, Vol. 12, Special Issue (1991), which contains 24 articles on various aspects of nuclear power plant decommissioning.

Nuclear power plant licensees are required to certify that sufficient financial resources will be available to decommission their nuclear power plants. Projected costs depend on the size and type of the plant. Licensees have established externally managed sinking funds to finance the future decommissioning costs. Each nuclear operator is required to undertake a site-specific decommissioning study at least 5 years before the projected end of plant operations and to provide any additional funds needed to cover the anticipated decommissioning cost before the date of actual decommissioning.

A recent report by the U.S. General Accounting Office states that, "The estimated cost to dismantle all of the commercial nuclear plants in this country, dispose of the resulting radioactive waste, and clean up the plant sites is about $30 billion dollars (in 1997 present-value costs), of which about $14 billion is currently unfunded."[51] The report estimates that the (overnight) cost to decommission a nuclear plant is on the order of $300 million to $400 million in current (1999) dollars. To determine the adequacy of decommissioning funds, it is necessary to project both cost escalation and the future rate of return for the monies deposited in the fund.

Nuclear operators recover their trust fund contributions through an increase in electricity rates, which is functionally similar to an excise tax. State and local regulators may impose additional funding requirements on nuclear operators and regulate the conditions under which decommissioning costs can be recovered through higher rates.

The NRC also imposes a somewhat similar requirement on domestic uranium producers, who are required to estimate future reclamation costs and provide guarantees or trust funds equal to the estimated costs. Under the Uranium Mill Tailings Reclamation and Control Act of 1978, the Federal Government assumed the liability for uranium mills and tailings abandoned before 1978.

These "off-budget" trust funds are fundamentally different from the "on-budget" trust funds described above: *the liability for decommissioning expenses continues to lie with the power plant owner, and not with the Federal Government*. Thus, the Federal Government has not assumed any new liabilities but merely required the private sector to make arrangements to meet an important future private liability. Consequently, an off-budget trust fund cannot be considered a subsidy, either positive or negative, in a narrow definition of the term. Rather, the fund is Federal intervention that imposes costs on a particular industry. Off-budget approaches represent a method of dealing with the problems of internalizing social costs.

Direct Price Effects of Fees for Energy Trust Funds

Receipts from energy excise taxes that are allocated to individual trust funds are generally less than 5 percent of the value of the product excluding taxes. The excise taxes on coal for the Black Lung Trust Fund are estimated to be equal to 3.5 percent of the average freight-on-board mine price of taxable coal in fiscal year 1999 (Table 12). On January 1, 1999, the maximum tax on coal from underground mines was $1.10 per ton, and the maximum tax on coal from surface mines was $0.55 per ton. The estimated average excise tax rate on all taxable coal for the Abandoned Mine Fund in fiscal year 1999 is estimated to be about $0.26 per ton. The nuclear waste fund imposes a 1.45-percent cost increment for power provided from nuclear energy.[52]

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[51]U.S. General Accounting Office, *Nuclear Regulation: Better Oversight Needed To Ensure Accumulation of Funds To Decommission Nuclear Power Plants*, GAO/RCED-99-75 (Washington, DC, May 1999).

[52]EIA's *Annual Energy Outlook 1999* projects that the national average price of electricity to all sectors will be 6.9 cents (nominal dollars) in 1999.

Table 12. Energy-Related Trust Fund Receipts Compared to Value of Commodity

Trust Fund	Fiscal Year 1999 Receipts (Million 1999 Dollars)	Relevant Commodity	Unit	Receipts as a Share of Value of Commodity (Percent)	Receipts per Unit of Commodity
Leaking Underground Storage	212	Motor Fuels	Gallons	0.14	0.1 cent per gallon
Black Lung	638	Coal Production	Tons	3.4	0.61 dollar per ton
Abandoned Mine Reclamation	305	Coal Production	Tons	1.1	0.26 dollar per ton
Nuclear Waste	642	Nuclear Generation	Kilowatthours	1.45	1.0 mill per kilowatthour

Source: Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2000* (Washington, DC, February 1999). Production forecasts from Energy Information Administration, *Annual Energy Outlook 1999*, DOE/EIA-0383(99) (Washington, DC, December 1998).

Energy Excise Taxes for General Revenue

At the outset of this chapter it was noted that the bulk of energy-related excise taxes and fees are collected to support the funding of a range of specific activities. Before 1990, all energy excise taxes were earmarked for specific projects. In 1990, however, the Congress for the first time levied transportation fuel taxes to support general revenue funding. Effective December 1, 1990, the Federal gasoline tax was increased from 9.1 cents per gallon to 14.1 cents, including 2.5 cents per gallon for deficit reduction. The Federal tax was increased to 18.4 cents in October 1, 1993, including 6.8 cents per gallon for deficit reduction. Effective October 1, 1995, 2.5 cents of the 6.8 cents was dedicated to the Highway Trust Fund, and effective October 1, 1997, proceeds of the 4.3 cents per gallon tax on highway motor fuel that were formerly deposited in the General Fund for deficit reduction are now deposited in the Highway Trust Fund.[53] Excise taxes of 4.3 cents per gallon on rail diesel fuel and inland waterways fuel, as well as 6.8 cents per gallon on motorboat fuel, small engine gasoline, and special fuels, continue to be deposited in the General Fund.

Energy excise taxes are disincentives to the production and consumption of the fuels on which they are levied. Excise taxes increase fuel prices and reduce volumes consumed. Some shift in the relative importance of the various modes of transportation occurs, because the various fuel taxes are applied differentially. Generally, the aggregate and compositional effects on fuel consumption can be greater in the long run as consumers adjust to higher prices and increase their demand for more fuel-efficient technologies. It should also be noted that all State and many local governments levy fuel-specific excise and sales taxes on energy commodities such as gasoline. Many States also levy severance taxes on oil, gas, and coal production.[54] State and local programs are not covered in this report.[55]

Superfund

Cleanup of hazardous waste sites and development of an emergency response capability to hazardous material disasters became part of the Federal Government's environmental protection policies in the 1970s. The Hazardous

[53]Taxpayer Relief Act of 1997.

[54]State oil and gas severance tax collections totaled $4.6 billion in 1993, and coal severance taxes totaled $559 million. State motor fuels sales and gross receipts were $28.33 billion in 1998. Source: U.S. Department of Commerce, web site www.census.gov/govs/statetax/98tax.txt.

[55]State and local severance taxes are discussed in Energy Information Administration, *State Energy Severance Taxes, 1985-1993*, DOE/EIA-TR/0599 (Washington, DC, September 1995).

Substance Superfund was established for these purposes by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, P.L. 96-510). Hazardous substances within the definition of the law included industrial and agricultural chemicals as well as energy products, but half of the revenue collected came from excise taxes on crude oil and petroleum products.

Until the implementation of the Superfund Amendments and Reauthorization Act of 1986 (P.L. 99-499), the Superfund was underfunded. The Superfund excise taxes expired after December 31, 1995. In recent years, however, the Superfund's balance has grown, reaching $5.12 billion (nominal dollars) at the end of 1998. The fund is largely supported by General Fund appropriations, supplemented by recoveries and interest on the Superfund balance. In the absence of the assumed General Fund appropriation, the Congressional Budget Office projects that the amount in the trust fund available for appropriation would fall to zero in fiscal year 2000.[56]

Price-Anderson Act

A Federal regulation that continues to have a cost-reducing effect on the nuclear power industry is the Price-Anderson Act of 1959, which placed a limit of $560 million on the liability of individual nuclear power plants for damage resulting from any one accident. In 1988, amendments to the Act increased the potential liability to $7 billion per accident. This limit provides a subsidy to the nuclear industry to the extent that insurance premiums paid by the operators of individual plants are reduced.

In a 1983 study, the U.S. Nuclear Regulatory Commission concluded that the liability limits established by the Price-Anderson Act constitute a subsidy; however, the subsidy was not quantified.[57] At issue are the probability distributions for various kinds of accidents on a plant-by-plant basis. From those distributions, the amount of the subsidy can be estimated by calculating the effect of the liability limit on the operators' insurance premiums. In 1990, Dubin and Rothwell developed estimates of nuclear insurance rates and concluded that the amount of the subsidy was $74.3 million per nuclear unit before the 1988 amendments and $27.7 million ($32.5 million in 1999 dollars) per unit after the amendments.[58] For the 110 nuclear units operating in 1991, the total subsidy according to this estimate would have been $3.6 billion in 1999 dollars, or 6 mills per kilowatthour for the 613 billion kilowatthours of electricity generated by nuclear power plants in 1991.

In September 1999, the nuclear power industry was insured to a maximum of $9.26 billion per incident. This dollar figure results from adding the maximum available primary insurance coverage ($200 million) to the maximum available secondary insurance coverage of $9.06 billion (the maximum per unit was $83.93 million in 1999, and 108 units held operating licenses for Price-Anderson purposes).[59] EIA reported total output of 673.7 billion kilowatthours from operable nuclear generators in 1998.[60]

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[56]Joint Committee on Taxation, *Schedule of Present Federal Excise Taxes (as of January 1, 1999)* (Washington, DC, March 29, 1999).

[57]U.S. Nuclear Regulatory Commission, *The Price-Anderson Act: The Third Decade*, NUREG-0957 (Washington, DC, 1983).

[58]J.A. Dubin and G.S. Rothwell, "Subsidy to Nuclear Power Through Price-Anderson Liability Limit," *Contemporary Policy Issues*, Vol. 8 (1990), pp. 73-79.

[59]U.S. Nuclear Regulatory Commission, *The Price-Anderson Act—Crossing the Bridge to the Next Century: A Report to Congress*, NUREG/CR-6617 (Washington, DC, August 1998).

[60]Energy Information Administration, *Annual Energy Review 1998*, DOE/EIA-0384(98) (Washington, DC, August 1999), pp. 241-243.

Appendix A

Studies of Federal Government Energy Interventions

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Studies of Federal Government Energy Interventions

Introduction

Over the past two decades, the extent of Federal Government interventions in energy industries has been considerably reduced. Price controls for domestic oil and natural gas production were largely eliminated in the early 1980s. The Tax Reform Act of 1986 reduced or eliminated many tax expenditures, several of which figured prominently in earlier studies. The Energy Policy Act of 1992, while introducing incentives for renewable energy and alternative transportation fuels, set the stage for the eventual privatization of Department of Energy uranium enrichment activities. The Energy Policy Act, in conjunction with FERC Orders 888 and 889, also required vertically integrated electric utilities to prepare for deregulation by posting prices for and allowing access to transmission networks. Thus, in comparing different studies of federal energy subsidies, it is helpful to keep in mind the date when the study was prepared (Table A1). More recent studies containing time series data tend to show a decrease in the amount of subsidies over the past 10 years. This appendix summarizes EIA's review of recent energy subsidy studies, describes interventions generally considered in the literature on energy subsidies, and briefly reviews the studies individually.

Beyond that, there are many differences in the manner, purpose, and scope of the estimation of energy subsidies (Table A2). As was noted in Chapter 1, the term "subsidy" has been widely interpreted in the literature. This report focuses on subsidies that involve direct market intervention and primary energy sources, thereby excluding Federal regulatory activities, attempts to internalize externalities, programs involving the provision of services, and all State and local government programs. In addition, though there may be general agreement that a certain intervention has some subsidizing effect, there may be no consensus as to the method of its measurement. Therefore, some reports may quantify certain provisions while others may simply describe the program without placing a valuation on it.[61] Finally, there may be consensus as to the fact of a subsidy and the method of measurement, but reasonable independent evaluations may yield different quantities.

[61]Table A3 displays tax expenditures explicitly quantified in EIA's 1992 Service Report, its 1999 update (this report), and the various reports reviewed. Table A4 displays direct expenditures (and selected Federal programs), including several that fall outside the primary energy scope of this report. All dollar values have been converted to 1999 dollars, except where values are cumulative or projected. Note that various reports may reference specific programs and line items differently, making direct comparisons difficult.

Table A1. Other Studies of Federal Energy Subsidies

Title	Author/Organization	Published	Year(s) of Subsidy Estimate
Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets	Energy Information Administration	1992	FY 1992
Federal Energy Subsidies: Energy, Environmental, and Fiscal	Koplow, Alliance to Save Energy	1993	1989
Energy Use and Emissions of Carbon Dioxide: Federal Spending and Credit Programs and Tax Policies	Congressional Budget Office	1990	FY 1990
Energy Taxes and Subsidies	Brannon, Ford Foundation	1974	1970s
An Analysis of Federal Incentives Used To Stimulate Energy Production	Pacific Northwest Laboratory (Battelle)	1980	FY 1978
The Hidden Costs of Energy	Heede, Morgan, and Ridley, Center for Renewable Resources and Rocky Mountain Institute	1985	1984
Money to Burn? The High Costs of Energy Subsidies	Kosmo, World Resources Institute	1987	1984
Fueling a Competitive Economy	Romm and Lovins, Rocky Mountain Institute	1993	1990s
Federal Incentives for the Energy Industries	Management Information Services, Inc.	1998	1950s-1997
Oil Slickers: How Petroleum Benefits at the Taxpayers Expense	Wahl, Institute for Local Self-Reliance	1996	1996
Paying the Piper: Subsidies, Politics and the Environment	Roodman, Worldwatch Institute	1996	1990s
Hazardous Handouts	Ryan, Northwest Environment Watch	1995	1990s

Sources: See Appendix D.

Table A2. Summary Comparison of Findings

Report (Author, Year)	Type, Coverage, and Method of Study	Summary, Comment
Energy Information Administration, 1992	Service report covering all fuels, enumerative.	Estimated at $5.6 billion. Subsidies characterized as direct expenditures, tax expenditures, trust funds and excise taxes, and R&D. Regulation effects described in detail, but not included in total estimate.
Koplow, Alliance to Save Energy, 1993	Policy report covering all fuels, enumerative.	Estimated at $27 to $45.9 billion. Subsidies characterized as tax benefits, agency programs, and direct market interventions, including Price-Anderson.
Brannon, Ford Foundation, 1974	Academic study commissioned for public review.	No estimate of subsidy total. Wide-ranging, detailed examination of taxes and subsidies which affected energy disposition in the early 1970s.
Battelle, 1980	Policy analysis covering all fuels, delivered under contract to DOE.	Estimated Federal program subsidies at $31.4 billion. Estimated cumulative Federal incentive for energy at $252 billion since 1918.
Congressional Budget Office, 1990	Covers all fuels with respect to CO2 emissions, enumerative.	Classified subsidy programs as either contributors to emissions or not: excise taxes (reduce emissions), R&D (increase emissions), tax preferences (both), and direct spending (mostly increase).
Heede, Morgan, Ridley, Center for Renewable Resources, 1984	Policy report covering all fuels, enumerative.	Estimated at $66.1 billion. Subsidies described as tax expenditures, agency outlays, and loans/guarantees. Does not include LIHEAP, uranium enrichment, or Price-Anderson.
Kosmo, World Resources Institute, 1987	Comparative economic study of subsidies, focusing on national economic impacts.	Estimated subsidy to U.S. electricity consumers at $91 billion.
Rocky Mountain Institute, 1992	Qualitative policy essay.	Subsidies neither specified nor quantified.
Management Information Services Inc., 1998	Policy report covering all fuels, cumulative, examines subsidy mix.	Subsidies quantified over a five-decade period. Estimated as $564 billion cumulatively since the 1950s.
Institute for Local Self-Reliance, 1996	Study of petroleum industry subsidies nationally, and Minnesota specifically.	Estimated direct tax subsidies to petroleum industry at $3.9 billion. Total indirect, external costs (defense, environmental costs) estimated as $87.5 billion.
Northwest Environment Watch, 1995	Environmental policy, Pacific Northwest impacts, public power and automobiles.	Cited EIA (1992) estimates on public power subsidies. Largest quantified estimate was $1.3 billion to Bonneville Power Administration.

Note: All dollar estimates are given in 1999 dollars.
Sources: See Appendix D.

Government Interventions Considered in Other Studies

Regulations

The issue of subsidy in energy policy analysis extends beyond consideration of actions involving some form of financial commitment by the Federal Government. Subsidy-like effects could flow from a range of regulations imposed by the Government on energy markets. Regulations may directly subsidize a fuel by mandating a specified level of consumption, thereby creating a market that might not otherwise exist.[62] More often, however, Federal regulations penalize rather than subsidize a targeted fuel. To the extent that regulations on coal emissions raise the costs of coal use, the competitive opportunities for alternatives, including renewables, natural gas, and conservation, are enhanced. The additional costs that influence the consumption of coal versus other fuels do not involve any exchange of money between the Government and buyers and sellers of energy, but they have indirect impacts on resource allocation and the relative prices of energy products.

Because the effects of regulation are indirect, most reports on energy subsidies avoid the subject, and those which address the topic in general avoid specific valuations. The 1992 service report by the Energy Information Administration (EIA) described the issue at length and provided estimates for several programs, but did not include these findings in the total subsidy estimate.[63] Similarly, Douglas Koplow and the Alliance to Save Energy discussed the issue but did not include a figure in their final estimate.[64]

Non-Internalized Externalities

Much current debate on energy policy focuses on externalities associated with energy use. Many analysts believe that, to the extent that government policies fail to recover the environmental costs of pollution from energy producers, they implicitly subsidize particular forms of energy production and consumption. According to this view, failure to internalize recognized externalities in the context of current fuel use may have the effect of causing conventional energy to be underpriced in comparison with other energy sources. For instance, some advocates of renewable energy claim that this form of "subsidy" is central to the continued dominance of fossil fuels as a component of energy supply.

In fact, the effort to deal with environmental concerns has become a central feature of Federal energy policy. Substantial costs that formerly were outside the market mechanism have, through the implementation of a series of taxes and regulations, been internalized to energy markets.

Several of the reports, however, emphasized that much more needs to be done before this issue is fully addressed. The Institute for Local Self-Reliance estimated that as much as $31 billion is not internalized in the aggregate cost of motor gasoline.[65] Unable to quantify most environmental externalities, the Center for Renewable Resources concluded that its estimate was "conservative," calling these environmental costs "large" and "important."[66] Energy

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[62]For example, the imposition of oxygenate requirements for gasoline in the winter of 1992 stimulated demand for alcohol-based additives.

[63]Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, SR/EMEU/92-02 (Washington, DC, November 1992), pp. 71-80.

[64]D.N. Koplow and The Alliance to Save Energy, *Federal Energy Subsidies: Energy, Environmental, and Fiscal Impacts* (Lexington, MA: The Alliance to Save Energy, 1993), pp. 9-10. See also p. 76, Appendix A-10, which discusses dozens of regulations, their points of intervention in energy markets, and their consequent effects.

[65]J.B. Wahl, Oil Slickers: How Petroleum Benefits at the Taxpayer's Expense (Washington, DC: Institute for Local Self-Reliance, 1996).

[66]H.R. Heede, R.E. Morgan, and S. Ridley, *The Hidden Costs of Energy* (Washington, DC: Center for Renewable Resources, October 1985), p. 7.

externalities in the Pacific Northwest, in particular electricity and automobiles, were emphasized especially by John Ryan and Rhys Roth.[67]

Transportation Programs

The Federal Government spends billions of dollars on transportation-related programs of various kinds, a considerable portion of which is funded by excise taxes on fuels or transportation-related activity. Transportation programs include construction of Federal highways, waterways, and airports; provision of air traffic control services; and extensive transportation safety and research and development programs. (Transportation programs are excluded from the analysis in this report, because they are not directed at energy consumption *per se*, and because they do not distinguish between the fuels used.[68])

Koplow included estimates for the Coast Guard, the Maritime Administration, and the Federal Railroad Administration in the subsidy total,[69] and H.R. Heede (Center for Renewable Resources) also estimated costs incurred by the Coast Guard.[70] Strikingly, David M. Roodman reported total expenditure on highway-related services at $88 billion, and he estimated that the total non-internalized cost of highway driving could be as high as $114 billion annually if costs attributable to congestion, lost time, wasted fuel, and additional accidents were included.[71]

Defense Expenditures

Some studies of Federal energy subsidies characterize U.S. defense expenditures related to the security of the Persian Gulf as energy subsidies. In addition to the technical question of what proportion of U.S. national security expenditures ought to be attributed to this mission, it is an exercise in judgment as to whether the expenditures confer a financial benefit to U.S. energy producers or consumers, and whether the level of defense expenditures bears any functional relationship to domestic energy prices. Strategic defense expenditures constituted more than half the subsidy estimated by the Institute for Local Self-Reliance, but were not emphasized elsewhere in the literature.

Tax Preferences for Investment or Research and Development

The Federal tax code contains provisions that favor corporate spending on research and development and the acquisition of capital assets over other forms of business expenses. Because energy industries historically have required heavy investment in fixed capital (power generation plants, tankers, offshore platforms, pipelines, oil refineries) and have consequently used these provisions, some analysts view such provisions of the tax code as energy subsidies. As in the case of transportation programs, however, the effects of tax code provisions on energy production or consumption are incidental to the intended purpose.

Tax provisions, however, play a large role in studies conducted in the 1980s. Koplow attributed roughly one-third of total energy subsidies to accelerated depreciation of equipment and machines and the Investment Tax Credit.[72]

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[67]J.C. Ryan, *Hazardous Handouts: Taxpayer Subsidies to Environmental Degradation* (Seattle WA: Northwest Environmental Watch, 1995).

[68]In practice, however, transportation energy use is dominated by petroleum products.

[69]D.N. Koplow and The Alliance to Save Energy, *Federal Energy Subsidies: Energy, Environmental, and Fiscal Impacts* (Lexington, MA: The Alliance to Save Energy, 1993), p. 74.

[70]H.R. Heede, R.E. Morgan, and S. Ridley, *The Hidden Costs of Energy* (Washington, DC: Center for Renewable Resources, October 1985), p. 26.

[71]D.M. Roodman, *Paying the Piper: Subsidies, Politics, and the Environment* (Washington, DC: Worldwatch Institute, 1996), p. 42. Roodman cited U.S. Department of Transportation, *Highway Statistics 1994*, and McKenzie et al., *The Going Rate: What It Really Costs To Drive* (Washington, DC: World Resources Institute, 1992).

[72]D.N. Koplow and The Alliance to Save Energy, *Federal Energy Subsidies: Energy, Environmental, and Fiscal Impacts* (Lexington, MA: The Alliance to Save Energy, 1993), p. 10.

Five years earlier, Heede attributed about half the total subsidy to these tax provisions.[73] Most of these provisions were reduced or eliminated by the Tax Reform Act of 1986.

Provision of Services

A number of Government programs take the form of provision of services. For example, the Federal Power Marketing Administrations are required by law to sell electricity preferentially to selected customers. The Price-Anderson Act makes the Federal Government a guarantor to nuclear power generators. The Strategic Petroleum Reserve may also function as a form of insurance for oil consumers, in the sense that the program normally confers benefits on oil consumers in the form of a reduction of the price risk associated with choosing to consume petroleum. Virtually all the reports reviewed here, including EIA's 1992 Service Report, recognize and itemize these types of subsidies. By definition, this report considers only the Price-Anderson Act.

Provision of Loans

Federal loans may confer financial benefits to recipients if the fees and interest rates charged do not compensate the Government for its cost of funds or if the funds are made available at lower cost than the borrower could otherwise obtain from private markets. In practice, Federal loans related to energy (or Federal tax exemptions on State and local debt incurred for energy projects) are made almost entirely for electricity. Examples include loans to Federal Power Marketing Administrations, loans made by the Rural Utilities Service, and tax exemptions for municipal bonds issued to fund energy projects. Providing loans of this type is widely recognized as an energy subsidy which can be estimated straightforwardly, and most of the literature includes these loans in total estimates of subsidy.

Review of Previous Studies

Ford Foundation Study

In 1971, the Ford Foundation authorized a comprehensive review of Federal energy policy. By 1974, the advent of the "energy crisis" had fundamentally altered the energy policy context, making Gerard M. Brannon's examination of energy tax and subsidy policy timely.[74] Brannon examined prevailing energy policy from the standpoint of economics, and suggested many of the policies that were implemented later in the 1970s and 1980s. Brannon concluded that the Government should remove or reduce subsidies that stimulate oil and gas production, and that the cost of petroleum ought to fully reflect the considerable security costs involved. He also weighed various pollution abatement alternatives, the proper role of excise taxes, and the possibility of "trust funds." Finally, he recommended an expansion of policy to promote renewable energy sources and energy-conserving technologies.

DOE Study of Federal Incentives for Energy Production

By the late 1970s, the Department of Energy (DOE), seeking to ascertain reasons for solar energy's inability to penetrate the energy market, commissioned a study to determine the extent of subsidy to traditional, fossil fuel supply obtained through Federal programs.[75] The report hypothesized that the public was overly sensitive to price signals emanating from energy markets, creating a perception of market failure, and that this justified vigorous Federal intervention to shift aggregate supply of energy to the right, restoring the intersection of the demand curve

[73]H.R. Heede, R.E. Morgan, and S. Ridley, *The Hidden Costs of Energy* (Washington, DC: Center for Renewable Resources, October 1985), p. 26.

[74]G.M. Brannon, *Energy Taxes and Subsidies* (Cambridge, MA: Ballinger, 1974).

[75]Pacific Northwest Laboratory, *An Analysis of Federal Incentives Used To Stimulate Energy Production*, PNL-2410 REV.II, prepared for DOE under contract EY-76-C-06-1830 (February 1980).

and the subsidized supply curve to the prevailing price perception. Such action would favor existing sources of energy production and make it difficult for alternatives, especially solar energy, to compete.

The report identified eight means by which Federal programs had achieved this supply shift, including the creation of organizations, tax exemptions or reductions, fees, disbursements, legal requirements, traditional regulation, research and development, and actual market activity. Taken together, these subsidies amounted to $31.4 billion. Of this, more than three quarters was attributed to DOE, the Tennessee Valley Authority (TVA), and the Army Corps of Engineers, and more than 82 percent was attributed to either electricity, nuclear, or coal programs.[76] While the report suggested some specific, creative policies that might boost the competitiveness of solar energy, the ultimate recommendation was simply to employ the Government's ability to subsidize, appending solar incentives to the list of existing Federal subsidies.

CBO Study: Energy Subsidies and Consequent Effect on Carbon Emissions

The Congressional Budget Office (CBO) responded to growing interest in the environmental effects of energy consumption with an examination of subsidies directed at fossil energy use and consequent emissions effects.[77] The CBO study considered expenditure, credit, and tax programs that directly affect energy use. The study also underscored the difficulty in tabulating energy subsidies by excluding several large Government regulatory interventions, fuel efficiency standards, regulation of nuclear generation facilities, the exclusion of interest on home mortgages, and Federal spending on highways. Even so, more than 10 forms of tax preferences, 13 forms of energy taxes, 5 key energy production and credit programs, and 6 major research and development initiatives were examined (Tables A3 and A4).

The main finding was that any energy impacts favoring fossil fuel use, thus increasing emissions, were small relative to those programs that either favored other sources (such as nuclear generation) or imposed excise taxes, thereby reducing emissions. The report described and quantified many other Federal provisions that affect energy consumption and emissions, the provision of power through Federal Power Marketing Administrations (PMAs), research and development programs, the Low Income Home Energy Assistance Program (LIHEAP), and subsidies to nuclear generation, but concluded that any measurable effects would be small relative to the size of the associated energy sector.

The Alliance to Save Energy: Expanding the Subsidy Discussion

The study with the longest list of subsidies was prepared by Douglas Koplow for the Alliance to Save Energy (The Alliance).[78] The report arrived at two estimates for total subsidies, a high figure of $46 billion and a low of $27 billion, largely by applying a broad definition to the concept of subsidy (Tables A3 and A4). The Alliance defined subsidy as any Government-provided good or service (including risk-bearing instruments) which otherwise would have to be obtained under market conditions, and any reduction in tax burden compared to the standard treatment for a similar activity. Further, the report assumed a zero budget baseline[79] and, in contrast to CBO and others, included and itemized subsidies to housing and transportation if they significantly benefitted the energy sector.

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[76]Energy Information Administration, *Annual Energy Review 1997*, DOE/EIA-0384(97) (Washington, DC, July 1998), Table 10, p. 92.

[77]Congressional Budget Office, *Energy Use and Emissions of Carbon Dioxide: Federal Spending and Credit Programs and Tax Policies* (Washington, DC, December 1990).

[78]D.N. Koplow, *Federal Energy Subsidies: Energy, Environmental, and Fiscal Impacts* (Lexington, MA: Alliance To Save Energy, 1993).

[79]That is, all expenditures to energy and all tax breaks constitute subsidy to the recipient.

Table A3. Comparison of Selected Tax Expenditure Estimates
(Million 1999 Dollars, Outlay Equivalents)[a]

Provision	EIA 1999 Service Report	EIA 1992 Service Report	Alliance to Save Energy (High)	Congressional Budget Office	Center for Renewable Resources	Institute for Local Self-Reliance
Capital Gains Treatment of Coal Royalties	85	11	Not estimated		165	
Expensing of Exploration and Development	-90	-63	-337	280	2,337	146
Enhanced Oil Recovery Credit[b]	245	[c]23	25	24	Not estimated	101
Exception from Passive Loss Limitation for Working Interest in Oil and Gas Properties	35	114	382			62
New Technology Credit	40	74	2,504			
Alternative Fuel Production Credit	1,030	764	25	12		787
Alcohol Fuel Credit	15	91	25	43	323	
Excess of Percentage over Cost Depletion	295	1,170	954	634	2,668	1,026
Exclusion of Interest on Certain State and Local Bonds		211	1,816	183		187
Alcohol Fuels Excise Tax Exemption	725	525	617	487	323	

[a]Data for Congressional Budget Office and Institute for Local Self-Reliance are revenues foregone.
[b]Enhanced Oil Recovery was added as a result of the Energy Policy Act of 1992.
[c]Includes only tertiary injectants, which were an expense item in 1992.
Note: Blank cells indicate the report made no mention of the item. "Not estimated" indicates a provision acknowledged by the authors but not quantified.
Sources: See Appendix D.

The report provided costs for 1989, the latest year for which the authors (writing in 1992) could find full, reliable data. Costs were divided among tax benefits, Federal agency program interventions, and other market interventions.[80] Like several other reports on energy subsidies, including EIA's 1992 report, the report by Koplow included provisions and programs that had been discontinued or discouraged, accounting for their "residual" effects. Chief among these items was accelerated depreciation of machinery and equipment, phased out by the Tax Reform Act of 1986, estimated at just over $12 billion.[81]

The Alliance report supplied both a high and a low estimate, along with an explanation of the methods used in arriving at each figure (Table A5). The estimates differed in two respects: the high figure used less conservative estimation methods for certain program losses, and it measured not only the revenue foregone but also a market value estimation of indirect benefits accruing from the Government's intervention.[82] Table A5 shows the differences as they pertain to the 10 largest subsidies in the report. Overall, the high estimate was nearly twice as large as the low.

[80]Other quantified market interventions were two, the Price-Anderson assumption of nuclear liability and the under-accrual of funds necessary for nuclear decommissioning.
[81]Besides accelerated depreciation, investment tax credits for new machinery and equipment ($2.5 billion) and tax-exempt bonds for pollution control equipment ($716 million) were also important residual items.
[82]For example, the 1989 revenue foregone from oil and gas percentage depletion exemption was estimated by Treasury at $496 million (ASE's low estimate of the tax expenditure), but since the tax expenditure increases taxable income, a grant of $674 million (ASE's high estimate) would be needed to produce a $390 million benefit after taxes.

Table A4. Comparison of Selected Direct Expenditures
(Million 1999 Dollars)

Provision	EIA 1999 Service Report	EIA 1992 Service Report	Alliance to Save Energy (High)	Congressional Budget Office	Center for Renewable Resources
Direct Expenditure Items					
DOE Research and Development	1,567	2,331.1	[a]3,538.5	3,070.7	6,085.0
Clean Coal	[b]183	288.7	241.6	675.1	
DOE Conservation	--	298.9		54.8	
Synthetic Fuels Subsidies	0	82.2			150.3
Power Marketing Administrations: Total	**--**	**394.8**	**783.9**		**625.2**
Alaska Power Administration	--	3.7	10.0		
Southeastern Power	--	28.0	90.7		
Southwestern Power	--	28.9	53.9		
Western Area Power	--	343.4	67.5		
Bonneville Power Administration	--	-9.7	561.7		390.7
Costs of Regulators					
Bureau of Reclamation	--	113.0	Not estimated	130.4	255.5
Nuclear Regulatory Commission	--	433.6	441.8		700.3
Mining Safety and Health	--	107.3	148.4		175.8
Office of Surface Mining	--	123.2	348.5		187.9
Minerals Management Service	--	237.3	213.3	214.5	243.5
Bureau of Land Management	--	95.8	Not estimated		136.8
Provision of Services					
Rural Utilities Service (RUS)	--		1,505.6	1,112.5	5,960.3
RUS, Federal Loans	--	50.2			
Corps of Engineers Projects	--	528.3	817.7	411.9	1,535.9
Tennessee Valley Authority	--	654.9	164.8	538.6	1,170.7
Price-Anderson Act	9,260	3,423	3,179	--	--

[a]Regulatory enforcement activities.
[b]DOE R&D totals for EIA 1999 and EIA 1992 include outlays for clean coal.
Note: Blank cells indicate the report made no mention of the item. “Not estimated” indicates a provision acknowledged by the authors but not quantified.
Sources: See Appendix D.

The Alliance concluded that this pattern of subsidies, by encouraging the consumption of fossil fuels, prevented a free market in energy, degraded the environment, slowed the development of renewable energy sources, and ignored possibilities associated with energy efficiency improvements. The inclusion of residual subsidies tended to support the conclusion that a level playing field for energy alternatives might be very difficult to achieve.

Table A5. Alliance to Save Energy, Comparison of Selected High and Low Estimates
(Million 1999 Dollars)

Provision	High Estimate	Low Estimate	Difference
Accelerated Depreciation of Machinery and Equipment	12,168	3,514	8,654
DOE Energy R&D	2,702	2,512	190
Strategic Petroleum Reserve	2,622	2,209	413
Investment Tax Credits	2,504	974	1,530
Tax Exempt Bonds Issued by State and Local Authorities	716	586	130
Rural Utilities Service (Loans)	1,506	1,428	78
Uranium Enrichment Enterprise	1,306	355	951
Utility Normalization of Excess Deferred Taxes	1,267	0	1,267
Black Lung Trust Fund	1,578	1,465	113
Subtotal, Displayed Provisions	26,369	13,043	13,326
Total	**45,876**	**26,999**	**18,877**

Source: Alliance to Save Energy, *Federal Energy Subsidies: Energy, Environmental, and Fiscal Impacts*, Tables 3 and 4.

1992 EIA Service Report

In contrast to The Alliance, EIA's 1992 service report quantified a smaller number of Federal subsidies while acknowledging that many other Federal interventions, most very difficult to quantify, undoubtedly acted as subsidies.[83] Like The Alliance, EIA also relied on Federal outlay numbers and netted out receipts to some programs, arriving at an overall estimate of $5.6 billion, with a high allowance of $11.4 billion. EIA classified the subsidies as both income and excise tax expenditures, direct expenditures, and research and development (Tables A3 and A4).

Tax expenditures, the largest of which was the excess of percentage over cost depletion exclusion, comprised just over half of the total in EIA's 1992 report. Direct expenditures amounted to $3.9 billion, and research and development subsidies totaled $2.3 billion, almost half of which went to nuclear programs. EIA then reduced this subsidy total by over $3.4 billion for excise taxes collected without offsetting liabilities, virtually all of which were attributed to taxes on motor gasoline and highway diesel, in arriving at the final estimate. With the excise taxes thus attributed entirely to petroleum, oil actually showed a negative subsidy of $2.4 billion. All other fuels were allocated a positive subsidy value.

Although it did not include them in the total estimate, EIA's 1992 service report described at length other Federal interventions that acted to subsidize the energy sector, chief among them, public power issues and various forms of regulation. The report found four subsidized areas: access to inexpensive Federal hydropower through PMAs, access to Rural Electrification Administration (now the Rural Utilities Service) credits, tax-exempt borrowing rights, and exemption from Federal income tax. The study estimated that the full cost of providing electricity could exceed the price actually obtained by $4.8 billion. It also estimated costs associated with several regulatory programs, including unleaded and oxygenated gasoline, oil storage tank safety, automobile efficiency (CAFE) standards, and

[83]Energy Information Administration, *Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets*, SR/EMEU/92-02 (Washington, DC, November 1992).

two interventions functioning as subsidies, the Price-Anderson Act and the Alaska North Slope oil export ban. Valued at roughly $29 billion, these energy-related regulatory programs dwarfed the quantified overall subsidy estimate of $5.5 billion.

The 1992 EIA report, while acknowledging and itemizing indirect subsidies, stressed that subsidies must affect the choice between energy and non-energy capital investment. The report therefore excluded some tax considerations and chose not to include strategic considerations such as defense expenditures in the Persian Gulf and the Strategic Petroleum Reserve.

Recent Studies: Management Information Services, Inc., and Green Scissors

Management Information Services, Inc. (MISI), conducting a study of the cumulative effects of energy subsidies, found that by 1997 Federal subsidies for energy had amounted to $564 billion (1997 dollars) over the last five decades, roughly half of which went to the oil industry in the form of tax expenditures.[84] MISI considered eight categories of Federal activity[85] and quantified subsidies in six. In contrast to other findings, MISI found that subsidies to renewable sources ($90 billion) outpaced those to natural gas ($73 billion), coal ($68 billion), or nuclear energy ($61 billion).[86] MISI itemized Federal research and development spending for nuclear, coal, and solar sources, reporting 1997 figures of $130 million, $227 million, and $259 million, respectively. MISI concluded that since renewable sources have contributed only marginally to the Nation's energy supply, solar research and development subsidies are disproportionately large and should be redirected to nuclear and fossil energy research.

The Green Scissors series of reports identified areas of Federal spending that subsidize environmental degradation.[87] Sixteen Federal energy programs were cited as wasteful, several of which contain subsidy activities, most notably the Power Marketing Administrations,[88] Clean Coal Technology Program,[89] Coal Research and Development,[90] various tax expenditures for petroleum,[91] and loans to the Rural Utilities Service.[92] According to Green Scissors, scaling back or eliminating entirely these programs would result in savings of nearly $16 billion over 5 years.

Other Reports

Eight years before the Alliance to Save Energy report, the Center for Renewable Resources estimated total Federal subsidies at $66 billion and asserted that current policy strongly favored fossil fuels over renewable sources and energy efficiency.[93] Although the report did not include LIHEAP or uranium enrichment costs, it still arrived at a relatively high figure, including the accelerated cost recovery system ($17.8 billion) and the Investment Tax Credit ($8 billion) and omitting the effect of excise taxes (principally, motor gasoline and highway diesel), which reduced total energy subsidies by discouraging energy consumption (Tables A3 and A4).

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[84]Management Information Services, Inc., *Federal Subsidies and Incentives for the Energy Industries* (Washington, DC, December 1998).
[85]Organizations, taxes, fees, disbursements, requirements, traditional and nontraditional Government services, and market activity, the same categories identified by the Pacific Northwest Laboratory report delivered under contract to DOE in 1980.
[86]MISI included subsidies estimated at $62.5 billion cumulatively to hydroelectricity in the renewable total of $90 billion.
[87]Friends of the Earth, *Green Scissors 98: Cutting Wasteful and Environmentally Harmful Spending* (Washington, DC, 1998).
[88]Subsidy estimated as $400 million annually.
[89]$1.5 billion since 1984.
[90]$107 million, FY 1998.
[91]$48.5 million, FY 1998.
[92]Estimated at $60 million annually.
[93]H.R. Heede, R.E. Morgan, and S. Ridley, *The Hidden Costs of Energy* (Washington, DC: Center for Renewable Resources, October 1985).

In another report from the mid-1980s, *Money to Burn? The High Cost of Energy Subsidies*, Mark Kosmo deduced that cost-of-service electricity regulation produced a subsidy estimated at $91 billion per year.[94] Kosmo, writing for the World Resources Institute, argued that the U.S. regulatory practice of pricing electricity at average historic cost, rather than marginal cost, constituted a huge subsidy to electricity consumers.[95]

Joseph Romm and Amory Lovins suggested reducing the number of supply-side subsidies, pursuing "more efficient, cleaner and cheaper energy options," and giving them "a fair chance to compete."[96] The Institute for Local Self-Reliance (ILSR), focusing on petroleum subsidies only, estimated that the petroleum industry received subsidies of $87.5 billion in 1996.[97] ILSR computed the estimate using tax expenditures ($3.9 billion), defense or protection costs ($52 billion), and environmental or health costs ($31 billion). It did not include excise tax effects in the analysis (Table A3). Stephen Moore, writing of the need to end corporate subsidies generally, mentioned several energy activities, including loans to the Rural Utilities Service and tax expenditures for ethanol.[98] Other reports analyzed the environmental effects attributable to subsidized activities (only some of which are energy specific) in the Pacific Northwest,[99] the OECD countries,[100] and around the world,[101] calling for a reduction or complete removal of certain subsidies.

[94]M. Kosmo, *Money to Burn? The High Costs of Energy Subsidies* (Washington, DC: World Resources Institute, 1987).

[95]Ten years later, the falling cost of bulk power generation has produced the phenomenon of "stranded costs," in many areas, suggesting that marginal costs are now lower than regulated prices in many areas. This, of course has given impetus to the restructuring initiative.

[96]J.J. Romm and A.B. Lovins, "Fueling a Competitive Economy," *Foreign Affairs* (Winter 1992/1993), pp. 44-62.

[97]J.B. Wahl, *Oil Slickers: How Petroleum Benefits at the Taxpayer's Expense* (Washington, DC: Institute for Local Self-Reliance, 1996), web site www.ilsr.org.

[98]S. Moore, *Welfare for the Well-Off: How Business Subsidies Fleece Taxpayers* (Stanford, CA: Hoover Institute, 1999).

[99]J.C. Ryan, *Hazardous Handouts. Taxpayer Subsidies to Environmental Degradation* (Seattle, WA: Northwest Environmental Watch, 1995).

[100]Organization for Economic Cooperation and Development, *Improving the Environment Through Reducing Subsidies* (Paris, France, 1998).

[101]D.M. Roodman, *Paying the Piper: Subsidies, Politics, and the Environment* (Washington, DC: Worldwatch Institute, 1996).

Appendix B

Fact Sheets on Federal Energy Subsidies and Other Federal Energy Interventions

1. Renewable Energy Production Incentive (REPI)

Description

The Renewable Energy Production Incentive (REPI) is part of an integrated strategy in the Energy Policy Act of 1992 (EPACT) to promote increases in the generation and utilization of electricity from renewable energy sources, and to advance renewable energy technologies. This program, authorized under EPACT Section 1212, provides financial incentive payments for electricity produced and sold by new qualifying renewable energy generation facilities. Eligible electricity production facilities are those owned by State and local government entities (such as municipal utilities) and not-for-profit electric cooperatives that started operations between October 1, 1993, and September 30, 2003. Qualifying facilities are eligible for annual incentive payments of 1.5 cents per kilowatthour (1993 dollars and indexed for inflation) for the first 10-year period of their operation, subject to the availability of annual appropriations in each Federal fiscal year of operation. Criteria for qualifying facilities and application procedures are contained in the rulemaking for this program. Qualifying facilities must use solar, wind, geothermal (with certain restrictions as contained in the rulemaking), or biomass (except for municipal solid waste combustion) generation technologies.

Revenue Loss/Outlay

Procedures for annual payments to qualifying facilities for the REPI program are contained in the rulemaking. Payments are dependent upon the availability of annual appropriations. If there are insufficient appropriations to make full payments for electricity production from all qualifying facilities, “Tier 1” applicants receive incentive payments first. Tier 1 qualifying facilities are facilities that use solar, wind, geothermal, or closed-loop (dedicated energy crops) biomass technologies to generate electricity. Tier 1 receives either full payments or *pro rata* payments if funds are insufficient to cover all requests. If funds are available after making full payments to these facilities, payments from the remaining funds are then made to “Tier 2” qualifying facilities. These facilities use open-loop biomass technologies, such as landfill methane gas, biomass digester gas, and plant waste material that is co-fired in a generation facility to generate electricity. If there are insufficient funds to make full payments to all Tier 2 qualifying facilities, payments are made to those facilities on a *pro rata* basis. *Pro rata* payments result in a portion of the electricity production being fully paid and the remainder not receiving payment. Electricity for which payment is not made may be added to the next fiscal year's electricity production and submitted by the qualifying facility for payment consideration, providing the annual application is made in a timely manner within the 10-fiscal-year eligibility window.

In the first year of the REPI program, there were sufficient appropriations to make full production incentive payments of $693,120 (nominal dollars) to the owners of all qualifying facilities. In the second year of the REPI program, there were sufficient appropriations to make full production incentive payments of $2,398,472 (nominal dollars) to the owners of all qualifying facilities. For the third year of the REPI program, the available funds of $2,490,893 (nominal dollars) were insufficient to make full production incentive payments to the owners of all qualifying facilities. Therefore, full payments have been made for electricity produced by Tier 1 facilities, and partial payments on a *pro rata* basis have been made for Tier 2 facilities. For the fourth year of the REPI program, the available funds of $2,853,997 (nominal dollars) were insufficient to make full production incentive payments to the owners of all qualifying facilities. Therefore, full payments have been made for electricity produced by Tier 1 facilities and partial payments have been made for Tier 2 facilities on a *pro rata* basis. The fifth year of the REPI program received $4,000,000 from Congress. This appropriation did not cover requests for reimbursement. Tier 1 was fully funded; Tier 2 funding was prorated on the basis of production.

1999 REPI Payments[a]

Receipt	Energy Source	Payment (1999 Dollars)
Gainesville Regional Utilities, FL	Solar	47
Sacramento Municipal Utility District, CA	Solar	73,605
New York Power Authority, NY	Solar	16,710
Traverse City Power and Light, MI	Wind	11,257
Waverly Light and Power, IA	Wind	1,431
Kotzebue Electric Association Inc., AK	Wind	3,342
Clay Central/Everly Community School District, IA	Wind	865
Platte River Power Authority, CO	Wind	14,911
Central Valley Financing Authority, CA	Biomass digester gas	359,281
Snohomish County, WA	Wood waste	1,803,268
City of Dane, WI	Landfill methane	50,272
City of Glendale, CA	Landfill methane	588,013
Emerald Peoples' Utility District, OR	Landfill methane	91,524
Lycoming County, PA	Landfill methane	71,909
Pacific Northwest Generating Cooperative, OR	Landfill methane	154,754
University of California, Los Angeles, CA	Landfill methane	337,037
Monterey Regional Waste Management District, CA	Landfill methane	131,711
Jacksonville Electric Authority, FL	Landfill methane	112,707
Sonoma County Central Disposal Site, CA	Landfill methane	177,356

[a]Applied to fiscal year 1998 production and prior year unpaid production.
Source: U.S. Department of Energy, Office of Power Technologies, web site www.eren.doe.gov/power/repi.html.

Rationale

REPI complements EPACT Sections 1914 and 1916, which provide tax incentives to certain private sector entities for certain types of new renewable energy generation facilities. The application of these changes to the U.S. Tax Code is administered by the Internal Revenue Service. The REPI program is managed by the Department of Energy. The regulations for the administration of the REPI program are contained in Title 10 to the Code of Federal Regulations, Part 451 (10 CFR 451). The final rulemaking, which contains clarifying supplementary information, is contained in 60 FR 36959.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Solar, wind, geothermal (with certain restrictions as contained in the rulemaking), or biomass (except for municipal solid waste combustion) generation technologies used to produce electricity by new generating facilities (which started operation between October 1, 1993, and September 30, 2003) owned by Publicly owned utilities.

Impact

The net impact of REPI has been minor, accounting for 528,899,024 kilowatthours in 1998, less than 0.02 percent of total electricity production in that year.

Net Electricity Production by REPI Qualifying Facilities, 1994-1998

Fiscal Year	Electricity Production (Kilowatthours)
1994	42,255,235
1995	152,609,779
1996	176,950,310
1997	458,021,775
1998	528,899,024

Source: U.S. Department of Energy, Office of Power Technologies, web site www.eren.doe.gov/power/repi.html.

2. Capital Gains Treatment of Royalties on Coal

Description

Owners of coal mining rights who lease their property usually receive royalties on mined coal. If the owners are individuals, these royalties can be taxed at the lower individual capital gains tax rate of 20 percent rather than at the higher regular individual top tax rate of 39.6 percent. In order to claim capital gains treatment, the royalty owner must own the property for a minimum of 1 year and meet other simple requirements. Owners who elect the capital gains tax rate cannot also elect percentage depletion. The capital gains treatment of coal royalties is provided for by law and has been in effect since the early 1950s.

Revenue Loss/Outlays

Estimated Revenue Loss and Outlay Equivalent, 1987-2004
(Million Nominal Dollars)

Fiscal Year	Revenue Loss			Outlay Equivalent[a] (Total)
	Individuals	Corporations	Total	
1987	45	5	50	65
1988	([b])	([b])	([b])	([b])
1989	0	0	0	0
1990	0	0	0	0
1991	5	0	5	10
1992	10	0	10	10
1992	10	0	10	10
1993	10	0	10	15
1994	10	0	10	10
1995	15	0	15	15
1996	15	0	15	15
1997	50	0	50	50
1998	60	0	60	80
1999	65	0	65	85
2000	65	0	65	85
2001	70	0	70	95
2001	70	0	70	95
2003	75	0	75	100
2004	80	0	80	105

[a]An outlay equivalent is the amount of outlay that would be required to provide the taxpayer the same after-tax income as would be received through the tax preference.
[b]Less than $2.5 million.
Note: All estimates have been rounded to the nearest $5 million.
Source: Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999). Also earlier editions.

The “Revenue Loss” data in the tabulation above were generated by the U.S. Treasury Department. They are the difference between estimated Federal income tax payments in a reference case and estimated actual Federal income tax payments. The reference case assumes that royalties on coal are taxed at the regular rate. The actual case assumes that the royalties are taxed at the capital gains tax rate to the extent taxpayers so choose.

Rationale

The capital gains treatment of coal royalties was apparently adopted for three reasons: (1) to encourage additional production, (2) to place coal on the same tax footing as lumber, and (3) to provide a benefit to long-term lessors who might not benefit substantially from percentage depletion.

Major Form of Energy/Fuel Cycle Stage(s) Affected

Coal production.

Impact

The capital gains treatment of royalties on coal causes Federal income tax payments by royalty owners to be lower than they otherwise would be, which encourages leasing and subsidizes production. However, those impacts are quite small because the capital gains provision cannot be used simultaneously with the percentage depletion provision. The capital gains tax rate dropped from 28 percent to 20 percent in 1997. This accounts for the higher estimated revenue loss beginning in 1997.

3. Expensing of Exploration and Development Costs: Oil, Gas, and Other Fuels

Description

Tax law allows energy producers, principally oil and gas producers, to write off (i.e., expense) certain exploration and development (E&D) expenditures rather than capitalizing them and depreciating them over time. The most important of these expenditures consist of intangible drilling costs (IDCs) associated with oil and gas investments. Integrated oil companies can expense 70 percent of their IDCs for successful domestic wells and 100 percent for unsuccessful domestic wells. The remaining 30 percent must be amortized over 5 years. Nonintegrated (independent) oil producers can expense 100 percent of their IDCs for all domestic wells. The 70-percent provision also applies to surface stripping and other selected expenditures for fuel minerals other than oil and gas (principally coal). The remainder must be amortized over 5 years.

The option to expense IDCs (and dry hole costs) of oil and gas wells was originally based on regulations issued in 1916. A court invalidated the regulations in 1945, but Congress subsequently gave its approval to the treatment and it became law in 1954. The option to expense mine development expenditures and the option to expense mine exploration expenditures were formalized in law in 1951 and 1966, respectively.

Integrated oil companies were constrained to expensing only 85 percent of their IDCs by a 1982 tax law. The percentage was subsequently reduced to 80 percent by the Tax Reform Act of 1984 and to its present 70 percent by the Tax Reform Act of 1986.

Revenue Loss/Outlays

The “Revenue Loss” data in the tabulation below were generated by the U.S. Treasury Department. They are the difference between estimated Federal income tax payments in a reference case and estimated actual Federal income tax payments. The reference case assumes that relevant IDCs and certain other E&D expenditures are cost depleted. The actual case assumes that they are expensed.

The data in the table have been mostly negative since fiscal year 1987. The negative values imply a payment to the Government of funds that it had loaned (tax deferrals), mostly to oil companies, in earlier periods. In a normal growth situation, the values would be positive. However, as a result of the sharp drop in oil E&D expenditures resulting from generally lower oil prices during the past several years, repayments of old “loans” have outweighed the receipt of new ones.

Estimated Revenue Loss and Outlay Equivalent: Oil, Gas, and Other Fuels, 1987-2004[a]
(Million Nominal Dollars)

Fiscal Year	Revenue Loss			Outlay Equivalent[b] (Total)
	Individuals	Corporations	Total	
1987	425	-1,065	-640	-640
1988	455	-805	-350	-350
1989	560	-590	-30	-30
1990	-70	-385	-455	-455
1991	-95	-185	-280	-280
1992	-40	-15	-55	-55
1993	-15	90	80	80
1994	0	-70	-70	-70
1995	-70	-215	-285	-285
1996	-60	-180	-240	-240
1997	-35	-115	-150	-150
1998	-20	-90	-110	-130
1999	-15	-55	-70	-90
2000	NA	-10	-10	-20
2001	NA	-15	-15	-25
2002	NA	NA	NA	NA
2003	5	25	30	40
2004	10	30	40	45

[a]"Other Fuels" are assumed to be primarily coal.
[b]An outlay equivalent is the amount of the outlay that would be required to provide the taxpayer with the same after-tax income as would be received through the tax preference.
NA = not available or not applicable.
Note: All estimates have been rounded to the nearest $5 million.
Sources: **1987-1996:** Office of Management and Budget, *Budget of the United States Government, Fiscal year 1996* (Washington, DC, 1996). Also earlier editions. **1997-2004:** Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999). Also earlier editions.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Crude oil, natural gas, and coal production.

Rationale

Intangible drilling costs were asserted by producers to be conventional operating expenses that therefore should be expensed. The provision is intended to encourage additional mineral exploration and development. It was explicitly codified to reduce uncertainty concerning its status in order to encourage further exploration and development.

Impact

This tax deferral provision has historically been one of the most important for oil and gas producers. The rapid writeoffs have added to other incentives to engage in exploration and development. As a result, domestic crude oil production has been greater than it otherwise would have been, and capital has been diverted from more productive activities. The increased output has contributed to making oil prices lower than they otherwise would be, despite OPEC's price-controlling position, and to constrained growth for nonconventional forms of energy.

4. Exception From Passive Loss Limitation for Working Interests in Oil and Gas Properties

Description

Owners of working interests in oil and gas properties are exempt from the "passive income" limitations, which limit the ability of individuals to offset their losses from passive activities against active income. Passive losses remaining after being netted against passive incomes can only be carried over to future-period passive incomes. The passive loss limitation provision and the oil and gas exception to it apply principally to partnerships and individuals rather than to corporations.

Revenue Loss/Outlays

Estimated Revenue Loss and Outlay Equivalent, 1987-2004
(Million Nominal Dollars)

Fiscal Year	Revenue Loss			Outlay Equivalent[a] (Total)
	Individuals	Corporations	Total	
1987	NA	NA	NA	NA
1988	55	0	55	75
1989	135	0	135	135
1990	180	0	180	245
1991	80	0	80	100
1992	80	0	80	100
1993	50	NA	50	50
1994	90	NA	90	50
1995	55	NA	55	55
1996	60	NA	60	60
1997	45	NA	45	45
1998	30	NA	35	30
1999	35	NA	35	35
2000	35	NA	35	35
2001	35	NA	35	35
2002	40	NA	35	40
2003	40	NA	40	40
2004	40	NA	40	40

[a]An outlay equivalent is the amount of the outlay that would be required to provide the taxpayer with the same after-tax income as would be received through the tax preference.

NA = not available or not applicable.

Note: All estimates have been rounded to the nearest $5 million.

Sources: **1987-1993:** Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1993* (Washington, DC, 1992). Also earlier editions. **1994-2004:** Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999). Also earlier editions.

The “Revenue Loss” data in the tabulation above were generated by the U.S. Treasury Department. They are the difference between estimated Federal income tax payments in a reference case and estimated actual Federal income tax payments. The reference case assumes that there are no exceptions to the passive loss limitations. The actual case assumes that exceptions are granted principally to noncorporate taxpayers.

Rationale

Working interests in oil and gas properties were exempted from the loss limitations in the Tax Reform Act of 1986. Factors that contributed to the adoption of the exemption included concern about the availability of investment funds for oil and gas development, given the collapse in oil prices that occurred during the same year the Act was passed.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Crude oil and natural gas production.

Impact

The major impact of the exception from the passive loss limitation is on business organizations that develop oil and gas properties. A shift toward the unlimited liability partnership form is likely, because the exception applies mainly to that form. Any shift is likely to be small because of the increased risk associated with unlimited liability. Nevertheless, some increase in exploration and development of oil and gas properties is likely as the subsidy attracts new capital.

5. Enhanced Oil Recovery

Description

Taxpayers are able to claim a general business credit allowing for the expensing of enhanced oil recovery investment. The enhanced oil recovery credit applies to the application of one or more tertiary recovery methods. The credit phases out when the price of oil exceeds $28 per barrel in the preceding year. Enhanced oil recovery (EOR) is the extraction of the oil that can be produced from a petroleum reservoir greater than that which can be economically recovered by conventional primary and secondary methods. EOR methods usually involve injecting heated fluids, pressurized gases, or special chemicals into an oil reservoir in order to produce additional oil. The credit was provided for in the Energy Policy Act of 1992.

Revenue Loss/Outlays

Estimated Revenue Loss and Outlay Equivalent, 1993-2004
(Million Nominal Dollars)

Fiscal Year	Revenue Loss			Outlay Equivalent[a] (Total)
	Individuals	Corporations	Total	
1993	NA	NA	NA	NA
1994	5	80	85	120
1995	5	80	85	115
1996	5	75	80	110
1997	5	90	95	145
1998	10	130	140	215
1999	10	150	160	245
2000	10	170	180	285
2001	15	195	210	325
2002	15	225	240	375
2003	15	260	275	425
2004	20	300	320	490

[a]An outlay equivalent is the amount of the outlay that would be required to provide the taxpayer with the same after-tax income as would be received through the tax preference.

NA = not available or not applicable.

Note: All estimates have been rounded to the nearest $5 million.

Note: For the year 1997, the credit was called a “new technology credit.”

Sources: **1993-1996:** Joint Committee on Taxation (Staff), *Estimates of Federal Tax Expenditures for Fiscal Years 1992-1996* (Washington, DC, 1996). Also earlier editions. **1997-2004:** Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

The purpose of the credit for enhanced oil recovery is to boost levels of domestically produced oil and gas bypassed by conventional production.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Oil and natural gas production.

Impact

According to the Department of Energy, enhanced oil recovery has increased domestic oil production by 580,000 per day.[102]

[102]Energy Information Administration, *Annual Energy Outlook 1999*, DOE/EIA-0383(99) (Washington, DC, December 1998), p. 132.

6. Alternative Fuel Production Credit

Description

An alternative (or nonconventional) fuels income tax credit applies to qualified fuels from wells drilled or facilities placed in service between January 1, 1980, and December 31, 1992, and sold through the year 2002. The qualified fuels are (1) oil produced from shale and tar sands; (2) gas from geopressurized brine, Devonian shale, coal seams, tight formations, or biomass; (3) liquid, gaseous, or solid synthetic fuels produced from coal; (4) fuel from qualified processed wood; and (5) steam from solid agricultural byproducts.

The tax credit for these fuels is $3 per barrel of oil-equivalent produced. (Conversion factors are used to convert the various fuels into their crude oil equivalent for purposes of calculating the credit.) The credit is fully effective when the price of crude oil is $23.50 per barrel or less and phases out gradually as the price of oil rises to $29.50 per barrel. All prices as well as the credit are specified in 1979 dollars, but for actual use they are indexed for inflation relative to that base. The credit is reduced if certain other energy subsidies, such as government grants and tax-exempt financing, are used.

The alternative fuel production credit was established by the Windfall Profit Tax Act of 1980 and became effective in the same year. The principal additional changes that have occurred since the 1980 Act have been to extend the time limits by which wells or facilities must be placed in service and fuels sold in order to be eligible for the credit. In 1989, legislation allowed a 1-year extension of the time limits. The Omnibus Budget Reconciliation Act of 1990 provided an additional 2-year extension. The 1990 act also greatly eased the qualification for gas produced from tight sands after 1990. The qualification had been sharply constrained by Executive Branch rulings and judicial decisions.

Revenue Loss/Outlays

The “Revenue Loss” data in the tabulation below were generated by the U.S. Treasury Department. They are the difference between estimated Federal income tax payments in a reference case and estimated actual Federal income tax payments. The reference case assumes that the alternative fuels receive no production credit. The actual case assumes that the credit is granted.

Estimated Revenue Loss and Outlay Equivalent, 1987-2004
(Million Nominal Dollars)

Fiscal Year	Revenue Loss			Outlay Equivalent[a] (Total)
	Individuals	Corporations	Total	
1987	([b])	10	10	25
1988	([b])	10	10	15
1989	([b])	10	10	15
1990	([b])	10	10	15
1991	50	205	255	380
1992	90	360	450	670
1993	120	640	760	995
1994	140	760	900	NA
1995	150	820	970	NA
1996	150	850	1,000	NA
1997	30	680	710	NA
1998	45	815	860	1,100
1999	45	765	810	1,030
2000	40	720	760	975
2001	40	680	720	915
2002	35	640	675	860
2003	15	420	435	555
2004	5	120	125	165

[a]An outlay equivalent is the amount of the outlay that would be required to provide the taxpayer with the same after-tax income as would be received through the tax preference.
[b]$2.5 million or less.
NA = not available or not applicable.
Note: All estimates have been rounded to the nearest $5 million.
Sources: **1987-1993:** Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1993* (Washington, DC, 1992). Also earlier editions. **1994-2004:** Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

The alternative fuel tax credit is one of several measures adopted in the early 1980s to encourage the development of synthetic fuels produced by nonconventional means or sources. The credit is designed to encourage capital investment in alternative fuel production by protecting producers of those fuels against the effects of oil price reductions.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Oil and natural gas production.

Impact

The tax credit provision has had a substantial impact on the production of alternative fuels. The fuel most affected has probably been gas produced from coal seams. The recent impact has been large both because it was expected that the credit would expire for wells and facilities not placed in service by a certain date and because crude oil prices have been low. The credit for qualified gas was about $0.1 per million Btu in 1998, or about one-half the wellhead price of domestically produced natural gas in that year. The extent to which other nonconventional fuels have been affected is less certain. Generally, however, the credit has caused oil and gas supplies to increase beyond levels that would otherwise have been reached.

The alternative fuels provision extends the applicable time period for the so-called "Section 29" tax credit as it applies to the production of some alternative (or nonconventional) fuels. The extension applies only to gas from biomass and to liquid, gaseous, or solid synthetic fuels produced from coal in facilities placed in service through 1996 (pursuant to a written binding contract in effect before 1996) and sold through the year 2007. Prior to the extension the years were 1992 and 2002, respectively. In the case of a facility that produces coke or coke gas, however, the extended dates apply only if the original use of the facility commenced with the taxpayer. The original dates continue to apply to all qualified alternative fuels not mentioned above. Those fuels include oil produced from shale and tar sands and gas from geopressurized brine, Devonian shale, coal seams and tight formations. Most of the credits appear to be related to gas from coal seams.[103]

[103]Energy Information Administration, *Performance Profiles of Major Energy Producers 1993*, DOE/EIA-0206(93) (Washington DC, January 1995), p. 17.

7. New Technology Credit: Investment Energy Tax Credit

Description

The 10-percent investment tax credit, otherwise known as the business energy tax credit, has been permanently extended as part of the passage of the Energy Policy Act of 1992 (EPACT). Anyone who invests in or purchases qualified solar[104] or geothermal energy property can take the credit, up to 10 percent of the investment or purchase and installation amount, when income tax forms are filed. Only commercial entities can take the credit. (This credit should not be confused with the residential tax credit, which permanently expired in 1985.) The credit cannot be claimed for property used mainly outside the United States, used by governmental units and foreign persons and entities, or used by a tax-exempt organization (unless the property is used mainly in an unrelated trade or business).[105]

In 1978, Congress approved the Energy Tax Act of 1978. This act established a 10-percent investment tax credit for photovoltaic (PV) projects, as well as a 15-percent energy tax credit added to an existing 10-percent investment tax credit for solar, geothermal, and wind generation facilities. The Tax Reform Act of 1986 eliminated the 10-percent investment tax credit, extended the energy tax credit until 1988 but reduced that credit from 15 percent to 10 percent, and eliminated wind as a candidate for any credits. The business tax credit was extended on a year-to-year basis until 1992, when the passage of EPACT made the 10-percent business tax credit for solar (PV and thermal) and geothermal permanent (Section 1916).

[104]Solar property eligible for the investment credit uses solar energy to generate electricity, to heat, cool, or provide hot water for use in a structure, or to provide process heat.

[105]The Federal Government also offers a Modified Accelerated Cost Recovery System (MACRS), which allows for a 5-year accelerated depreciation for all solar energy equipment (U.S. Code Citation: 26 USC Sec. 168). Without MACRS, depreciation for such equipment would be done over the standard 20-year period.

Revenue Loss/Outlays

Estimated Revenue Loss and Outlay Equivalent, 1987-2004[106]
(Million Nominal Dollars)

Fiscal Year	Revenue Loss			Outlay Equivalent[a] (Total)
	Individuals	Corporations	Total	
1987	10	140	150	180
1988	0	80	80	95
1989	0	80	80	110
1990	0	75	75	110
1991	0	75	75	110
1992	0	45	45	65
1993	0	55	55	85
1994	0	60	60	80
1995	0	30	30	195
1996	0	60	60	40
1997	0	25	25	80
1998	0	30	30	30
1999	0	30	[b]30	40
2000	0	35	[b]35	45
2001	0	40	[b]40	50
2002	0	40	[b]40	55
2003	0	35	[b]35	55
2004	0	35	[b]35	40

[a]An outlay equivalent is the amount of the outlay that would be required to provide the taxpayer with the same after-tax income as would be received through the tax preference.

[b]According to the Department of treasury, the investment tax credit portion is one-fourth to one-third of this total; the remainder is the production tax credit, which is discussed in the next fact sheet.

Note: May include unknown amounts that apply to tax expenditure provisions that expired before January 1, 1992, and which were not new technology credits.

Note: All estimates have been rounded to the nearest $5 million.

Sources: **1987-1992:** Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1993* (Washington, DC, 1992). Also earlier editions. **1993-2004:** Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

EPACT contains several provisions that encourage investment in renewable energy technologies by private and public entities. Under the Act, businesses can take a 10-percent business investment tax credit for purchases of solar and geothermal energy property. EPACT made this credit permanent so that solar and geothermal energy industries will no longer be burdened with the prospect of a continually expiring and reinstated credit.

[106]These tax expenditures include a production tax credit for wind-generated electricity. See the next Fact Sheet, "New Technology Credit: Production Tax Credit."

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Qualified solar and geothermal energy property.

Impact

Even with existing incentives, the higher costs of solar and geothermal energy sources have limited their commercial application.

8. New Technology Credit: Production Tax Credit

Description

The Energy Policy Act of 1992 (EPACT) enacted the production tax credit as Section 45 of the Internal Revenue Code of 1986. The credit is phased out if the price of wind-generated electricity is sufficiently high. The production tax credit provides a 1.5 cents per kilowatthour credit (adjusted for inflation) for electricity produced from a facility placed in service after December 31, 1993, and before July 1, 1999, for the first 10 years of the facility's existence. In 1999, the Internal Revenue Service set the production tax credit at 1.7 cents per kilowatthour. Renewable energy sources that qualify for the tax credit are wind and “closed loop” biomass power facilities that utilize biomass grown exclusively for energy production (no closed loop biomass facilities are in operation). The credit is only available if the wind energy equipment is located in the United States and electricity is sold to an unrelated party. Under current law, the tax credit qualification date expired on July 1, 1999. Legislation has been introduced in both Houses of Congress to extend the qualification date for the production tax credit beyond the current expiration date.

Revenue Loss/Outlay

The value of the Production Tax Credit for wind is included in the Investment (Business) Energy Tax Credit values in the preceding fact sheet.

Rationale

Wind is a clean, renewable energy source that may help to protect public health, secure a cleaner environment, enhance America's national security through energy independence, and reduce pollution. The credit is intended to enhance the development of technology to utilize wind energy sources and to promote competition between wind energy sources and conventional energy systems.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Wind and closed loop biomass.

Impact

Since its inception, the production tax credit has supported wind energy development and production. A number os States, including California, Minnesota, and Iowa, have had a number of new wind turbines installed prior to the expiration of the tax credit on July 1, 1999. However, the production tax credit alone may have been insufficient to spur the growth of wind power. Other forces have also contributed to the growth in wind power, including State incentives and mandates, research and development, testing programs, and green power or other environmental programs. Although wind is not yet cost competitive with other energy sources, the growth in wind power is helping the industry to become more cost competitive.

9. Renewable Transportation Fuels: Ethanol

Description

Federal financial incentives for renewable fuels in the transportation sector, strictly speaking, are limited to ethanol. Ethanol is produced from grain crops, with corn being the primary feedstock. The main use of ethanol is for gasohol (a blend of 90 percent unleaded gasoline and 10 percent ethanol, E-10) and for lower blends of ethanol to meet oxygenated gasoline requirements. Ethanol used in gasohol and other oxygenated gasoline blends meets the definition of a replacement fuel, but not of an alternative fuel. Two higher blends of ethanol, E-85 and E-95 are being used as alternative fuels in limited amounts. The value of the tax expenditure for renewable transportation fuels is $15 million in fiscal year 1999.

The Federal tax code contains four overlapping tax incentives for ethanol: the 5.4 cents per gallon excise tax exemption, the 54 cents per gallon blender's tax credit, the 10 cents per gallon small ethanol production tax credit, and the alternative fuels production tax credit. The tax credit continues at 54 cents per gallon through 2000, then drops to 53 cents per gallon in 2001-2002, 52 cents per gallon in 2003-2004, and 51 cents per gallon in 2005-2007. Because the tax credit applies to the ethanol component of the fuel, the effective credit for ethanol blends is a function of the ethanol percentage in the blend. Gasohol, for example, is typically 10 percent ethanol and 90 percent gasoline. A credit of 54 cents per gallon for the ethanol translates into a credit of 5.4 cents per gallon for the 10-percent ethanol blend.

The alcohol fuel income tax credit and its associated excise tax credit were initially implemented in the early 1980s. The income tax credit was initially 40 cents per gallon minus the amount of excise tax exemption, which was 4 cents per gallon. Some changes have been made since that time. The most recent resulted from the Omnibus Budget Reconciliation Act (OBRA) of 1990, which reduced the income tax credit from 60 cents per gallon to 54 cents per gallon. The excise tax credit was also reduced, from 6 cents per gallon to 5.4 cents per gallon. The 1990 OBRA also introduced the small producer income tax credit of 10 cents per gallon. These provisions went into effect on January 1, 1993. The value of the $725 million excise tax exemption on taxable motor gasoline mixed with ethanol is far greater than the $15 million ethanol tax expenditure cited above.

Revenue Loss/Outlays

The “Revenue Loss” data in the tabulation below were generated by the U.S. Treasury Department. They are the difference between estimated Federal income tax payments in a reference case and estimated actual Federal income tax payments. The reference case assumes that no income tax credits are granted. The actual case assumes that the income tax credit exists and that the excise tax credit remains in effect.

Estimated Revenue Loss and Outlay Equivalent, 1987-2004
(Million Nominal Dollars)

Fiscal Year	Revenue Loss			Outlay Equivalent[a] (Total)
	Individuals	Corporations	Total	
1987	([b])	5	5	10
1988	([b])	5	5	10
1989	0	([b])	([b])	([b])
1990	0	([b])	([b])	([b])
1991	0	0	0	0
1992	0	80	80	80
1993	10	10	20	20
1994	10	10	20	20
1995	5	5	10	10
1996	5	5	10	10
1997	10	10	20	20
1998	5	10	15	15
1999	5	10	15	15
2000	5	10	15	15
2001	5	10	15	15
2002	5	10	15	15
2003	5	10	15	15
2004	5	10	15	15

[a]An outlay equivalent is the amount of the outlay that would be required to provide the taxpayer with the same after-tax income as would be received through the tax preference.
[b]Less than $2.5 million.
NA = not available or not applicable.
Note: All estimates have been rounded to the nearest $5 million.
Sources: **1987-1993:** Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1993* (Washington, DC, 1992). Also earlier editions. **1994-2004:** Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

The Energy Policy Act of 1992 (EPACT) sets a national goal to displace 10 percent of the petroleum content of light-duty motor vehicle fuels by 2000. For 2010, the goal is 30 percent. The alternative fuels specified in EPACT that may replace petroleum are natural gas, methanol, ethanol, propane, electricity, hydrogen, and certain other fuels that may be developed in the future. In addition, the Clean Air Act Amendments of 1990 (CAAA90) require that, beginning in 1998, 30 percent of new vehicles purchased by centrally fueled fleets in certain pollution nonattainment areas[107] must use "clean fuels," as well as meeting more stringent tailpipe emission standards. The requirement increases to 70 percent of all fleet vehicles by 2000. Clean fuels include alternative fuels as well as other fuels such as biodiesel. The emphasis in EPACT was to encourage the purchase of "alternative fueled vehicles" (AFVs) in fleets and the

[107]Initially, the areas affected included 19 States and 22 designated high-pollution geographic areas.

establishment of alternative refueling facilities. Accordingly, most of the EPACT alternative fuel incentives are indirect—principally mandating the purchase of AFVs in certain fleets.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Ethanol production and alternative fueled vehicles.

Impact

Even with existing incentives, E-85 is not competitively priced with gasoline on a per-Btu basis. Any short-term increase in E-85 (or E-95) consumption is therefore likely to be motivated either by environmental considerations or as a consequence of fulfilling EPACT's AFV mandates.

10. Excess of Percentage Over Cost Depletion: Oil, Gas, and Other Fuels

Description

Independent oil and gas producers and royalty earners, and all producers and royalty owners of certain other natural resources, including mineral fuels, may take percentage depletion deductions rather than cost depletion deductions to recover their capital investments. Under cost depletion, the annual deduction is equal to the unrecovered cost of acquisition and development of the resource times the proportion of the resource removed during that year. Under percentage depletion, taxpayers deduct a percentage of gross income from resource production at rates of 10 percent for coal; 15-percent for oil, gas, oil shale and geothermal deposits; and 22 percent for uranium. However, two special provisions apply to oil and gas. First, percentage depletion for independent producers and royalty earners is limited to 1,000 barrels per day. Second, the 15 percent rate is increased by 1 percentage point for each dollar that the average wellhead price of domestically produced crude oil is less than $20 a barrel. The maximum increase allowed is 10 percentage points. This special provision applies only to oil and gas wells with marginal production, generally defined to include production from stripper wells and from wells substantially all of whose production is heavy oil. Marginal production eligible for the higher rate has a prior claim on the 1,000 barrel per day limitation.

The percentage depletion deductions based on gross income are subject to net income limitations. The annual deduction is limited to 100 percent of net income from the property for oil and gas and 50 percent of net income for other mineral fuels. Since percentage depletion is based on gross income, the resultant allowances can exceed the actual acquisition and development costs for the property from which the resource is extracted.

Percentage depletion for oil and gas properties became law in 1926. It was extended to most other minerals, including mineral fuels, in 1932. Whoever is eligible for percentage depletion must use it rather than cost depletion. This provision reduces the tax burden on independent oil and gas producers and royalty owners by repealing, for them, the excess percentage depletion tax preference for oil and gas for taxable years beginning after December 31, 1992. Excess preferences are preferences that are added back to the regular tax base in calculating income tax liabilities under the alternative minimum tax (AMT) system. The oil and gas provisions have been changed several times since they were first introduced in 1926.

Revenue Loss/Outlays

The “Revenue Loss” data in the tabulation below were generated by the U.S. Treasury Department. They are the difference between estimated Federal income tax payments in a reference case and actual Federal income tax payments. The reference case assumes that cost depletion is used. The actual case assumes that percentage depletion is used.

Estimated Revenue Loss and Outlay Equivalent: Oil, Gas, and Other Fuels,[a] 1987-2004
(Million Dollars)

Fiscal Year	Revenue Loss			Outlay Equivalent[b] (Total)
	Individuals	Corporations	Total	
1987	595	345	940	1,360
1988	385	205	590	895
1989	320	205	525	740
1990	550	245	795	1,080
1991	470	245	715	975
1992	490	255	745	1,025
1993	265	830	1,095	1,540
1994	265	845	1,110	1,565
1995	265	800	1,165	1,500
1996	275	830	1,105	1,560
1997	285	860	1,145	1,620
1998	55	200	255	285
1999	55	205	260	295
2000	55	210	265	300
2001	55	215	270	310
2002	55	220	275	320
2003	55	225	280	325
2004	55	235	290	335

[a]"Other Fuels" are assumed to be primarily coal.
[b]An outlay equivalent is the amount of the outlay that would be required to provide the taxpayer with the same after-tax income as would be received through the tax preference.
Note: All estimates have been rounded to the nearest $5 million.
Sources: **1987-1996:** Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1996* (Washington, DC, 1996). Also earlier editions. **1997-2004:** Office of Management and Budget, *Analytical Perspectives, 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

Percentage depletion for oil and gas properties was introduced as a substitute for a related provision (discovery-value depletion) that had been adopted for a wide range of resources during World War I to stimulate production, but which was fraught with administrative problems. Discovery-value depletion was based on the market value of the deposit after discovery rather than on the cost of the property, as is done for cost depletion. Congress subsequently extended percentage depletion to a wide range of other minerals to be consistent with the treatment of oil and gas.

Major Energy Form/Fuel Cycle Stage(s) Affected

Crude oil, natural gas, and coal production, as well as minor energy forms, include uranium, oil shale, and geothermal.

Impact

Percentage depletion had the effect of substantially increasing the development of existing property, because the total depletion claimed could exceed the original investment. The increase in output benefitted producers (operators and royalty holders) through increased royalties and higher after-tax profits. Consumers also benefitted as a result of lower prices. The benefits to producers were considered so substantial that beginning in 1969 percentage depletion rates were reduced for oil and gas, major oil and gas companies were excluded from the percentage depletion provisions (1975), and other restrictive measures were adopted.

11. Nuclear Power Plants: Nuclear Energy Research Initiative

Description

In January 1997, the President tasked his Committee of Advisors on Science and Technology (PCAST) to evaluate the current national energy research and development (R&D) portfolio and to provide a strategy to address the Nation's energy and environmental needs for the next century. In the November 1997 report responding to this request, the PCAST Energy Research and Development Panel determined that restoring a viable nuclear energy option to meet future energy needs is important and that a properly focused R&D effort should be implemented by the U.S. Department of Energy (DOE) to address obstacles to achieving this option. These obstacles include issues related to proliferation, economics, nuclear waste, and safety. The panel recommended that technologies to be addressed include, but not be limited to, work on proliferation-resistant reactors or fuel cycles; new reactor designs with higher efficiency, reduced cost, and enhanced safety to compete in the global market; lower output power reactors for applications where larger reactors may not be advantageous; and new techniques for on-site and surface storage and for permanent disposal of nuclear waste.

DOE created the Nuclear Energy Research Initiative (NERI) to address and help overcome the technical and scientific obstacles to the future use of nuclear energy in the United States. NERI is also expected to help preserve the nuclear science and engineering infrastructure within the Nation's universities, laboratories, and industry to advance the state of nuclear energy technology and to maintain a competitive position worldwide. DOE believes that, in funding creative research ideas at the Nation's science and technology institutions and companies, solutions to important nuclear issues will be realized, and a new potential for nuclear energy in the United States will emerge.

NERI R&D will involve scientific and engineering research, development, and demonstrations designed to produce advanced technologies that address nuclear energy's key issues. The primary areas in which the DOE will seek research proposals in fiscal year 1999 include:

- Proliferation-resistant reactor and fuel technologies
- New high-efficiency reactor designs
- Advanced low-power reactor designs and applications
- New technologies for on-site and surface storage of nuclear waste
- Advanced nuclear fuel
- Fundamental nuclear science and technology.

The NERI program features a competitive, peer-reviewed R&D selection process to fund researcher-initiated R&D proposals from universities, national laboratories, and industry.

The Department's response to the PCAST recommendations proposed the Nuclear Energy Plant Optimization (NEPO) program in coordination with the Electric Power Research Institute (EPRI) and NERI. Congress approved funding for the NERI program in fiscal year 1999 but denied funding for NEPO. The goal of NEPO is to develop and demonstrate technologies that can enhance safe, reliable, and economic operation of U.S. nuclear power plants through their current and renewed license terms. The Department has included both programs in its budget request for 2000.

DOE will continue to support the NERI program to stimulate innovative research at U.S. universities and provide for a modest increase in the reactor upgrade program to improve the operation and maintenance of U.S. university research reactors. The Department will support education and research grants; supply fresh fuel to and transport spent fuel from university research reactors; fund reactor equipment upgrades; and continue the conversion of university reactor fuel cores from highly enriched uranium to low-enriched uranium.

The fiscal year 2000 request provides for a new Nuclear Energy Plant Optimization (NEPO) activity to cooperate with industry in developing advanced technologies to enhance the long-term operability of U.S. nuclear power plants. NEPO will accomplish two major tasks:

- Laboratory benchmark of technology to reduce stress crack corrosion in nuclear plant components
- Demonstration of a prototype method for nondestructive measurement of steam generator tube cracking.

Revenue Loss/Outlay

The appropriation for these programs is $30 million in fiscal year 1999: $19 million for NERI and $11 million for university research. The fiscal year 2000 request for NEPO is $5.0 million (nominal dollars).

Rationale

The primary mission of the NERI is the long-term advancement of nuclear energy science. As a result, NERI will address both innovative technologies that can be developed and implemented over the next 10 years and revolutionary technologies that can be implemented over the next 30 years.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Nuclear energy.

Impact

The NERI sponsors new and innovative scientific and engineering research and development to address the key issues affecting the future of nuclear energy, and to preserve our nation's nuclear science and technology infrastructure. In accomplishing this goal, the following objectives have been established for the NERI program: develop advanced reactor and fuel cycle concepts and scientific breakthroughs in nuclear technology to overcome scientific and technical obstacles to expanded future use of nuclear energy in the United States, including issues involving nuclear proliferation, unfavorable economics, and nuclear waste disposition; advance the state of U.S. nuclear technology to maintain a competitive position in overseas and domestic markets; and promote and maintain nuclear science and engineering infrastructure to meet future technical challenges and improve the performance, efficiency, reliability, economics, and other attributes to enhance nuclear energy applications.

Fulfillment of these objectives will provide advanced technologies that will allow nuclear energy to become a significant global source of electricity in the 21st century. In addition, it will allow the United States to retain its technical competence and human resource and knowledge base and strengthen its world leadership position in nuclear energy technology and the underlying sciences.

12. Waste/Fuel/Safety (Environmental Management)

Description

After the Department of Energy (DOE) ceased most nuclear weapons production operations in the late 1980s, it established a program to manage the legacy of contamination resulting from the operation of the largest government-owned industry. DOE manages thousands of contaminated areas and buildings, huge waste volumes, and nuclear materials left over from the nuclear weapons production and process and nuclear-related research efforts. In 1996, the Department began working toward a goal of completing cleanup at as many sites as possible by the end of the decade. In fiscal year 1998, Congress established the Non-Defense Environmental Management appropriation (formerly part of the Energy Supply Research and Development appropriation). The mission of the Non-Defense Environmental Management Program—to clean up as many of its contaminated sites as possible by 2006—did not change.

Revenue Loss/Outlay

The Non-Defense Environmental Management fiscal year 1999 budget request of $466.6 million is a $30.0 million (6 percent) decrease from the fiscal year 1998 budget request (see Appendix C, Table C2).

Rationale

Thousands of contaminated areas and buildings now exist. The goal of this program is to clean up and close as many sites as possible by 2006. After cleanup there will be no further DOE presence, with the exception of long-term surveillance and maintenance.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Nuclear contamination.

Impact

Fiscal year 1999 marks the first year in which the budget structure is aligned with the 2006 plan process. DOE expects sites within this account to be in compliance with applicable environmental and other requirements.

13. Fusion Energy Sciences

Description

The Fusion Energy Sciences program is a broad-based, fundamental research effort, geared to produce scientific knowledge and technical benefits in the near term and to provide the science base for a fusion energy option in the long term. Cross-cutting and interrelated objectives of the Fusion Energy Sciences program include: understanding the physics of plasmas, the fourth state of matter; identifying and exploring innovative and cost-effective development paths to fusion energy; and exploring the science and technology of energy-producing plasmas, the next frontier in fusion research, as a partner in an international effort.

The Fusion Energy Sciences budget is divided into three subprograms: Science, Facility Operations, and Enabling R&D. The Science subprogram includes research funds for plasma science and the development of improved confinement concepts. Funds for building and operating major experimental facilities are in the Facility Operations subprogram. The Enabling R&D subprogram includes funds for establishing the scientific foundation which underlies current advances in fusion technology and provides technological capabilities and innovations needed to advance plasma science and develop the knowledge base for an attractive fusion energy source.

Revenue Loss/Outlay

The fiscal year 1999 appropriation is $223 million, allocated approximately as follows: Science, $119 million; Facilities Operations, $61 million; Enabling R&D, $43 million. The appropriation was $217 million in fiscal years 1997 and 1998. (All figures are in nominal dollars.)

Rationale

The introduction of fusion energy power plants could provide an economical and secure electricity supply while reducing the environmental impacts of increasing worldwide demands for electricity. The Fusion Energy Sciences program supports DOE's strategic goal of delivering the scientific and technological innovations critical to meeting the Nation's energy challenges.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Nuclear energy.

Impact

The goal of the Fusion Energy Sciences program is to “acquire the knowledge base for an economically and environmentally attractive fusion energy source.” Although there is not a schedule for developing and deploying fusion energy systems the availability of fusion as an option for large central station power plants would be valuable insurance against possible environmental concerns about fossil and nuclear energy. In addition, there may be nearer term applications of fusion in transmutation of wastes and isotope production.

14. Basic Energy Research

Description

Basic Energy Research includes research in the natural sciences and engineering leading to new and improved energy technologies. It also includes understanding and mitigating the environmental impacts of energy technologies; a science base for identifying, understanding, and anticipating the long-term health and environmental consequences of energy production, development, and use; and advanced computing research, including operation of supercomputers, networks, and related facilities for analysis, modeling, simulation, and prediction of complex phenomena. Associated activities include support laboratory infrastructure management, evaluation of research programs, and construction and operation of scientific facilities. In the high energy and nuclear physics area, funds are used for construction of new facilities. The Life Sciences subprogram supports the Human Genome program. In the environmental area, funds will be used to develop advanced environmental remediation tools. Within the Climate Change Technology Initiative the focus will be on energy-efficient technologies, energy utilization, carbon sequestration, and photosynthesis. The Computational and Technology Research will support the Next Generation Internet initiative.

Revenue Loss/Outlay

Outlays for basic energy sciences excluding fusion were about $2.0 billion in fiscal year 1998 and are expected to be $2.5 billion in fiscal year 1999. The request for fiscal year 2000 is $2.2 billion. In fiscal year 1998, $0.5 billion was allocated for Environmental / Health / Safety. (All figures are in nominal dollars.)

Rationale

Government generally undertakes basic research where commercial payoffs are uncertain, long-term, or unavailable to the public. Private, for-profit organizations may invest insufficient amounts in basic research, especially in an era of increased economic competition.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Nuclear energy and others.

Impact

If the results of basic research follow in the pattern of previous discoveries, then benefits of the associated applied technological advances will be felt in the future. It is difficult, however, to assess such benefits against the dollars allocated to the programs in the present. Ultimately, it is hoped that increased understanding of fundamental processes will reap applications that improve the energy sources and technologies that are in use today.

15. Clean Coal Technology Program

Description

Public Law 99-190 (1985) provided funds from the Energy Security Reserve in the Department of Treasury for a Clean Coal Technology (CCT) Program in the Department of Energy (DOE). The program was authorized under the Clean Coal Technology Reserve proviso of P.L. 98-473 to subsidize the construction and operation of facilities to demonstrate the potential commercial feasibility of such technologies. Cost-shared (e.g., with the Electric Power Research Institute) innovative CCT projects demonstrate technologies appropriate for replacing, retrofitting, or modernizing existing coal-fired facilities to provide significantly reduced emissions. The provisions of cost-sharing allow the Government to recoup investments if the technologies achieve commercialization.

Revenue Loss/Outlay

Congress has appropriated $2.3 billion for the CCT Program. As of September 30, 1998, the program consisted of 40 active or completed projects. The 40 projects have resulted in a combined commitment by the Federal Government and the private sector of $5.7 billion. DOE has obligated $1.9 billion to date. (All figures are in nominal dollars.)

In fiscal year 2000, only two projects are expected to have outstanding obligation commitments: the Clean Energy Demonstration Project in Southern Illinois and the CPICOR combined steelmaking and generation project planned for Geneva, Utah. DOE's current projections are that neither of these two projects will require funding allotments from previous appropriations in fiscal year 2000, and consequently $246 million can be deferred into future years. Program outlays were $77 million in fiscal year 1998 and are estimated to be $183 million in fiscal year 1999. (All figures are in nominal dollars.)

Rationale

The purpose of the CCT Program is to speed up the introduction of technologies that use low-cost coal, while ensuring that progress toward meeting air quality goals is made.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Coal combustion.

Impact

The CCT Program has demonstrated a portfolio of technologies that have improved the economic and environmental performance of coal technologies for electricity generation and for industrial processes.

16. Coal Research and Development

Description

Coal research and development (R&D) projects are supported by funding in the Office of Fossil Energy, U.S. Department of Energy. The R&D program has three related facets—coal power systems, coal-derived fuels, and advanced research. The Clean Coal Technology (CCT) Program is discussed in the preceding fact sheet. The program includes low-emission boiler systems, coal gasification techniques, fluidized-bed combustion, direct and indirect liquefaction, and long-range research, as well as studies to provide the technological foundation for future coal-related systems. DOE's new "Vision 21" program calls for research on integrated power plants that are equipped with carbon capture and sequestration devices.

Revenue Loss/Outlay

Coal R&D appropriations for 1997 through 1999, excluding the unallocated component, were distributed to technology programs as follows (in million nominal dollars):

Program	1997	1998	1999
Advanced Clean Efficient Power Systems	69.3	72.4	87.7
Advanced Clean Fuels	16.2	15.6	15.5
Advanced Research and Technology Development	17.6	17.3	19.9
Total	**103.0**	**105.3**	**123.1**

Rationale

The objective of coal R&D is to provide an adequate scientific and engineering knowledge base to foster technological advances in the private sector. Also, coal-burning power plants are at the center of the controversies involving acid rain and global warming. New technology may help alleviate these problems.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Coal mining, combustion, liquefaction, and gasification.

Impact

If R&D is successful, improved coal technologies may benefit consumers through reduced electric power costs and improved environmental performance. The Energy Information Administration's *Annual Energy Outlook 1999* reports that coal accounted for 53 percent of total U.S. electricity generation in 1997.

17. Oil Technology Research and Development

Description

The overall approach of oil R&D is, first, to identify those types of oil deposits that have both the greatest potential for improved oil recovery and the greatest risk of abandonment within the next 5 to 10 years and, second, to apply available technologies. The technologies to be further investigated are called secondary and enhanced oil recovery. The first generally involves drilling and improved production methods based on sophisticated geological and geophysical interpretation. Enhanced oil recovery includes the injection of chemicals, gases, or heat to overcome physical barriers in the reservoir.

Revenue Loss/Outlay

Oil R&D appropriations were $49 million in fiscal year 1998 and are expected to be $50 million in fiscal year 1999.

U.S. Department of Energy Oil Research and Development Appropriations, 1995-2000
(Million Nominal Dollars)

Fiscal Year	Appropriation
1995	82
1996	56
1997	46
1998	45
1999	48
[a]2000	50

[a]Estimate for Congressional request.

Sources: U.S. Department of Energy, *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).

Rationale

Enhanced oil recovery research is aimed at capturing a significant portion of the estimated 300 billion barrels left in the ground from past recovery rates and methods. The goal is to preserve access to identified deposits while developing and testing technologies designed to overcome the specific problems that prevent increased oil recovery.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Crude oil production.

Impact

The impact of oil technology R&D is to boost domestic crude oil production from marginal wells.

18. Natural Gas Research and Development

Description

The Department of Energy's (DOE) research and development (R&D) spending focuses on enhanced natural gas production and high-efficiency, low-NO_x turbines. In order to increase domestic production, DOE has funded R&D spending directed at developing and testing new technologies such as hydraulic pulse and underbalanced drilling; improved techniques for imaging and predicting gas production in naturally fractured reservoirs; deep gas production; and revitalizing stripper wells. Secondarily, DOE has also funded R&D directed at increasing gas storage capabilities. DOE is also currently funding an 8-year effort to produce working prototypes of a natural gas turbine for baseload generation that will be 10 percent more efficient and produce less than half the NO_x of current technology systems. Improved fuel cell technology has also been a focus of DOE R&D efforts.

Revenue Loss/Outlay

The 1998 gas R&D appropriation were $103 million in fiscal year 1998. They are expected to be $115 million in fiscal year 1999.

U.S. Department of Energy Natural Gas Research and Development Appropriation, 1995-2000
(Million Nominal Dollars)

Fiscal Year	Natural Gas Research	Fuel Cell Research	Total
1995	27	4	**31**
1996	59	4	**62**
1997	69	49	**117**
1998	63	39	**103**
1999	71	44	**115**
[a]2000	68	38	**105**

[a]Estimate for Congressional request.

Sources: U.S. Department of Energy, *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).

Rationale

Natural gas has become a more attractive fuel in light of the global warming controversy. Its combustion adds less CO_2 to the atmosphere than other fuels. Enhancing the technologically secure reserve of this fuel, while the industry is made more competitive through regulatory changes, can add large potential benefits to the U.S. economy and improve the potential for reducing greenhouse gases.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Natural gas exploration and production.

Impact

The goals of DOE's natural gas R&D are increased gas production, improved storage capabilities, and improved fuel cell and turbine technology.

19. Renewable Energy Technology Research and Development

Description

A mission of the Department of Energy (DOE) is to lead the national effort to support and develop clean, competitive, reliable power technologies for the 21st century. In the field of renewable energy technology, DOE's research and development (R&D) program includes the following activities:

- Encouraging electricity suppliers to choose and deploy renewable energy and energy efficiency technologies on an equitable basis with other supply technologies
- Addressing the technological and institutional constraints that impede the adoption of renewable energy and energy efficiency technologies worldwide
- Working with utility, industry, and other stakeholders to realize the full market potential for renewable energy and energy efficiency technologies, both in the United States and in other countries.

A key strategy in accomplishing the Department's mission is to establish and maintain a renewable energy technology base. The Department works with industry, State and local governments, universities, and the national laboratories to support R&D in photovoltaic, concentrating solar, wind, geothermal, hydropower, and biomass power and biofuels technologies and systems. Much of this research is cost-shared with industry, whose contribution is typically 30 to 50 percent of a total project budget, particularly for system hardware development and demonstration. Industry's willingness to share the cost of R&D indicates its belief in the market potential of these technologies and its commitment to commercialize them. In addition to R&D on renewable energy technologies, DOE supports research on electric technologies that complement and enhance the use of renewable energy. These include energy storage technologies, hydrogen, high-temperature superconductivity, and reliability in the transmission and distribution of electricity.

Revenue Loss/Outlay

The fiscal year 1999 budget for renewable energy technology R&D is approximately $327.2 million, distributed as follows: wind, solar photovoltaic, concentrating solar power, and solar buildings, $133.9 million; biomass and biofuels, $95.5 million; electricity technologies, $44.1 million; geothermal, $28.5 million; hydroelectric, $3.3 million; and unallocated, $22.0 million. The fiscal year 1997 appropriation was $269.6 million, and for fiscal year 1998 the appropriation was $313.8 million (nominal dollars).

Rationale

Renewable energy systems are a domestic resource alternative that can help meet the Nation's increasing energy needs. Renewable energy resources (such as the sun, wind, biomass, geothermal energy, and falling water) have characteristics that make them attractive from a national policy perspective:

- Renewable resources are inexhaustible, which means that they represent a sustainable energy choice (using them today will not limit opportunities for future generations to use them).

- Renewable resources are wholly domestic, so they can be used without interference from, or manipulation by, foreign entities.

- As energy conversion systems for renewable resources can be designed and built domestically, they can create jobs and economic growth in the United States.

- Renewable energy systems create very little air pollution, so their use helps the United States meet national environmental and global climate change goals.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Electricity and renewable energy.

Impact

Renewable energy R&D has contributed to performance and cost improvements in several technologies over the past two decades. For example, the cost of electricity from wind energy today is about 4 to 5 cents per kilowatthour, depending on the quality of the wind resource. This is an eight- to ninefold reduction in costs from 1980 levels of 35 to 40 cents per kilowatthour. Similarly, the cost of electricity from photovoltaic systems has fallen from about $1.00 per kilowatthour in 1980 to about 25 to 30 cents per kilowatthour today in regions with the best solar potential. DOE's goal is to reduce the costs of these technologies even further: to 2.5 to 3.5 cents per kilowatthour for electricity from wind, 12 to 20 cents per kilowatthour for electricity from photovoltaics, less than 8 cents per kilowatthour for electricity from concentrating solar power systems, 5 to 6 cents per kilowatthour for electricity from biomass, and 4.5 cents per kilowatthour for electricity from geothermal resources. Hydropower is already an abundant and relatively inexpensive source of electricity. The hydropower R&D focuses on making hydroelectric power plants more compatible with aquatic life and other uses that share water resources.

20. Advanced Turbine Systems

Description

There is a growing national need for increased electricity and reduced emissions from electric power generating plants. The objective of the Advanced Turbine Systems (ATS) program is to develop ultra-high-efficiency gas turbine systems for utilities, independent power producers, and industrial markets. The ATS program is striving for revolutionary, yet achievable advances that include: industrial turbine systems for distributed power generation that will show a 15-percent improvement over today's best gas turbine systems; and large central power plants for utility systems that will break the 60-percent barrier in net thermal efficiency.

Revenue Loss/Outlay

The fiscal year 1999 appropriation for ATS research and development is $33 million. The appropriation was $35 million for fiscal year 1998 and $25 million for fiscal year 1997. (All figures are in nominal dollars.)

Rationale

There is a growing need for increased electricity and reduced emissions from electric power generating plants. The availability of affordable energy will be essential to the Nation's economic strength in the coming decades. To continue to enjoy the economic benefits of lower cost energy, ensure a reliable energy supply, and minimize the impact on the environment, advances in fossil fuel technology are needed. Although renewable energy technology is starting to penetrate the electricity generation market, fossil fuels will be the dominant energy source for the foreseeable future.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Natural gas combustion.[108]

Impact

Advanced gas turbine systems have higher efficiencies and burn less fuel, resulting in lower operating costs and lower electricity prices as well as improved environmental performance. Because of their high efficiency, advanced turbine systems emit less carbon dioxide than other competing fossil-fueled technologies, thus providing an alternative for meeting future electrical demands while minimizing contributions to global warming.

[108]Although the ATS program will demonstrate performance with natural gas fuel, advanced turbine design systems will make use of fuels other than natural gas, such as coal and renewable biomass.

21. Abandoned Mine Reclamation Fund

Description

This fund is designated for carrying out the provisions of Title IV of the Surface Mining Control and Reclamation Act (SMCRA) of 1977. The Office of Surface Mining in the Department of the Interior is responsible for carrying out the provisions of the Act. There are three major programs. The first program is for State reclamation grants. Each State and Indian Tribe with an approved reclamation program is entitled, subject to appropriation, to receive 50 percent of fund revenues derived from operating mines in that State or Tribal Land. With grants, States and Tribes assume primary responsibility for addressing problems such as subsidence, underground fires, open shafts, and acid drainage in accordance with SMCRA. States with approved reclamation plans are responsible for emergency reclamation. The second program covers Federal reclamation. This activity includes fee collection and assistance to States in developing reclamation programs, abandoned mine lands reclamation projects undertaken directly by the Office of Surface Mining Reclamation and Enforcement for States lacking approved reclamation plans, and the Rural Abandoned Mine Program administered by the Department of Agriculture's Soil Conservation Service. The third program is for small operator assistance payments. This activity provides for payments for authorized services to eligible coal mine operators in preparing applications for mining permits under a permanent State or Federal regulatory program. Services include determining the probable hydrologic consequences of the proposed mining operation and analysis of test borings and core samples. Fees of 35 cents per ton of surface coal, 15 cents per ton of coal mined underground, and 10 cents per ton of lignite are collected from mining operations. Fees are deposited in the Abandoned Mine Lands (AML) Reclamation Fund, which is used to pay the costs of abandoned mine reclamation projects. Since the inception of the fund through fiscal year 1998, Office of Surface Mining has collected $5.1 billion.[109]

Revenue Loss/Outlay

In fiscal year 1998, $198 million was disbursed from the fund, including $142.3 million for State reclamation grants. In addition, $32.6 million was transferred to the United Mine Workers of America Combined Benefit Fund. Estimated Government receipts in fiscal year 1999 total $305 million from reclamation fees. The estimated cash outlay during fiscal year 1999 is $247 million. (All figures are in nominal dollars.)

Rationale

Coal mining has affected more than 1 million acres of land, resulting in health and safety problems. An adequate AML fund ensures that these problems will be abated by providing the financial resources for State, Tribal, and Federal reclamation efforts.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Coal mining.

[109]U.S. Department of the Interior, Office of Surface Mining, *1998 Annual Report* (Washington, DC, 1999).

Impact

The fund is expected to have a positive balance of $1,785 million at the end of fiscal year 1999, indicating that the industry has been paying fees in excess of claims on the fund. Because the costs of producing coal are increased by the fee, coal prices may be increased.

22. Black Lung Disability Fund

Description

The Black Lung Disability Trust Fund consists of all moneys collected from the coal mine industry under the provisions of the Black Lung Benefits Revenue Act of 1977 (P.L. 95-227), as amended, in the form of an excise tax on mined coal. In addition, the fund pays all administrative expenses incurred in the operation of Part C of the Black Lung program. The fund is administered jointly by the Secretaries of Labor, Treasury, and Health and Human Services. The Benefits Revenue Act provides for repayable advances to the fund in the event resources will not be adequate to meet program obligations.

The excise tax is $1.10 per ton for coal from underground mines and 55 cents per ton for coal from surface mines (but no more than 4.4 percent of the coal's selling price). The tax does not apply to lignite and, pursuant to a 1998 U.S. District Court ruling, does not apply to coal sold for export.

Revenue Loss/Outlay

Tax revenues were $636 million in fiscal year 1998 and are projected to be $638 million in fiscal year 1999. Outlays (benefit payments) from the fund were $452 million in fiscal year 1998 and are expected to be $454 million in fiscal year 1999. The fund's balance was a negative $5,837 million at the end of fiscal year 1998 and a negative $6,218 million at the end of fiscal year 1999. The Black Lung Disability Trust Fund is in deficit because, in the past, benefit payments exceeded tax receipts credited to the fund. Under present law, the Trust Fund owes interest on past borrowing. Outlays are estimated to total $1,021 million in fiscal year 1999, including benefit payments ($454 million), other services ($51 million), and interest on advances ($516 million). (All figures are in nominal dollars.)

Rationale

These monies are expended to pay compensation and medical and survivor benefits to eligible miners and their survivors, where mine employment terminated prior to 1970 or where no mine operator can be assigned liability.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Coal mining.

Impact

The excise tax on coal is expected to put some upward pressure on the prices of mined coal. However, current coal prices are relatively low, and the small increase in the price does not affect demand significantly. Approximately 90 percent of domestic coal consumption in 1998 was for electricity generation.[110]

[110]Energy Information Administration, *Annual Energy Review 1998*, DOE/EIA-0384(98) (Washington, DC, August 1999).

23. Nuclear Waste Fund

Description

The Nuclear Waste Policy Act of 1982 established the Federal Government's responsibility and statutory framework to provide permanent disposal of commercially generated spent nuclear fuel and the high-level radioactive waste generated by the Nation's nuclear defense activities. The Department of Energy (DOE), as directed by the Act, initially undertook a national screening exercise to evaluate candidate repository sites. In 1986, at the conclusion of this scientific screening activity, DOE recommended three sites to the President for further study as potential repositories. Congress, however, in the Nuclear Waste Policy Amendments Act of 1987, directed DOE to investigate only one site—Yucca Mountain, Nevada—for possible development as a geologic repository.

The Conference Report to the fiscal year 1997 Energy and Water Appropriations Act directed DOE to complete a Viability Assessment for the Yucca Mountain site. This report was completed and sent to Congress in December 1998. The program continues to build on the momentum achieved over the past 4 years. DOE is planning to complete the Draft Environmental Impact Statement for Yucca Mountain In fiscal year 1999, and, in fiscal year 2000, issue the Final Environmental Impact Statement. The completion of these major program objectives will be followed by (1) a decision by the DOE Secretary whether to recommend the Yucca Mountain site to the President in 2001, if the site is found to be suitable; and (2) if recommended, submission of a license application for the construction of a repository to the Nuclear Regulatory Commission in 2002.

Revenue Loss/Outlay

The fund is paid for by the users of the disposal service. The funding for the program's activities are appropriations principally from two sources: the Nuclear Waste Disposal Appropriation and the Defense Nuclear Waste Disposal Appropriation. The budget requests a total of $409 million in budgetary resources for the Civilian Radioactive Waste Management Program in fiscal year 2000. This sum includes a request for new budget authority totaling $370 million, as well as a request that an additional $39 million be provided from $85 million in unobligated balances remaining in the 1996 Defense Nuclear Waste Disposal Appropriation (Public Law 104-46) and transferred to the Nuclear Waste Disposal account for fiscal year 2000. The fiscal year 1998 appropriation was $346 million, and the fiscal year 1999 appropriation is $358 million. (All figures are in nominal dollars.)

Cash outlays from the Nuclear Waste Fund total $182 million in 1998, an estimated $183 million in 1999, and an estimated $256 million in 2000. Estimated receipts from electric utilities were $600 million in fiscal year 1998 and $642 million in fiscal year 1999. (All figures are in nominal dollars.)

Rationale

A permanent repository site will enable the Nation to continue to demonstrate leadership and advance nonproliferation goals by moving forward with its plans for the disposition of nuclear waste. The Federal Government can provide the leadership in developing and implementing strategies to accomplish this mission that assure public and worker health and safety, protect the environment, merit public confidence, and are economically viable.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Nuclear power waste storage.

Impact

The Nuclear Waste Policy Act of 1982 directed that activities associated with the management and disposal of civilian spent nuclear fuel conducted under the Act be funded through fees on the commercial generation of nuclear power. The fee was set initially at 1.0 mill per kilowatthour, to be deposited into the Nuclear Waste Fund. The Secretary of Energy is directed to review the fee amount annually to determine its adequacy to meet Federal Government costs of managing civilian spent nuclear fuel, and to propose adjustments as needed to ensure full cost recovery. Costs associated with the disposal of high-level radioactive waste from defense activities are to be paid by the Federal Government. As the costs of generation from nuclear power are increased by contributions to the fund, electricity prices may increase. The increase in the cost of generation spread over generation from all energy sources represents about 0.02 cents per kilowatthour.

24. Uranium Enrichment Decontamination and Decommissioning Fund

Description

The Uranium Enrichment Decontamination and Decommissioning Fund was established by the Energy Policy Act of 1992 (EPACT) to carry out environmental management responsibilities at the Nation's three gaseous diffusion plants, located in the East Tennessee Technology Park in Tennessee, at the Portsmouth site in Ohio, and at the Paducah site in Kentucky. EPACT also directs that this fund be used to reimburse licensees operating uranium or thorium processing sites for the costs of environmental cleanup at those sites, subject to a site-specific reimbursement limit.

The Uranium Enrichment Decontamination and Decommissioning Fund is an integral and necessary component of legislation to privatize uranium enrichment activities in the United States. The fund addresses the cleanup liabilities at the three gaseous diffusion plants that are attributable to past Department of Energy (DOE) operations for weapons and commercial fuel. The future operations of the enrichment facilities will be managed by the commercial United States Enrichment Corporation (USEC). Ultimate cleanup of the facilities that are leased from DOE by the USEC will commence when operations are completed and the leases are terminated. The Decontamination and Decommissioning Fund includes contributions from annual budget appropriations and contributions from commercial utilities based upon historical enrichment services, measured in “separative work units.”

Revenue Loss/Outlay

Cash income during fiscal year 1999 is estimated at $645 million (nominal dollars), with governmental receipts from assessments of $171 million, earnings of investments at $76 million, and transfers from the General Fund at $398 million. Outlays are projected to be $223 million.

Rationale

The goal of the Uranium Enrichment Decontamination and Decommissioning Fund is to clean up the surplus enrichment plants as soon as possible and reimburse licensees for their remediation activities at uranium and thorium sites. The enrichment plants include valuable facilities and equipment, and the cleanup costs will be offset to the extent that DOE is able to recover the value from these surplus assets. The Department plans to “re-industrialize” the surplus sites and infrastructure, which will reduce the Department's cleanup cost and will transfer the surplus Federal facilities to private-sector firms for productive re-use. In this way, the local socioeconomic impacts of shutting down these facilities will be offset by increased commercial job creation.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Nuclear power waste storage.

Impact

Licensees are subject to an annual assessment for 15 years based on their *pro rata* share of past enrichment services. The costs are recorded as a fuel cost and are recovered through electricity customer rates.

25. Leaking Underground Storage Tank Fund

Description

The Leaking Underground Storage Tank Fund, authorized by the Superfund Amendments and Reconciliation Act of 1990 and administered by the U.S. Environmental Protection Agency (EPA), provides funds for responding to releases from leaking underground petroleum tanks. It is financed by a tax of 0.1 cent per gallon on motor fuels, effective January 1, 1987.

Revenue Loss/Outlay

Outlays from this fund were $62 million in fiscal year 1998 and are expected to be $67 million in fiscal year 1999. The fund's balance was $1,255 million at the end of fiscal year 1998 and is expected to be $1,466 million at the end of fiscal year 1999. Government receipts from the excise tax are $212 million in fiscal year 1999.

Estimated Outlay Equivalent and End-of-Year Balance, 1987-2000
(Million Nominal Dollars)

Year	Outlays	End-of-Year Balance
1987	NA	NA
1988	NA	NA
1989	NA	NA
1990	59	NA
1991	66	468
1992	87	578
1993	80	677
1994	70	799
1995	70	1,040
1996	46	1,057
1997	67	1,071
1998	62	1,255
1999	67	1,466
2000	69	1,655

NA = not available or not applicable.
Source: Office of Management and Budget, *Budget of the United States Government, Appendix 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

The fund acts as insurance in the case of leakages from underground storage tanks.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Oil storage.

Impact

Consumers and producers of motor fuels are affected by the increased price implied by the tax.

26. Oil Spill Liability Fund

Description

Although the Oil Spill Liability Fund is administered by the Department of the Interior, monies in the fund are used to finance oil pollution prevention and cleanup responsibilities by various Federal Agencies. The Omnibus Budget Reconciliation Act of 1989 (Public Law 101-239) triggered the collection of a 5-cent tax on each barrel of oil produced domestically or imported, to be deposited in the fund. The authority to collect this tax expired on December 31, 1994.

Revenue Loss/Outlay

Outlays for this fund were $48 million in fiscal year 1998 and are estimated to be $52 million in fiscal year 1999. The fund's balance was $1,076 million at the end of fiscal year 1998 and $1,035 million at the end of fiscal year 1999.

Estimated Outlay Equivalent and End-of-Year Balance, 1987-2000
(Million Nominal Dollars)

Year	Outlays[a]	End-of-Year Balance
1990	42	366
1991	41	647
1992	66	894
1993	66	1,148
1994	49	1,074
1995	61	1,121
1996	61	1,119
1997	62	1,091
1998	48	1,076
1999	52	1,035
2000	48	1,303

[a]Trust fund share of expenses.

Source: Office of Management and Budget, *Budget of the United States Government, Appendix 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

The purpose of the Oil Spill Liability Fund is to aid in the prevention or remediation of potentially damaging oil spill events.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Oil transportation.

Impact

It is often the case that prevention is cheaper than remediation. To the extent that the fund wards off or minimizes oil-spill damages through its spending on prevention, the problem is solved in a less expensive manner. The tax tends to increase the prices of oil products and thereby reduce petroleum consumption.

27. Pipeline Safety Fund

Description

The Research and Special Programs Administration of the Department of Transportation is responsible for this fund. Monies in the fund are used to conduct the functions of the pipeline safety program and for grants-in-aid to carry out a pipeline safety program, as authorized by Section 5 of the Natural Gas Safety Act of 1968 and the Hazardous Liquid Pipeline Safety Act of 1979. Activities include enforcement programs, research and development, and grants for State pipeline safety programs.

Revenue Loss/Outlay

Outlays for this fund were $34 million in fiscal year 1998 and are expected to be $36 million in fiscal year 1999. The fund's balance was $18 million at the end of fiscal year 1998 and is expected to be $16 million at the end of fiscal year 1999. Estimated receipts from pipeline safety user fees are $29 million.

Estimated Outlay Equivalent and End-of-Year Balance, 1987-2000
(Million Nominal Dollars)

Year	Outlays	End-of-Year Balance
1987	NA	17
1988	5	17
1989	10	18
1990	9	18
1991	12	17
1992	14	18
1993	14	17
1994	14	19
1995	22	19
1996	34	20
1997	34	20
1998	34	18
1999	36	16
2000	37	16

Source: Office of Management and Budget, *Budget of the United States Government, Appendix 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

The public interest in pipeline safety calls for Government intervention.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Oil and natural gas transportation.

Impact

To the extent that collections do not cover all expenses, the fund underwrites pipeline safety.

28. Aquatic Resources Trust Fund

Description

This trust fund consists of two accounts: (1) the Sport Fish Restoration Account, which provides for the restoration and management of fish with material value in sport or recreation; and (2) the boating safety account, which provides for public access to marine sites, emergency search-and-rescue assistance, waterway markers, boating navigation, and boating education and law enforcement. The trust fund receives revenues from excise taxes imposed on sport fishing equipment, electric outboard motors, and sonar devices suitable for the location of fish. A 14 cent excise tax is levied on gasoline and special motor fuels used in motorboats and small engines.

Revenue Loss/Outlay

The motor boat fuel tax portion of the Aquatic Resources Trust Fund amounted to $146 million in fiscal year 1998 and is expected to amount to $205 million in fiscal year 1999. Receipts in fiscal year 2000 are expected to total $172 million.

Estimated Outlay Equivalent, 1987-2000
(Million Nominal Dollars)

Year	Motor Boat Fuel Tax
1987	NA
1988	NA
1989	111
1990	112
1991	118
1992	192
1993	213
1994	238
1995	244
1996	250
1997	255
1998	146
1999	205
2000	172

NA = not available or not applicable.
Source: Office of Management and Budget, *Budget of the United States Government, Appendix 2000* (Washington, DC, 1999). Also earlier editions.

Rationale

According to the National Transportation Safety Board, “recreational boating accidents result in the highest number of transportation fatalities annually after highway accidents. Over 900 people are killed each year in boating accidents, and over 350,000 are injured, more than 40 percent of which require treatment beyond first aid. The

number of boats, especially high speed boats, is increasing each year." This fund is used primarily to provide grants to States to help them enforce boating safety laws and expand boating education programs.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Motorboat gasoline consumption.

Impact

Consumers of motorboat gasoline and special motor fuels used in motorboats and small engines pay higher fuel prices that reflect the tax.

29. Price-Anderson Act

Description

The Price-Anderson Act, enacted as a section of the Atomic Energy Act of 1957, provides indemnification to U.S. Department of Energy (DOE) contractors who manage and conduct nuclear activities in the DOE complex. In addition, under the Nuclear Regulatory Commission domain, the Act limits the liability of nuclear plant operators in the event of accidents involving commercial nuclear power plants.

For commercial nuclear power plants, the Price-Anderson Act provides for a two-layer compensation system to pay public liability claims. The first layer consists of a set amount of insurance for each reactor site currently available from the private insurance market. The second is provided by funds made available through an assessment on each licensed reactor of a pro-rated share not to exceed a specified amount. In order to make a larger pool of money available to pay public liability claims, the 1988 amendments to the Act increased maximum secondary insurance assessments from the $5 million (nominal dollars) established in 1975 to $63 million per reactor per incident, to be adjusted for inflation at 5-year increments effective in August. The 1988 amendments also increased potential liability limits to $7.34 billion ($200 million primary insurance and $7.14 billion secondary insurance coverage) per accident. The 1988 amendments extended the Price-Anderson Act for 15 years, to August 1, 2002. With the August 1998 inflation adjustment required by the Act, the maximum retrospective premium will be $83.9 million per reactor per incident. As of September 1999, the nuclear power industry was expected to be insured per incident to a maximum of $9.26 billion (i.e., 108 units holding an operating license for Price-Anderson purposes, multiplied by $83.9 million plus $200 million primary insurance).[111] The number of reactors participating in the Price-Anderson system is important, because most of the total financial coverage derives from the secondary insurance layer. The greater the number of reactors, the greater the coverage and the higher the liability limit. Thus, the Act effectively controls the individual liability and provides a form of subsidized insurance.

DOE is required by the Price-Anderson Amendments Act, a Federal law, to protect its contractors from legal claims that may arise as the result of a nuclear accident that occurs at a DOE facility. Price-Anderson also allows the DOE to establish nuclear safety rules that its contractors must follow, and gives the Department authority to fine contractors for violating those rules.

Revenue Loss/Outlay

There are no associated revenue losses or budgetary outlays at this time. However, Federal outlays could rise if the Federal Government is forced to clean up a nuclear incident in excess of individual liability limits. As the Act limits liability, it reduces the cost of insurance to the owners of nuclear power plants and nuclear activities at DOE sites and, hence, reduces the cost of nuclear power and other nuclear activities.

Rationale

The Price-Anderson Act was enacted into law on September 2, 1957, as Section 170 of the Atomic Energy Act, to meet two basic objectives: remove the deterrent to private-sector participation in atomic energy presented by the threat

[111]U.S. Nuclear Regulatory Commission, *The Price-Anderson Act—Crossing the Bridge to the Next Century: A Report to Congress*, NUREG/CR-6617 (Washington, DC, August 1998).

of potentially enormous liability claims in the event of a catastrophic nuclear accident; and ensure that adequate funds are available to the public to satisfy liability claims if such an accident were to occur.

Major Form(s) of Energy/Fuel Cycle Stage(s) Affected

Nuclear power production and other nuclear activities.

Impact

There is an implied subsidy in the form of reduced insurance premiums per operating unit which reduces the operating costs of commercial nuclear power plants. The Government acts as an insurer for DOE contractors against any finding of liability arising from nuclear activities of the contractor within the scope of the contract. Price-Anderson coverage could become more critical with the significant increase in potential radioactive waste shipment numbers which can be anticipated in both the near and long term. An increase in shipments is likely to stem from a variety of sources, including the decommissioning and decontamination of nuclear reactors, DOE and Department of Defense environmental restoration activities, and shipments of spent nuclear fuel and high-level radioactive waste under the Nuclear Waste Disposal Act.

Appendix C

Federal Energy Research and Development Appropriations

Appendix C

Federal Energy Research and Development Appropriations

The tables in this appendix (C1 through C4) document annual Federal energy research and development appropriations illustrated in Figures 2 through 6 in Chapter 3. The tables also document the allocation of Department of Energy budget line items into the programmatic groupings discussed in Chapter 3. Most of the data are taken from an internal appropriations tally maintained by the Office of the Chief Financial Officer within the Department of Energy. This tally is considerably more detailed than the budget presentations in the *Budget of the United States Government*. As in any data set, however, it is best to know exactly what is being measured. Thus, users of this data set should be aware of the following considerations:

- Data are for appropriations and not for outlays, with the exception of the Clean Coal Technology Program, for which both outlays and appropriations are shown.

- The appropriations shown are for final spending authority, after any subsequent reprogramming and supplemental appropriations have been made. Thus, the figures shown are not necessarily identical with the figures appropriated by the Congress in each year's budget. There were several instances of large-scale reprogramming of Departmental funds in the early 1980s.

- FY 1999 appropriations are estimated.

- The term "unallocated" is used to describe budget items that cannot be attributed to particular fuels or energy types. Much of this spending is administrative "overhead" within the Department of Energy and capital and operating costs of the national laboratories. However, because overhead costs have not been treated uniformly over time and are not treated uniformly by different offices within the Department of Energy, it is not possible to use these figures to ascertain what portion of research and development spending is actually devoted to overhead costs, nor to compare overhead spending across programs.

Table C1. Summary of U.S. Department of Energy Research and Development Expenditures, Fiscal Years 1978-1999

(Million 1999 Dollars)

Item	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Renewable Energy	1,356.5	1,590.5	1,616.3	1,453.6	668.1	474.2	384.4	348.8	280.0	235.5	193.9
Nuclear Power	2,583.4	2,256.8	2,044.5	1,815.9	1,765.4	1,614.0	1,140.4	886.5	849.2	772.8	693.5
Fossil Energy	1,716.4	1,732.7	1,602.4	1,414.9	921.6	484.9	497.4	507.7	482.0	411.0	465.5
Conservation and End Use	388.3	472.6	557.6	505.5	247.0	210.1	225.6	255.0	245.7	220.4	205.4
Clean Coal Technology	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	9.5	33.9
Total	**6,044.5**	**6,052.6**	**5,820.8**	**5,189.9**	**3,602.2**	**2,783.1**	**2,247.8**	**1,998.1**	**1,857.3**	**1,649.3**	**1,592.2**

Sources: 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).

Table C2. U.S. Department of Energy Nuclear Power Research and Development Appropriations, Fiscal Years 1978-1998

(Million 1999 Dollars)

Item	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
New Nuclear Plants											
Nuclear Energy Research Initiative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nuclear Energy Plant Optimization	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Advanced Reactor R&D	231.3	133.4	74.9	69.9	61.1	60.7	51.0	52.6	274.4	177.4	190.7
University Reactor Fuel Help	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Breeder and Converter Reactors	1,886.2	1,661.3	1,528.0	1,199.1	1,269.9	983.2	837.5	546.9	26.5	18.7	0.0
Total New Reactors	**2,117.6**	**1,794.8**	**1,602.9**	**1,269.1**	**1,331.0**	**1,044.0**	**888.5**	**599.5**	**300.9**	**196.1**	**190.7**
Waste/Fuel/Safety											
Non-Defense Environmental Management	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uranium Programs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste and Fuel Cycle Programs	465.9	462.1	441.6	543.9	434.4	569.0	249.2	285.1	348.3	389.5	333.6
Nuclear Safety	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Waste/Fuel/Safety	**465.9**	**462.1**	**441.6**	**543.9**	**434.4**	**569.0**	**249.2**	**285.1**	**348.3**	**389.5**	**333.6**
Unallocated											
Termination Costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fast Flux Test Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Program Direction and Management	0.0	0.0	0.0	2.9	0.0	1.0	2.8	1.9	14.2	12.9	14.2
Facilities and Facilities Management	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	185.8	174.4	155.1
Total Unallocated	**0.0**	**0.0**	**0.0**	**2.9**	**0.0**	**1.0**	**2.8**	**1.9**	**200.0**	**187.2**	**169.3**
Total Nuclear Power	**2,583.4**	**2,256.8**	**2,044.5**	**1,815.9**	**1,765.4**	**1,614.0**	**1,140.4**	**886.5**	**849.2**	**772.8**	**693.5**

Sources: 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).

Table C1. Summary of U.S. Department of Energy Research and Development Expenditures, Fiscal Years 1978-1999 (Continued)

(Million 1999 Dollars)

Item	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Renewable Energy	187.7	169.5	235.9	275.8	284.2	351.8	395.2	296.0	271.8	295.8	327.2
Nuclear Power	775.8	775.1	955.0	1,131.7	1,082.0	1,027.8	1,022.5	803.5	859.3	654.9	639.6
Fossil Energy	481.1	505.0	541.3	515.0	475.6	420.3	396.9	390.8	373.2	354.9	384.1
Conservation and End Use	208.9	234.9	270.6	297.2	345.8	426.6	471.1	393.9	423.5	455.8	525.7
Clean Coal Technology	52.0	80.0	145.9	151.7	131.5	252.1	257.9	258.3	100.2	78.0	183.0
Total	**1,705.5**	**1,764.4**	**2,148.7**	**2,371.4**	**2,319.2**	**2,478.6**	**2,543.6**	**2,142.5**	**2,028.1**	**1,839.4**	**2,059.6**

Table C2. U.S. Department of Energy Nuclear Power Research and Development Appropriations, Fiscal Years 1978-1998 (Continued)

(Million 1999 Dollars)

Item	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
New Nuclear Plants											
Nuclear Energy Research Initiative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0
Nuclear Energy Plant Optimization	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Advanced Reactor R&D	164.7	100.1	126.1	139.1	130.0	103.4	111.6	43.1	58.6	0.0	0.0
University Reactor Fuel Help	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	4.1	7.1	11.0
Breeder and Converter Reactors	10.8	70.2	113.5	82.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total New Reactors	**175.5**	**170.3**	**239.6**	**221.2**	**130.0**	**103.4**	**111.6**	**46.8**	**62.7**	**7.1**	**30.0**
Waste/Fuel/Safety											
Non-Defense Environmental Management	0.0	357.1	520.9	695.9	788.9	752.4	780.6	643.8	584.5	469.2	431.2
Uranium Programs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.7	27.4	35.4
Waste and Fuel Cycle Programs	439.0	1.2	0.8	44.4	5.4	0.7	0.7	0.0	0.0	0.0	0.0
Nuclear Safety	0.0	0.0	9.3	14.3	1.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Waste/Fuel/Safety	**439.0**	**358.3**	**531.1**	**754.6**	**795.4**	**753.1**	**781.3**	**643.8**	**642.3**	**496.6**	**466.6**
Unallocated											
Termination Costs	0.0	0.0	0.0	0.0	0.0	113.7	73.5	83.1	80.9	88.8	85.0
Fast Flux Test Facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.7	30.4	30.0
Program Direction and Management	2.8	40.8	77.6	45.6	53.4	24.4	26.9	8.3	15.1	24.7	21.2
Facilities and Facilities Management	158.6	205.7	106.8	110.3	103.1	33.3	29.2	21.4	15.7	7.4	6.8
Total Unallocated	**161.3**	**246.4**	**184.4**	**155.9**	**156.5**	**171.3**	**129.6**	**112.9**	**154.4**	**151.2**	**143.0**
Total Nuclear Power	**775.8**	**775.1**	**955.0**	**1,131.7**	**1,082.0**	**1,027.8**	**1,022.5**	**803.5**	**859.3**	**654.9**	**639.6**

Table C3. U.S. Department of Energy Fossil Energy Research and Development Appropriations, Fiscal Years 1978-1999

(Million 1999 Dollars)

Item	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Coal											
Advanced Power Systems	483.0	465.5	389.8	286.7	193.1	137.6	145.4	164.4	146.1	112.5	142.4
Advanced Clean Fuels	750.6	713.5	724.8	725.8	472.8	128.5	107.2	91.6	109.1	70.1	70.1
Advanced Research Technology	245.0	275.4	313.0	248.8	150.2	99.6	107.0	108.2	93.2	96.4	97.3
Total Coal	**1,478.6**	**1,454.4**	**1,427.6**	**1,261.4**	**816.1**	**365.7**	**359.6**	**364.2**	**348.4**	**279.1**	**309.8**
Clean Coal Technology Program											
Appropriations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	139.0	202.3	260.9
Outlays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	9.5	33.9
Petroleum and Synthetic Fuels											
Oil Shale	64.5	100.4	51.1	55.6	31.1	19.1	24.1	21.3	17.2	15.0	12.6
Other Petroleum Research	111.8	108.0	65.6	44.3	32.9	17.9	21.3	24.8	24.1	20.6	26.5
Total Petroleum and Synthetic Fuels	**176.3**	**208.4**	**116.7**	**99.9**	**64.0**	**37.0**	**45.4**	**46.0**	**41.2**	**35.6**	**39.0**
Natural Gas											
Fuel Cells	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Natural Gas Research	61.5	69.9	58.1	53.6	19.0	21.3	23.1	14.7	12.0	11.0	14.0
Total Natural Gas	**61.5**	**69.9**	**58.1**	**53.6**	**19.0**	**21.3**	**23.1**	**14.7**	**12.0**	**11.0**	**14.0**
Unallocated											
Program Direction and Management	0.0	0.0	0.0	0.0	22.4	60.8	69.3	82.7	80.4	85.4	102.7
Cooperative Research and Development	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel Conversion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Unallocated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Unallocated	**0.0**	**0.0**	**0.0**	**0.0**	**22.4**	**60.8**	**69.3**	**82.7**	**80.4**	**85.4**	**102.7**
Total Fossil Fuels	**1,716.4**	**1,732.7**	**1,602.4**	**1,414.9**	**921.6**	**484.9**	**497.4**	**507.7**	**482.4**	**420.6**	**499.4**

Note: Clean Coal Technology Program outlays (rather than appropriations) are included in the total.

Sources: 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).

Table C3. U.S. Department of Energy Fossil Energy Research and Development Appropriations, Fiscal Years 1978-1999 (Continued)

(Million 1999 Dollars)

Item	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Coal											
Advanced Power Systems	143.1	161.9	168.0	166.4	134.3	54.9	93.1	82.5	69.3	73.3	87.7
Advanced Clean Fuels	70.3	71.9	68.9	57.1	52.9	44.6	22.1	20.1	16.2	15.8	15.5
Advanced Research Technology	94.7	102.6	102.7	91.8	75.9	80.6	57.4	67.9	22.9	17.5	19.9
Total Coal	**308.1**	**336.5**	**339.6**	**315.3**	**263.1**	**180.1**	**172.6**	**170.5**	**108.3**	**106.6**	**123.1**
Clean Coal Technology Program											
Appropriations	238.8	667.0	453.0	468.0	0.0	240.5	38.5	152.9	15.2	(102.2)	(40.0)
Outlays	52.0	80.0	145.9	151.7	131.5	252.1	257.9	258.3	100.2	78.0	183.0
Petroleum and Synthetic Fuels											
Oil Shale	13.4	11.0	20.4	6.7	6.1	0.0	0.0	0.0	0.0	0.0	0.0
Other Petroleum Research	35.3	36.6	49.0	57.8	62.4	80.6	79.8	57.2	46.2	48.3	48.6
Total Petroleum and Synthetic Fuels	**48.7**	**47.6**	**69.4**	**64.5**	**68.5**	**80.6**	**79.8**	**57.2**	**46.2**	**48.3**	**48.6**
Natural Gas											
Fuel Cells	0.0	0.0	0.0	0.0	0.0	0.0	4.6	3.8	49.9	39.6	44.2
Other Natural Gas Research	14.5	17.6	18.6	14.2	32.3	47.5	28.6	61.0	70.0	64.1	71.0
Total Natural Gas	**14.5**	**17.6**	**18.6**	**14.2**	**32.3**	**47.5**	**33.2**	**64.8**	**119.9**	**103.7**	**115.2**
Unallocated											
Program Direction and Management	109.8	93.3	95.2	90.6	83.6	84.3	77.1	69.7	70.3	67.7	69.5
Cooperative Research and Development	0.0	5.6	13.9	12.3	11.0	10.4	9.4	6.4	5.7	5.8	6.8
Fuel Conversion	0.0	3.2	3.5	3.5	3.4	3.2	3.2	2.8	2.2	2.2	2.2
Other Unallocated	0.0	1.3	1.0	14.6	13.7	14.1	21.6	19.3	20.5	20.7	18.6
Total Unallocated	**109.8**	**103.4**	**113.6**	**121.1**	**111.8**	**112.1**	**111.3**	**98.3**	**98.7**	**96.3**	**97.1**
Total Fossil Fuels	**533.1**	**585.0**	**687.2**	**666.7**	**607.2**	**672.3**	**654.8**	**649.1**	**473.4**	**432.9**	**567.1**

Table C4. U.S. Department of Energy Renewable Energy Research and Development Appropriations, Fiscal Years 1978-1999

(Million 1999 Dollars)

Item	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Wind, Photovoltaic, and Other Solar											
Wind Power	82.3	123.0	114.5	134.0	55.9	49.0	39.6	41.2	35.1	22.8	11.2
Solar Photovoltaic	142.4	214.5	283.7	262.1	120.3	90.3	75.4	79.4	57.1	55.3	46.0
Concentrating (Thermal) Solar	233.5	203.1	285.9	239.0	91.0	77.1	65.6	49.2	36.2	31.3	22.3
Solar Buildings	276.9	262.5	160.5	132.1	35.9	18.1	24.6	13.3	11.6	8.1	7.1
International Solar	0.0	0.0	0.0	18.7	6.5	15.6	0.8	0.7	1.4	1.0	1.0
Ocean Thermal (OTEC)	80.7	85.0	81.3	59.8	33.8	16.4	8.2	5.8	6.8	6.1	5.3
Other Solar	0.0	0.0	0.0	0.0	16.5	6.2	6.0	8.9	5.6	4.3	5.6
Total Wind and Solar	**815.8**	**888.1**	**926.0**	**845.6**	**360.0**	**272.7**	**220.3**	**198.6**	**153.6**	**128.9**	**98.5**
Biomass and Biofuels											
Biofuels	47.5	87.6	104.0	85.8	49.6	32.7	42.5	43.6	38.2	32.9	22.4
Hydrogen Fuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alcohol Fuels (Solar)	0.0	0.0	41.6	31.1	16.3	0.0	0.0	0.0	0.0	0.0	0.0
Total Biomass/Biofuels	**47.5**	**87.6**	**145.6**	**116.9**	**65.8**	**32.7**	**42.5**	**43.6**	**38.2**	**32.9**	**22.4**
Geothermal	**242.1**	**302.0**	**282.2**	**269.7**	**113.7**	**89.8**	**45.5**	**43.1**	**37.5**	**28.5**	**27.5**
Hydropower	**23.4**	**80.9**	**39.6**	**5.5**	**4.9**	**3.1**	**1.1**	**0.6**	**0.7**	**0.6**	**0.0**
Electricity Technologies											
Electric Energy Systems and Storage	208.6	204.8	195.5	193.1	97.2	66.8	66.0	55.7	40.4	38.2	39.2
Federal Buildings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Electricity Technologies	**208.6**	**204.8**	**195.5**	**193.1**	**97.2**	**66.8**	**66.0**	**55.7**	**40.4**	**38.2**	**39.2**
Unallocated											
Program Direction (Solar)	19.2	20.8	8.6	14.2	26.5	9.1	9.0	7.1	6.4	5.6	5.6
Renewable Indian Resources	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NREL/SERI[a]	0.0	6.2	18.9	8.6	0.0	0.0	0.0	0.0	3.2	0.7	0.8
Renewables Policy and Management	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Unallocated	**19.2**	**27.0**	**27.5**	**22.8**	**26.5**	**9.1**	**9.0**	**7.1**	**9.6**	**6.4**	**6.4**
Total Renewable Energy	**1,356.5**	**1,590.5**	**1,616.3**	**1,453.6**	**668.1**	**474.2**	**384.4**	**348.8**	**280.0**	**235.5**	**193.9**

[a]SERI = Solar Energy Research Institute. NREL = National Renewable Energy Laboratory.

Sources: 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).

Table C4. U.S. Department of Energy Renewable Energy Research and Development Appropriations, Fiscal Years 1978-1999 (Continued)

(Million 1999 Dollars)

Item	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Wind, Photovoltaic, and Other Solar											
Wind Power	11.1	10.6	13.0	24.3	26.5	31.7	47.3	32.7	29.3	32.5	34.8
Solar Photovoltaic	44.7	41.8	54.4	68.5	72.1	81.3	88.0	63.8	60.6	65.5	72.2
Concentrating (Thermal) Solar	18.8	19.5	22.5	32.8	30.0	34.1	31.9	25.0	22.4	16.5	17.0
Solar Buildings	6.7	4.7	2.3	2.3	3.3	5.2	4.6	2.0	2.6	2.7	3.6
International Solar	1.3	1.3	1.7	2.3	2.2	5.5	9.5	4.0	0.8	1.4	6.4
Ocean Thermal (OTEC)	5.2	4.7	3.1	2.2	1.1	1.0	0.0	0.0	0.0	0.0	0.0
Other Solar	5.2	4.1	4.8	3.5	4.6	29.9	32.6	13.9	0.0	0.0	0.0
Total Wind and Solar	**93.1**	**86.8**	**101.9**	**135.9**	**139.8**	**188.7**	**213.9**	**141.5**	**115.6**	**118.6**	**133.9**
Biomass and Biofuels											
Biofuels	16.8	21.1	38.8	44.5	53.4	60.6	57.7	55.4	56.6	58.8	73.2
Hydrogen Fuels	0.0	0.0	0.0	0.0	0.0	10.4	9.4	14.9	15.1	16.0	22.3
Alcohol Fuels (Solar)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Biomass/Biofuels	**16.8**	**21.1**	**38.8**	**44.5**	**53.4**	**71.0**	**67.0**	**70.3**	**71.7**	**74.8**	**95.5**
Geothermal	**24.6**	**20.9**	**35.1**	**30.7**	**25.8**	**25.0**	**43.9**	**30.6**	**30.3**	**29.0**	**28.5**
Hydropower	**0.0**	**0.0**	**1.2**	**1.2**	**1.2**	**1.1**	**5.1**	**3.6**	**1.0**	**0.7**	**3.3**
Electricity Technologies											
Electric Energy Systems and Storage	46.8	34.8	47.8	42.9	47.0	48.0	45.2	35.1	32.5	43.8	40.1
Federal Buildings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	4.0
Total Electricity Technologies	**46.8**	**34.8**	**47.8**	**42.9**	**47.0**	**48.0**	**45.2**	**35.1**	**32.5**	**48.7**	**44.1**
Unallocated											
Program Direction (Solar)	5.6	5.1	5.1	5.3	6.5	7.6	8.7	0.0	13.3	15.8	18.1
Renewable Indian Resources	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	4.8	0.0
NREL/SERI[a]	0.8	0.8	6.1	13.1	7.3	6.3	6.3	2.1	3.4	3.2	3.9
Renewables Policy and Management	0.0	0.0	0.0	2.2	3.2	4.1	5.1	12.7	0.0	0.0	0.0
Total Unallocated	**6.4**	**5.8**	**11.1**	**20.6**	**17.0**	**17.9**	**20.1**	**14.8**	**20.8**	**23.9**	**22.0**
Total Renewable Energy	**187.7**	**169.5**	**235.9**	**275.8**	**284.2**	**351.8**	**395.2**	**296.0**	**271.8**	**295.8**	**327.2**

Appendix D

Bibliography

Appendix D

Bibliography

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Appendix E

Letters From the DOE Office of Policy