



Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022

August 2023

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Overview and Key Findings

Overview

Our report on direct federal financial interventions and subsidies in energy markets continues a series of EIA reports¹ that respond to congressional requests and the Energy Policy Act of 1992. In this update, we introduce multiple, sequential fiscal year² (FY) data for the first time from FY 2016 (the last fiscal year we analyzed) through FY 2022. To accommodate the increase in reported data, we reformatted and reorganized this update.

The scope of this report is limited to direct federal financial interventions and subsidies (that is, subsidies from the federal government that provide a financial benefit with an identifiable federal budget impact and that are specifically targeted at energy markets). We have excluded state and local programs—although significant in several cases—from our reporting. As a result of this exclusion and other exclusions, this report does not encompass all subsidies that affect energy markets and should, therefore, be viewed in context and with related information from other sources.

Consistent with our independent role and mission, this report informs discussion rather than draws conclusions or addresses policy issues related to energy subsidies. By using comprehensive data acquisition and analysis, we estimate how federal financial actions are distributed among a defined set of 14 energy types³ that make up the U.S. energy system. We have made only limited observations of the scale, trends, and relationships within the data and the report tables. In this report, we focus only on expenditures on subsidies, and we do not attempt to quantify the impact or evaluate the value of these subsidies. So, readers should exercise caution in drawing conclusions. [Select Energy Subsidy Studies](#) section in Appendix C notes related studies from other sources; we do not endorse other parties' reports and include them for reference only.

Federal financial interventions and subsidies included in this report fall into four categories:

- **Tax expenditure estimates**, which measure the effects in federal government revenue resulting from preferential tax treatment for particular taxpayers
- **Direct expenditures** to non-federal recipients (that is, both energy producers and consumers) in the form of a grant, loan, or other financial assistance award
- **Research and development (R&D) support** in the form of a grant, loan, or other financial assistance award made to non-federal recipients.⁴

¹ We performed our first federal energy subsidies study at Congress's request in FY 1992, based on the requirements published in the House Committee on Appropriations' report on our FY 1992 appropriations. The most obvious subsidies are the direct expenditures and R&D support from the federal budget. Tax expenditure subsidies are targeted tax incentives that producers or consumers of specific forms of energy receive. In this case, the government does not spend money, but it loses revenue that it would have otherwise received.

² Federal government fiscal years begin on October 1 of the preceding calendar year and end on September 30.

³ We use the following energy type labels: Biofuels, Biomass, Coal, Conservation, End Use, Geothermal, Hydropower, Natural Gas and Petroleum Liquids, Uncategorized, Nuclear, Other Renewables, Electricity—Smart Grid and Transmission, Refined Coal, Solar, and Wind.

⁴ Federal energy-related R&D falls into three classes: basic research, applied research into developing new technologies and new forms of energy supply, and research into improving existing technologies. Although R&D is a subset of direct expenditures, this report treats it separately due to the importance of R&D for energy technology and markets.

- **Loan guarantees** (a form of credit subsidy) that provide financial support for innovative clean energy technologies that typically do not qualify for conventional private financing because of their high technology risks⁵

Organization of this report

This overview and key findings section is followed by three appendices:

- Appendix A presents detailed tables
- Appendix B presents our analytic approach
- Appendix C provides a listing of select other subsidy reports

Detailed tables are included in Appendix A and are denoted with an “A” in the numbering scheme. Table A1 summarizes total within-scope energy subsidies (in 2022 dollars) and selected U.S. energy system indicators (in physical units). [Table A3](#) summarizes the allocation of federal direct financial interventions in U.S. energy markets by year and energy type, and it serves as the basis for Figures 1-7. Overall, Appendix A (Tables A1–A7) provide critical details regarding energy subsidy expenditures.

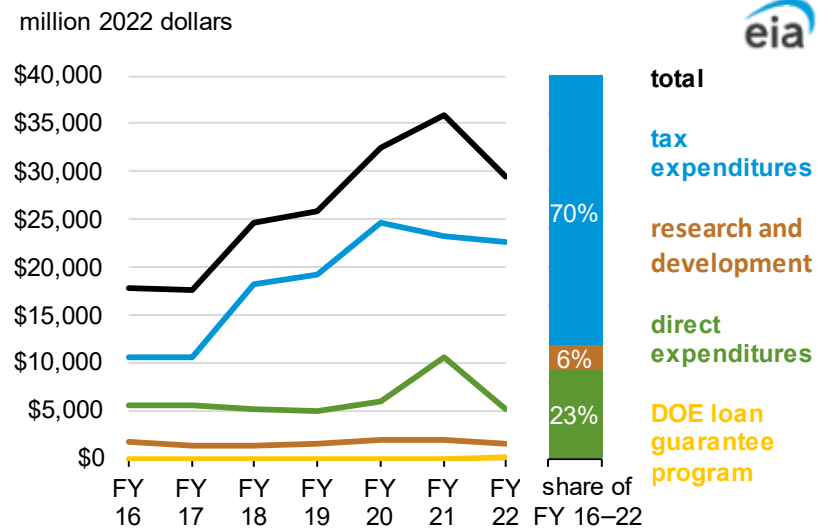
Key findings

Several key findings stand out.

Beginning in FY 2016, tax expenditures rose rapidly and leveled off, but direct federal support remained steady until Congress recently enacted temporary provisions.

Federal activities within the scope of this study were decreasing through FY 2016, because the provisions and programs under the American Reinvestment and Recovery Act (ARRA) of 2009 expired, after which direct expenditures remained relatively steady through FY 2020. Budgetary and statutory actions in response to the COVID-19 pandemic and related economic effects have resulted in a sharp but temporary rise in federal direct expenditures on energy

Figure 1. Energy-specific subsidies and support, FY 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table 1 and Table A3
 Note: DOE=U.S. Department of Energy.

⁵ The U.S. Department of Energy (DOE) administers four credit programs: Title XVII Innovative Technology Loan Guarantee Program (Title XVII), the Advanced Technology Vehicle Manufacturing (ATVM) Loan Program, the Tribal Energy Loan Guarantee Program, and the Carbon Dioxide Transportation Infrastructure Finance and Innovation Program. The DOE’s Loan Programs Office has [more information about these programs](#). The Federal Credit Reform Act of 1990 (FCRA) requires federal agencies to estimate the cost to the government of extending or guaranteeing credit. This cost, referred to as credit subsidy cost, equals the net present value of estimated cash flows from the government minus estimated cash flows to the government over the life of the loan and excluding administrative costs. Title XVII requires that a subsidy cost be paid—through a combination of appropriations and payment by the borrower—prior to finalizing a loan guarantee agreement.

in FY 2020 and FY 2021. Meanwhile, tax expenditures steadily increased from FY 2017 to FY 2020 and have since been slightly decreasing (Figure 1).

The U.S. energy system has continued to grow, except in FY 2020, when total energy use fell by a record 7% (Table A1). As a result, the relative scale of federal financial interventions into U.S. energy markets varied during FY 2016–22 as both federal energy-directed activities and the economy underwent historic volatility.

During FY 2016–22, most federal subsidies were for renewable energy producers (primarily biofuels, wind, and solar), low-income households, and energy-efficiency improvements. During FY 2016–22, nearly half (46%) of federal energy subsidies were associated with renewable energy, and 35% were associated with energy end uses. Federal support for renewable energy of all types more than doubled, from \$7.4 billion in FY 2016 to \$15.6 billion in FY 2022. Table A4 shows a more detailed distribution of renewable energy-related federal support, which is further discussed in the Renewable-related subsidy trends section of this Overview. Combined conservation and end-use subsidies increased from \$9.0 billion in FY 2016 to \$10.1 billion in FY 2022 (Table A3). The largest program of this combined category—the Low Income Home Energy Assistance Program (LIHEAP), administered through the U.S. Department of Health and Human Services (HHS)—slightly decreased its funding from \$4.0 billion in FY 2016 to \$3.9 billion in FY 2022, with a noteworthy one-year increase to nearly \$10.0 billion in FY 2021 (Table A6).⁶

During FY 2016–22, provisions in the tax code were the largest source of federal financial support. In FY 2016, the Internal Revenue Code (IRC)—with its 31 wide-ranging, energy-specific tax provisions—provided greater financial support to energy than direct expenditures, including R&D expenditures (Table A2 and Table A3). Total tax expenditures were 70% of the total federal financial support (Table 1). Since FY 2016, tax expenditures have continued to grow, rising to over 75% of total federal support in recent years. In FY 2021, this support dipped slightly to 65%.

Table 1. Quantified total energy-specific subsidies and support by type, FY 2016–22

million 2022 dollars

Fiscal year	Direct expenditures	Tax expenditures	Research and Development	DOE Loan Guarantee Program	Total	Annual share of FY 2016–22
2016	5,559	10,586	1,640	-	17,785	10%
2017	5,629	10,555	1,406	-	17,589	10%
2018	5,086	18,234	1,326	-	24,646	13%
2019	4,923	19,217	1,602	-	25,742	14%
2020	5,938	24,572	1,861	-	32,370	18%
2021	10,658	23,255	1,900	-	35,813	20%
2022	5,054	22,682	1,461	166	29,363	16%
Total	42,847	129,099	11,197	166	183,309	100%
Share of total	23%	70%	6%	0%	100%	

Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A3

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. DOE=U.S. Department of Energy.

Natural gas and petroleum-related subsidies became a net cost to the federal government. Natural gas and petroleum-related tax expenditures increased to \$2.1 billion in FY 2022 to reverse a trend from an

⁶ Congress appropriated additional funding for LIHEAP under the American Rescue Plan Act (ARP) of 2021 (Public Law 117-2).

estimated revenue inflow (versus a positive tax expenditure) of \$1.1 billion in FY 2016 and FY 2017; combined, these tax provisions had been, in aggregate, the largest energy-related, revenue-generating tax provisions to the government in any of the fiscal years covered in this report (Table A5).

U.S. Department of Energy (DOE) loan guarantees were once again issued in FY 2022.⁷ The subsidy cost of the loans issued in FY 2022 was \$166 million. Because this type of cost is assessed at the time the loan is issued, we did not identify any subsidy costs for FY 2016–21; for example, the loan guarantees associated with the Vogtle nuclear project⁸ were included with FY 2010 subsidy costs in our previous report updates. Although lending authority for the Section 1705 loan program expired by FY 2016, budget authority remains for future lending on the Section 1703 loan program.

Subsidy and Energy Type-Specific Results

Federal financial interventions and subsidies included in this report fall into four categories, and we use 14 energy types in categorizing the resulting financial impacts. This section describes the subsidy types and presents the financial results for each energy type.

Subsidy types

Tax expenditures

When preparing data on energy-related tax expenditures, we relied on the definitions of tax expenditures incorporated in the federal budget and the associated tax expenditures estimated by the U.S. Department of the Treasury (Treasury) (Table A2). To a lesser extent, we also use data estimates by the Joint Committee on Taxation (JCT). Tax expenditures, as estimated by the Treasury or JCT, arise from provisions in federal tax laws including credits, deductions, deferrals, preferential rates, and exemptions (exclusions). Treasury identified items in the budget as tax expenditures different from those the JCT determined to be tax expenditures—that is, the two bodies sometimes do not agree. For this report, we took historical tax expenditure data from two primary federal sources. Treasury is the primary source of estimates for tax expenditures; JCT supplements data as a secondary source when greater details are necessary than provided in the Office of Management and Budget’s (OMB) *Analytical Perspectives*.

Note that, in this report, *de minimis* tax expenditures (that is, \$5 million or less) are not tabulated, which is consistent with Treasury’s reporting practices.

Direct expenditures including R&D

Direct expenditures, compared with tax expenditures, involve transferring congressionally appropriated funds to recipients by federal agencies. The volume and diversity of federal direct expenditures make them very difficult to assign energy-related activities to specific aspects of the energy system. As

⁷ According to the Congressional Research Service’s report *Energy and Water Development: FY2023 Appropriations* (R47293, updated March 20, 2023), Title XVII allows DOE to provide loan guarantees for up to 80% of construction costs for eligible energy projects. In general, successful applicants must pay an up-front fee, or *subsidy cost*, to cover potential losses under the loan guarantee program. The Inflation Reduction Act (IRA; Public Law 117-169) appropriated \$3.6 billion for Section 1703 subsidy costs. IRA also established a time-limited (available through FY 2026), \$250 billion Title 17 loan guarantee commitment authority—Section 1706—for *Energy Infrastructure Reinvestment Financing*. IRA appropriated \$5 billion to carry out the Section 1706 program. DOE, “DOE Announces First Loan Guarantee for a Clean Energy Project in Nearly a Decade,” June 8, 2022, <https://www.energy.gov/articles/doe-announces-first-loan-guarantee-clean-energy-project-nearly-decade>.

⁸ U.S. Department of Energy, Loan Guarantee Office, website: <https://energy.gov/lpo/vogtle>, accessed May 5, 2023. On September 29, 2017, the U.S. Department of Energy has offered conditional commitments for construction to the Vogtle project, website: <https://energy.gov/lpo/articles/vogtle-conditional-commitments-support-energy-infrastructure>, accessed May 5, 2023.

discussed in the [Analytic Approach](#) section, we have developed several powerful methods of obtaining and processing federal expenditure data, but the resulting estimates in this section are still subject to scope and measurement issues. The tax expenditure figures are more often precise accounts of the annual cost of a given provision of the IRC.

The most comprehensive picture of the direct expenditure amounts estimated for each part of the energy system is displayed in [Table A6](#). As described in the [Analytic Approach](#) section of Appendix B, the Catalog of Federal Direct Assistance (CFDA) is the primary source for program information. The CFDA coding is shown with agency and program designations.⁹

We treat research and development (R&D) in this report as it applies to specific parts of the U.S. energy system based on the research topics, program descriptions, and other available information, including information from the programs in some cases.

We broadly characterize R&D as either *basic* or *applied*. R&D investment more generally applies to a wider variety of activities, both energy-related and non-energy-related, when the activity is aimed at basic technological improvement.

Basic R&D activities are not intended to support specific kinds of energy; instead, they broadly support technological advancements such as high-speed computing or basic science such as physics. This distinction is true of certain DOE programs, notably those of the DOE Office of Science (SC) under CFDA 81.049, the Office of Science Financial Assistance Program. We did not include these activities as line items in the direct expenditure and R&D tables for this report.

Recently, some overlapping federal programs aimed at direct acquisition of renewable, sustainable, resilient, or other designated energy resources have grown rapidly. Driven in part by statute and executive orders, these programs allow or require federal organizations to use certain energy resource acquisition procedures, sometimes on a pooled or regional basis.

The definition of direct federal financial interventions (or subsidies) used in this report would generally only include federal energy purchases that add incremental cost for the federal government and are intended to provide market support for the purchased resource. Because federal acquisition programs pursue a variety of goals—both operational and policy related—it’s difficult to determine which subsidies should be included. To date, we have not included federal energy acquisition programs in the report tables or summaries.

Without determining what portion of these activities might be considered subsidies or market interventions, reports from federal programs cover a full range of energy management topics and indicate the magnitude of direct energy acquisition activities:

- U.S. Department of Defense. [Annual Energy Management and Resilience Report](#). October 2022.
- Federal Energy Management Program. [Annual Report on Federal Government Energy Management and Conservation Programs](#). August 23, 2022.

Loan subsidy cost

When the government guarantees a loan, it expects the loan to be repaid. However, for any given loan program (for example, student loans, small business loans) some individual loans are not repaid. The loan only costs the government if it is in default (not repaid). Subsidy cost is the government’s way to

⁹ Certain programs (for example, grants in lieu of tax credits) administered by the Treasury have no CFDA coding.

estimate a loan’s likely cost to the government based on the size of the loan (that is, its face value), the interest rate, the modeled risk of default in full or in part, and other factors. That is, the subsidy cost is the expected value of the governmental liability to make the lender whole for guaranteed loans in default. Subsidy costs are computed as a percentage of the loan value and do not include administrative costs. Subsidy costs can be positive (indicating that the government is likely to lose money on the loan) or negative (indicating that the government is likely to make money on the loan). Loan subsidy cost estimates have a direct budgetary impact and are factored into obligations and outlays when positive.

Energy type-specific subsidies

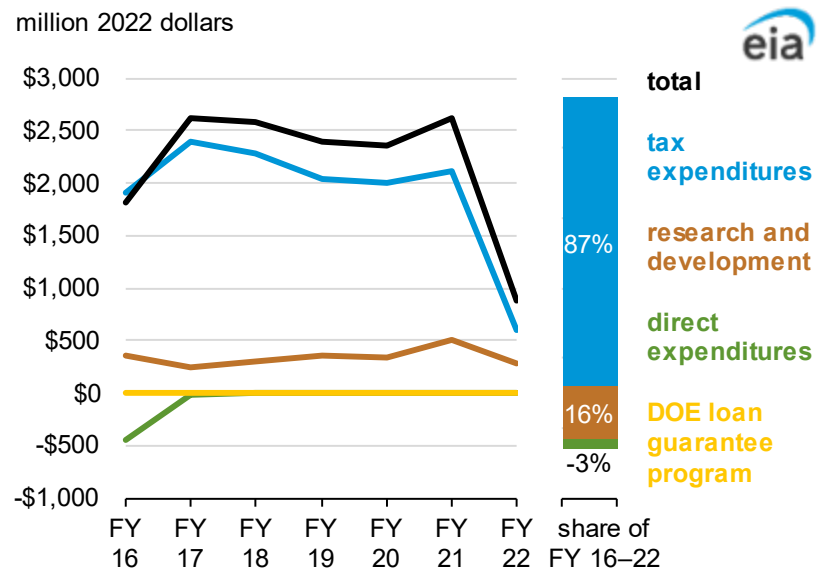
This section summarizes the total federal energy subsidies associated with various categories of energy-related beneficiaries (energy types).

Coal and refined coal

Coal-related tax expenditures were lower in FY 2022, at an estimated value of \$590 million, than in FY 2016, at an estimated \$1,904 million, largely because the production tax credit for refined coal expired ([Table A5](#)).¹⁰

Direct expenditures for coal-related programs increased from a negative \$446 million in FY 2016 (that is, a de-obligation of funds) to \$3 million in FY 2022, and R&D spending decreased from \$363 million in FY 2016 to \$280 million in FY 2022 ([Table 2](#)). Coal-related program obligations are shown in [Table A6](#) and [Table A7](#).

Figure 2. Coal-related energy-specific subsidies and support, FY 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table 2 and Table A3
 Note: DOE=U.S. Department of Energy.

¹⁰ U.S. Energy Information Administration, *U.S. refined coal production and consumption declines with the expiration of a tax credit*, [Today in Energy](#), July 20, 2022, Washington, DC, accessed May 5, 2023.

Table 2. Quantified coal-related energy-specific subsidies and support by type, FY 2016–22

million 2022 dollars

Fiscal year	Direct expenditures	Tax expenditures	Research and Development	DOE Loan Guarantee Program	Total	Annual share of FY 2016–22
2016	(446)	1,904	363	-	1,821	12%
2017	(13)	2,386	248	-	2,621	17%
2018	4	2,275	299	-	2,578	17%
2019	1	2,044	356	-	2,400	16%
2020	5	2,005	338	-	2,347	15%
2021	2	2,120	500	-	2,622	17%
2022	3	590	280	-	873	6%
Total	(445)	13,324	2,383	-	15,262	100%
Share of Total	(3)%	87%	16%	-	100%	

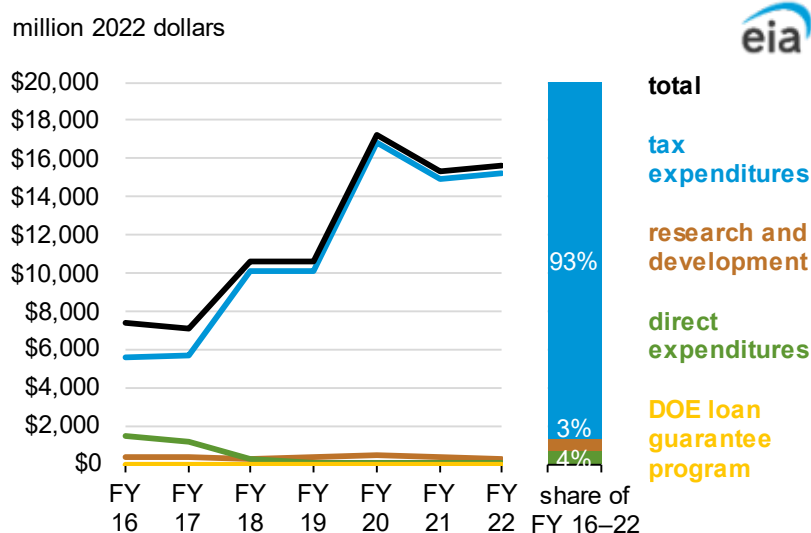
Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A3

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. DOE=U.S. Department of Energy.

Renewable energy, including biofuels

In FY 2022, 67% of energy-related tax expenditures were for renewable fuels. At \$15.3 billion, renewable-related tax expenditures in FY 2022 nearly tripled from \$5.6 billion in FY 2016 (Table A5). As discussed in further detail in the [Renewable-related subsidy trends](#) section, wind- and solar-powered renewable electricity accounted for a large share of these tax credits. Biofuels tax credits grew over this period but at a slower rate than either wind or solar.

Ethanol and biodiesel both provide sizable volumes of the U.S. liquid fuels supply, accounting for 6% in 2022. Their market penetration has increased as the result of several policies that have resulted in significant income and excise tax expenditures. The largest decrease in support for renewable energy since FY 2010 is attributable to the alcohol fuel exemption—referred to as the volumetric ethanol excise tax credit (VEETC)—that expired, which received \$5.7 billion in FY 2010 but has since decreased to zero. The biodiesel mixture credit—referred to as the biodiesel producer tax credit—increased from \$3.2 billion in FY 2016 to \$3.7 billion in FY 2022 due to greater domestic biomass-

Figure 3. Renewable-related energy-specific subsidies and support, FY 2016–22

Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table 3 and Table A3

Note: DOE=U.S. Department of Energy.

based diesel production and imports of these products.¹¹

Renewable energy direct expenditures varied considerably over the FY 2016–22 period, dropping to \$74 million in FY 2022 from over \$1.5 billion in FY 2016. In each fiscal year, as shown in [Table A6](#), the largest share of renewable energy direct expenditures came from congressional modifications to two tax expenditure programs:

- The production tax credit (PTC) for electricity generation from eligible new renewable electricity facilities
- Two tax credit bond programs, Clean Renewable Energy Bonds (CREB) and Qualified Energy Conservation Bonds (QECB), for public-sector renewable projects

Congress created direct expenditure programs related to each of these after the 2008 recession. At that time, few companies interested in constructing projects that would qualify for the PTC, CREBs, or QECBs had sufficient tax liability to offset those programs' tax credits.¹² To maintain support for building new renewable energy facilities, Congress created direct-payment programs at Treasury that entities could opt for instead of the tax credits. Note that Treasury does not regard these two direct expenditure programs as *domestic financial assistance*, so they do not appear in the Catalog of Federal Domestic Assistance (CFDA) hosted by GSA's SAM.gov website.

Table 3. Quantified renewables-related energy-specific subsidies and support by type, FY 2016–22

million 2022 dollars

Fiscal year	Direct expenditures	Tax expenditures	Research and Development	DOE Loan Guarantee Program	Total	Annual share of FY 2016–22
2016	1,456	5,567	347	-	7,370	9%
2017	1,111	5,637	365	-	7,113	8%
2018	296	10,069	265	-	10,629	13%
2019	75	10,103	387	-	10,565	13%
2020	56	16,794	409	-	17,258	21%
2021	60	14,896	343	-	15,299	18%
2022	74	15,266	250	-	15,589	19%
Total	3,127	78,332	2,364	-	83,823	100%
Share of Total	4%	93%	3%	-	100%	

Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A3

Note: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. DOE=U.S. Department of Energy.

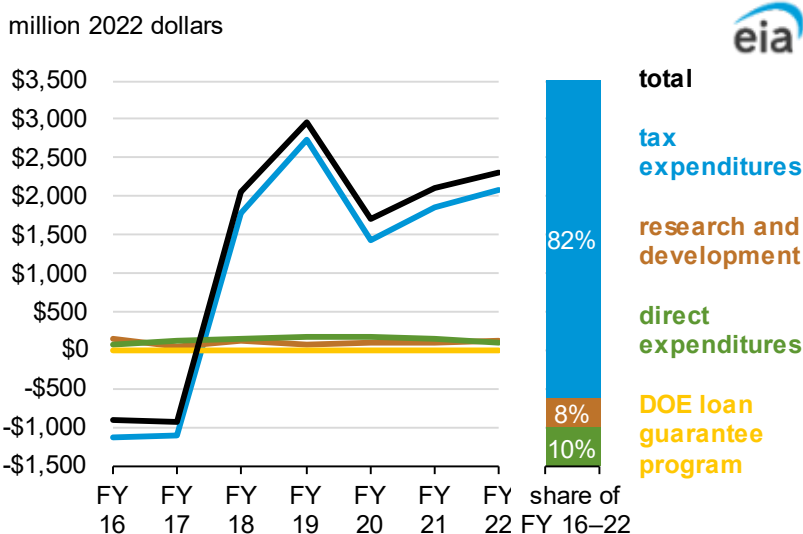
¹¹ U.S. Energy Information Administration, *U.S. biomass-based diesel tax credit renewed through 2022 in government spending bill*, [Today in Energy](#), January 28, 2020, accessed May 5, 2023. The Inflation Reduction Act ([IRA] Public Law 117-169), reinstates and extends several energy-related tax provisions in the IRC.

¹² Many firms during and after the 2008–09 recession were making little or no profit, so they owed little or no tax. Under such conditions, a firm's eligible PTC tax credit exceeded its total tax liability, greatly limiting the amount of the tax credit it could claim.

Natural gas and petroleum liquids

Natural gas and petroleum-related tax expenditures increased to \$2.1 billion in FY 2022; the same tax provisions provided an estimated tax revenue inflow (versus a tax expenditure or revenue cost) of \$2.2 billion when FY 2016 and FY 2017 are combined. These tax provisions had been, in aggregate, the largest energy-related, revenue-generating tax provisions to the government (Table A5). For example, in FY 2022 the tax provision for exploration and development costs increased expenses to \$720 million after being a revenue-generating tax provision¹³ in FYs 2016 and 2017.

Figure 4. Natural gas and petroleum liquids-related energy-specific subsidies and support, FY 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table 4 and Table A3

Note: DOE=U.S. Department of Energy.

Table 4. Quantified natural gas and petroleum liquids-related energy-specific subsidies and support by type, FY 2016–22

million 2022 dollars

Fiscal year	Direct expenditures	Tax expenditures	Research and Development	DOE Loan Guarantee Program	Total	Annual share of FY 2016–22
2016	63	(1,129)	145	-	(921)	(10)%
2017	111	(1,107)	58	-	(938)	(10)%
2018	150	1,783	132	-	2,065	22%
2019	171	2,724	71	-	2,966	32%
2020	166	1,428	107	-	1,701	18%
2021	153	1,842	105	-	2,100	23%
2022	103	2,080	121	-	2,304	25%
Total	915	7,622	739	-	9,276	100%
Share of Total	10%	82%	8%	-	100%	

Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A3

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. DOE=U.S. Department of Energy.

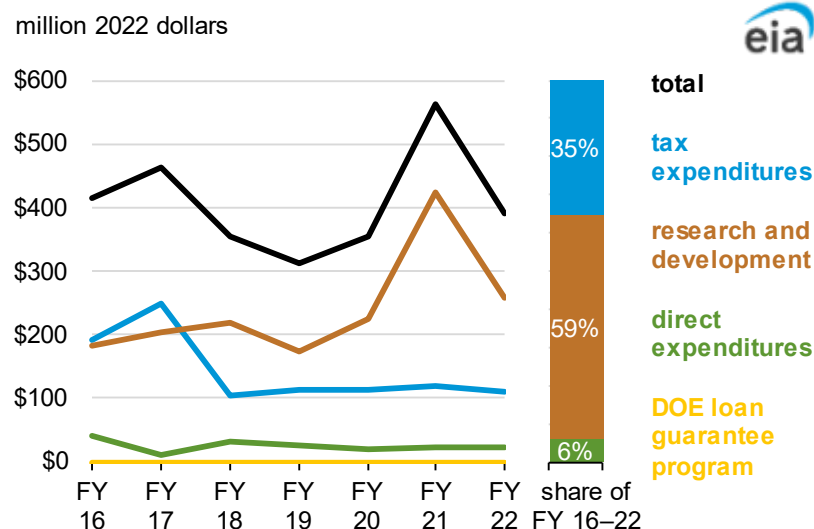
¹³ As noted by Treasury: “A tax expenditure estimate for a provision that properly is thought of as a tax subsidy or tax break nonetheless can take on a negative value in some years, indicating that it raises revenue in those years. This happens because of timing effects. Provisions that accelerate deductions or defer the recognition of income have offsetting revenue impacts over time and, depending on the pattern of the underlying economic activity, can have a negative revenue impact in a particular year.” See <https://home.treasury.gov/policy-issues/tax-policy/tax-expenditures>

Petroleum liquids and natural gas-related direct expenditures more than tripled from \$63 million in FY 2016 to \$171 million in FY 2019 and then declined \$103 million in FY 2022.

Nuclear

Nuclear-related tax provisions increased from \$192 million in FY 2016 to \$249 million in FY 2017 and then decreased to \$110 million in FY 2022 (Table A5). Most of this decrease stemmed from the tax treatment of qualified and nonqualified nuclear decommissioning trust funds. We relied on the estimates JTC prepared rather than estimates OMB prepared. A small portion of the advanced energy property tax credit was also directed to nuclear facilities in FY 2017.

Figure 5. Nuclear-related energy-specific subsidies and support, FY 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table 5 and Table A3

Note: DOE=U.S. Department of Energy.

Table 5. Quantified nuclear-related energy-specific subsidies and support by type, FY 2016–22

million 2022 dollars

Fiscal year	Direct expenditures	Tax expenditures	Research and Development	DOE Loan Guarantee Program	Total	Annual share of FY 2016–22
2016	40	192	183	-	415	15%
2017	11	249	203	-	463	16%
2018	31	104	219	-	354	12%
2019	27	113	173	-	313	11%
2020	19	112	224	-	355	12%
2021	22	118	423	-	563	20%
2022	21	110	259	-	390	14%
Total	172	999	1,684	-	2,855	100%
Share of total	6%	35%	59%	-	100%	

Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A3

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. DOE=U.S. Department of Energy.

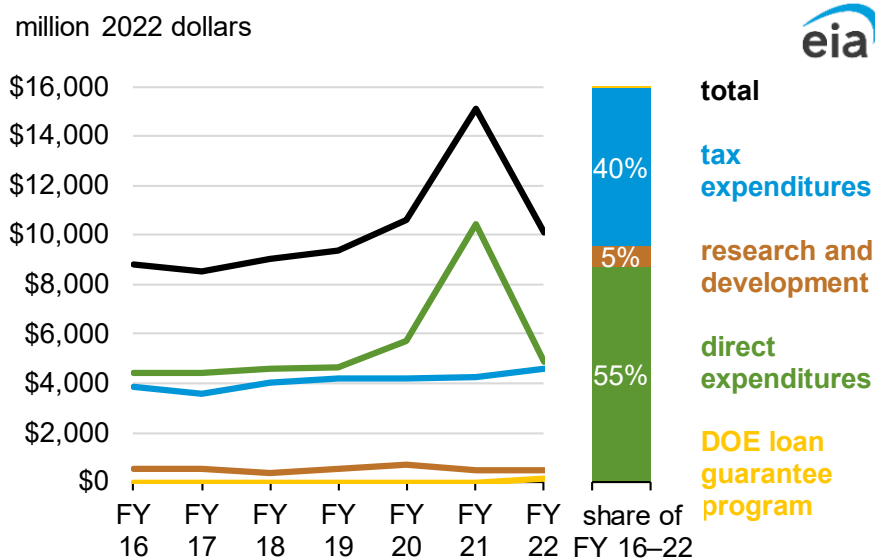
Nuclear total support peaked in FY 2021 at over \$500 million and then decreased in FY 2022 to under \$400 million. DOE accounted for most of these expenditures. Unlike most kinds of federal energy assistance, nuclear support is significantly higher in R&D (59% share) than in direct expenditures (6% share). Note that some DOE R&D for general application doesn't fall into an energy-system category, as

discussed in the [Direct expenditures including R&D](#) section; presumably, the U.S. nuclear energy industry and others use some of this basic R&D.

Efficiency, end use, and conservation

Nine energy efficiency- and conservation-related tax provisions collectively increased from \$3.9 billion in FY 2016 to \$4.6 billion in FY 2022 (Figure 6 and Table A5). The tax credit for residential energy-efficient property and for clean-burning vehicles (largely electric vehicles) accounted for \$959 million and \$505 million of those increases between FY 2016 and FY 2022, respectively, as other end use provisions decreased or remained relatively flat over the same period.

Figure 6. Conservation and end use-related energy-specific subsidies and support, FY 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table 6 and Table A3

Notes: DOE=U.S. Department of Energy.

Table 6. Quantified conservation and end use-related energy-specific subsidies and support by type, FY 2016–22

million 2022 dollars

Fiscal year	Direct expenditures	Tax expenditures	Research and Development	DOE Loan Guarantee Program	Total	Annual share of FY 2016–22
2016	4,446	3,858	513	-	8,817	12%
2017	4,404	3,564	511	-	8,478	12%
2018	4,598	4,049	383	-	9,031	13%
2019	4,639	4,186	541	-	9,366	13%
2020	5,692	4,188	734	-	10,615	15%
2021	10,419	4,234	459	-	15,113	21%
2022	4,845	4,595	499	166	10,104	14%
Total	39,043	28,674	3,641	166	71,523	100%
Share of Total	55%	40%	5%	0%	100%	

Data source: U.S. Energy Information Administration, *Federal Energy Interventions and Subsidies, FY 2016–22*, Table A3

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. DOE=U.S. Department of Energy.

Combined, the direct and R&D support for conservation and efficiency increased from \$5.0 billion in FY 2016 to \$5.3 billion in FY 2022 (Table A6 and Table A7). The large increase in direct expenditures after FY 2020 resulted from congressional actions in response to the pandemic. In FY 2022, the Low-Income Home Energy Assistance Program (LIHEAP) administered by the U.S. Department of Health and Human

Services (funded at \$3.9 billion) accounted for more than 70% of that FY 2022 total. R&D program expenditures that relate to conservation and efficiency in FY 2022 were \$499 million; most of this support originated at DOE.

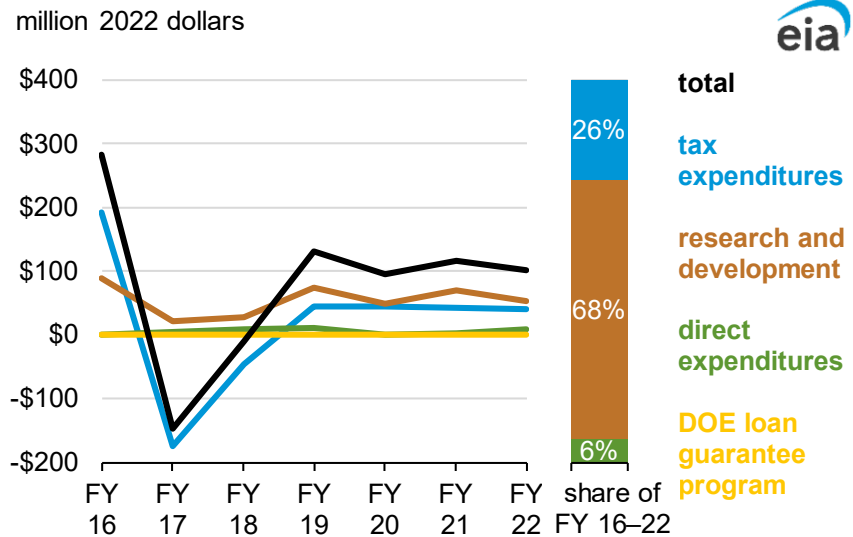
Electricity transmission and grid network

Smart grid and transmission-related tax expenditures fell from \$193 million in FY 2016 to \$40 million in FY 2022 (Table A5). This decrease resulted from two factors: the decrease in the estimated expenditures from transmission property treated

as 15-year depreciation property, which fell by more than half from FY 2016 to FY 2022, and the retirement on December 31, 2017, of a tax provision that encouraged energy transmission infrastructure reinvestment and assisted those in the industry who were restructuring. These changes and energy producers’ decisions on the timing of credits and expenses resulted in a negative expenditure, that is, a positive revenue inflow for the government in some fiscal years.¹⁴

DOE’s Electricity Delivery and Energy Reliability Research, Development, and Analysis program provided most of the support for transmission grid-related R&D programs. This program accounted for 43% of total obligations in this category. The program was expanded prior to FY 2016 under now-expired ARRA funding.

Figure 7. Electricity transmission and grid-related energy-specific subsidies and support, fiscal years (FY) 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table 7 and Table A3
 Note: DOE=U.S. Department of Energy.

¹⁴ As noted by Treasury: “A tax expenditure estimate for a provision that properly is thought of as a tax subsidy or tax break nonetheless can take on a negative value in some years, indicating that it raises revenue in those years. This happens because of timing effects. Provisions that accelerate deductions or defer the recognition of income have offsetting revenue impacts over time and, depending on the pattern of the underlying economic activity, can have a negative revenue impact in a particular year.” <https://home.treasury.gov/policy-issues/tax-policy/tax-expenditures>

Table 7. Quantified electricity transmission and smart grid-related energy-specific subsidies and support by type, FY 2016–22

million 2022 dollars

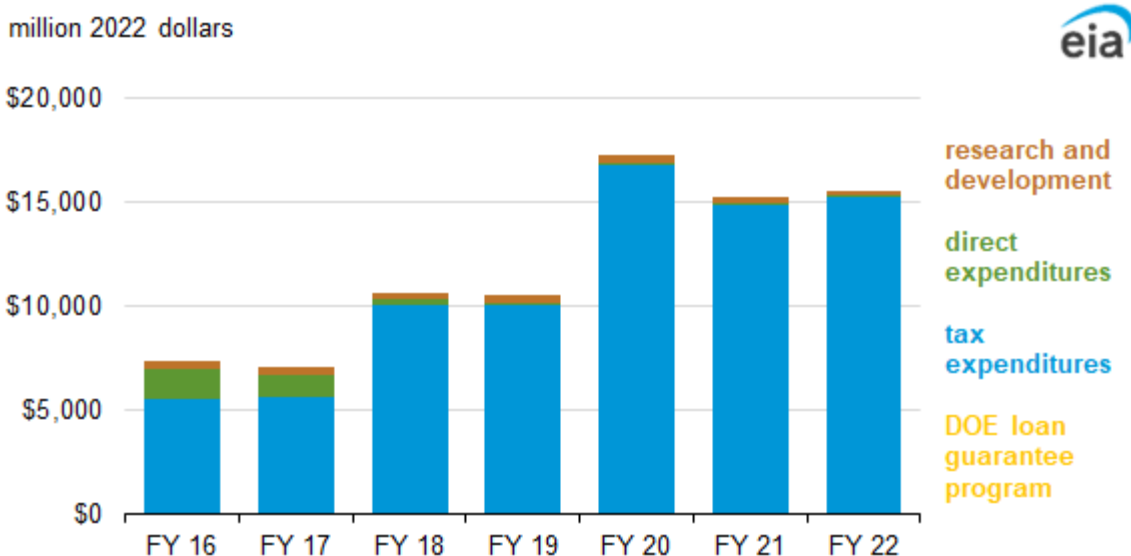
Fiscal year	Direct expenditures	Tax expenditures	Research and Development	DOE Loan Guarantee Program	Total	Annual share of FY 2016–22
2016	1	193	89	-	283	50%
2017	5	(174)	21	-	(148)	(26)%
2018	8	(46)	28	-	(10)	(2)%
2019	11	46	75	-	131	23%
2020	0	45	49	-	94	17%
2021	2	43	71	-	116	20%
2022	8	40	53	-	102	18%
Total	36	148	387	-	570	100%
Share of Total	6%	26%	68%	-	100%	

Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A3

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. DOE=U.S. Department of Energy.

Renewable-related subsidy trends

Total renewable subsidies increased from \$7.4 billion in FY 2016 to \$15.6 billion in FY 2022. Tax and direct expenditures combined accounted for about 97% of total renewable subsidies over that period. Due to decreasing direct expenditures and growing tax expenditures, tax expenditures have made up nearly all of the renewable subsidies in recent years (Figure 8).

Figure 8. Renewable-related energy subsidies, FY 2016–22

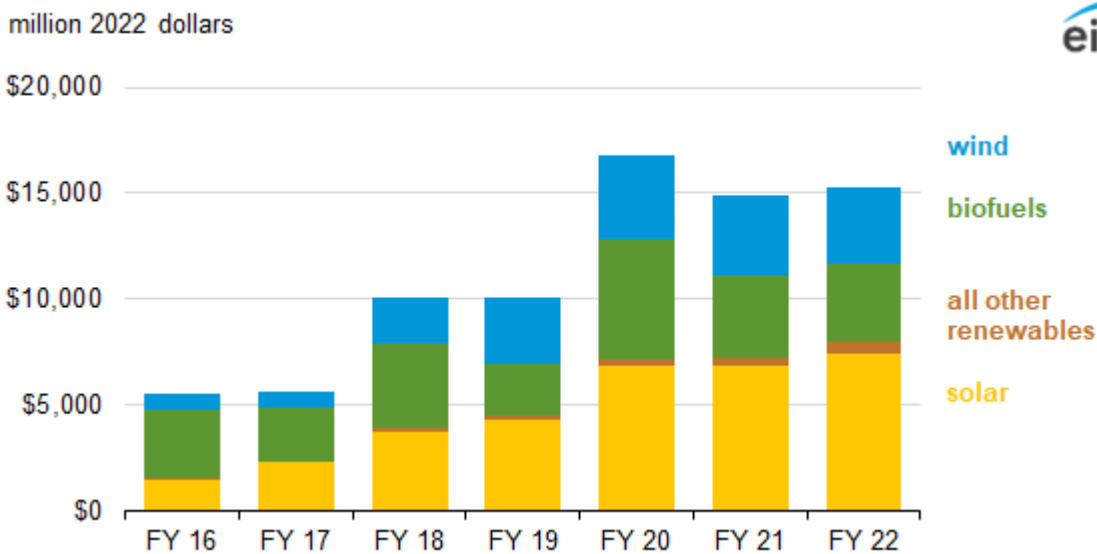
Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A4

Note: DOE=U.S. Department of Energy.

Tax expenditures for solar applications have become the largest share of subsidies for renewable energy, not only because of rapid industry growth but also because the investment tax credit designated for

solar projects is claimed in full in the year an asset enters commercial operation (Figure 9). Other technologies, particularly wind, claim the production tax credit (PTC), which is based on annual production and remains available in future operating years. Biofuels, once the largest recipient of the PTC, have grown during FY 2016–22 but not as rapidly as solar.

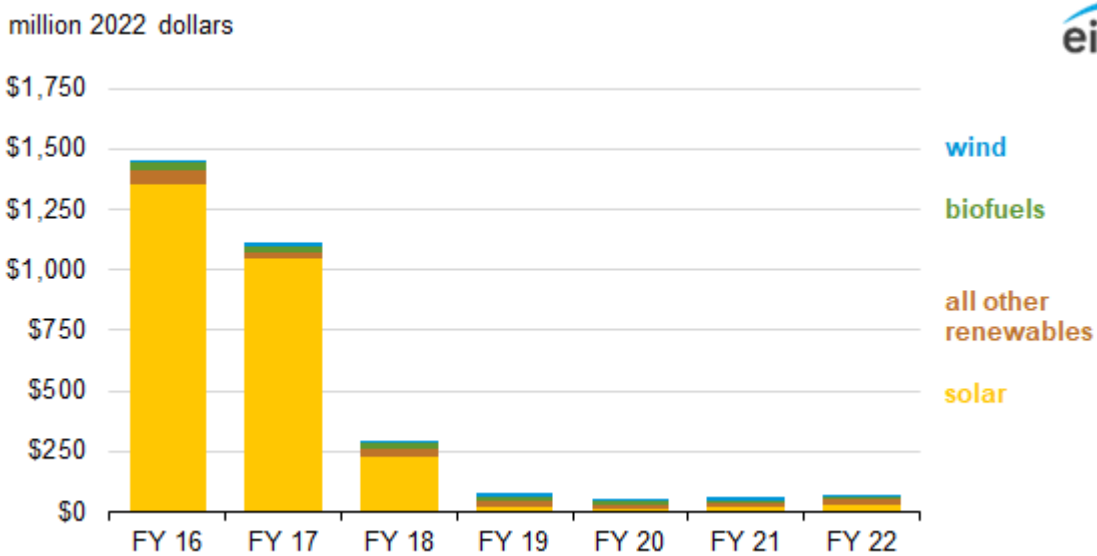
Figure 9. Renewable-related estimated tax expenditures, FY 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A4

Nearly all direct expenditures for renewable-related energy subsidies for 2016 through 2018 were associated with solar energy applications (Figure 10). Direct expenditures declined significantly, by almost 75% over two successive periods, from FY 2017 to FY 2018 and from FY 2018 to FY 2019 and remained comparatively low through FY 2022. Solar-related direct expenditures decreased the most over the period.

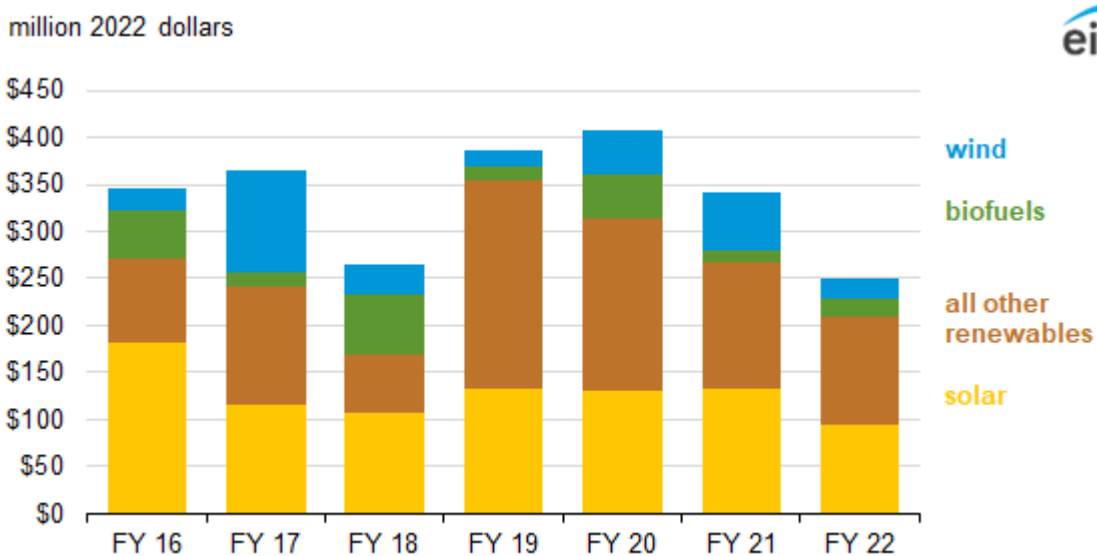
Figure 10. Renewable-related direct expenditures, FY 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A4

Renewable R&D spending was \$347 million for FY 2016, increased to about \$409 million for FY 2020, and dropped to \$250 million in FY 2022 (Figure 11). Over 75% of each fiscal year’s federal renewable R&D funds were for electricity projects.

Figure 11. Renewable-related research and development expenditures, FY 2016–22

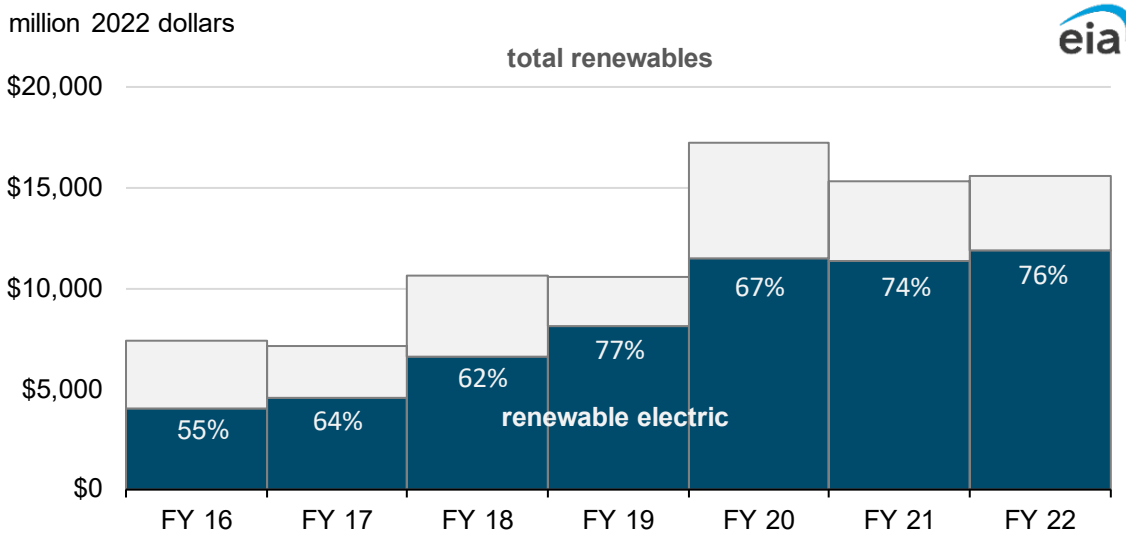


Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A4

Expenditures for solar, wind, and other renewable electricity technologies (for example, biomass electricity, hydro, and geothermal) accounted for between 76% and 96% of R&D expenditures for renewables from FY 2016 through FY 2022. Spending for biofuels varied similarly from 4% to 24% of total R&D expenditures over that period.

Figure 12 shows the total subsidy amounts broken out by electric-related and non-electric renewable energy. This breakout mainly pertains to biomass energy, separating biomass used for electric power from biofuels. We provide this graph for analytic purposes; it does not exist from any other source.

Figure 12. Renewable electric- and non-electric-related total expenditures, FY 2016–22



Data source: U.S. Energy Information Administration, *Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2016–2022*, Table A4

Appendix A. Detailed Tables

Table A1. Energy subsidies and support, select indicators, fiscal years (FY) 2016–22

million 2022 dollars, unless otherwise noted

Indicators	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Total energy subsidies and support	17,785	17,589	24,646	25,742	32,370	35,813	29,363
U.S. energy consumption (trillion Btu)	96,599	96,999	100,704	100,820	94,519	96,943	99,905
U.S. energy production (trillion Btu)	84,766	86,615	93,740	100,528	97,899	96,626	102,247
U.S. coal production (trillion Btu)	14,807	15,721	15,355	14,839	11,356	11,339	12,033
U.S. dry natural gas and natural gas plant liquids production (trillion Btu)	32,476	32,422	36,447	40,664	41,998	42,122	44,477
U.S. crude oil production (trillion Btu)	18,786	18,986	21,847	25,018	24,624	22,994	24,327
U.S. nuclear production (trillion Btu)	8,352	8,328	8,557	8,410	8,336	8,125	8,065
U.S. hydroelectric production (trillion Btu)	2,481	2,756	2,628	2,612	2,498	2,230	2,360
U.S. biomass production (trillion Btu)	5,084	5,161	5,296	5,243	4,877	4,940	5,171
U.S. wind production (trillion Btu)	2,037	2,285	2,504	2,540	2,846	3,215	3,791
U.S. solar production (trillion Btu)	534	744	898	992	1,167	1,458	1,811
U.S. geothermal production (trillion Btu)	209	213	208	209	196	204	212

Data source: **Consumption:** U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3, accessed April 2023. **Production:** U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.2, accessed April 2023. **Tax expenditure estimates:** Office of Management and Budget, *Budget of the United States Government, Analytical Perspectives*, Fiscal Years 2018, 2019, 2020, 2021, 2022, 2023, and 2024, accessed March 13, 2023. Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (Washington, DC, January 2017), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2017–2021*, JCX-34-18 (Washington, DC, May 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2018–2022*, JCX-81-18, (Washington, DC, October 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2019–2023*, JCX-55-19, (Washington, DC, December 2019), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2020–2024*, JCX-23-20, (Washington, DC, November 2020), Table 1; and Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2022–2026*, JCX-22-22, (Washington, DC, December 2022), Table 1. **Federal direct expenditure and R&D expenditure subsidies:** U.S. Department of the Treasury, USASpending.gov - the official open data source of federal spending information, <https://www.usaspending.gov/>, accessed February 8, 2023. U.S. Department of the Treasury, *1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits*, <https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/1603-program-payments-for-specified-energy-property-in-lieu-of-tax-credits>, accessed February 8, 2023. **Loan guarantee programs credit subsidy:** Computed from data from U.S. Department of Energy, Loan Program Office, <https://www.energy.gov/lpo/portfolio-projects>, accessed May 5, 2023, and U.S. Department of the Treasury, USASpending.gov—the official open data source of federal spending information, <https://www.usaspending.gov/search>.

Notes: Totals may not equal the sum of components due to independent rounding. Energy subsidies and support excludes *uncategorized* direct and R&D expenditures. Btu=British thermal units.

Table A2. Estimates of energy-specific tax expenditures, fiscal years (FY) 2016–22

million 2022 dollars

Tax provision	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Energy Investment Credit	1,429	2,179	3,658	4,194	6,773	6,812	7,340
Energy Production Credit	1,681	1,873	3,624	4,782	5,602	5,666	4,160
Biodiesel Producer Tax Credit ^a	3,182	2,462	3,923	2,408	5,680	3,867	3,660
Credit for residential energy efficient property	1,741	1,685	2,186	2,238	2,645	2,774	2,700
Tax credit and deduction for clean-burning vehicles	576	695	851	1,063	636	482	1,082
Excess of percentage over cost depletion	492	518	403	757	658	664	960
Expensing of exploration and development costs	(540)	(766)	1,116	1,051	45	(54)	780
Credit for energy efficiency improvements to existing homes	636	342	299	271	268	257	450
Amortization of certain pollution control facilities	600	942	690	452	446	428	400
Alternative Fuel and Fuel Mixture Credit	708	495	817	565	614	1,093	320
Allowance for the deduction of certain energy efficient commercial building property	96	35	46	11	179	225	160
Amortize all geological and geophysical expenditures over two years	84	82	265	260	89	118	120
Credit for construction of new energy efficient homes	252	200	138	57	357	396	120
Nuclear decommissioning	192	247	104	113	112	118	110
Credit for holding Clean Renewable Energy Bonds ^b	84	82	81	79	78	75	70
Capital gains treatment of royalties on coal	180	165	184	170	112	75	50
Exclusion from income of conservation subsidies provided by public utilities	516	554	495	509	67	64	50
Transmission property treated as 15-year property	120	47	46	45	45	43	40
Biodiesel and small agri-biodiesel producer tax credits	36	47	23	-	33	43	30
Qualified Energy Conservation Bonds ^b	36	35	35	34	33	32	30
Exclusion of special benefits for disabled coal miners	36	24	23	23	22	21	20
Advanced Energy Property Credit	12	59	-	11	11	11	10
Exception from passive loss limitation for working interests in oil and natural gas properties	72	24	12	11	22	21	10
Mine Rescue Training Credit	2	12	12	11	11	11	10
Alcohol fuel credits	12	24	12	-	-	11	-
Credit for investment in clean coal facilities	192	165	104	23	33	-	-
Credit for production from advanced nuclear power facilities	-	-	-	-	-	-	-
Deferral of gain from disposition of transmission property to implement FERC restructuring policy	72	(224)	(92)	-	-	-	-

Tax provision	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Natural gas distribution pipelines being treated as 15-year property	168	165	115	79	-	-	-
Partial expensing of investments in advanced mine safety equipment	29	12	12	-	-	-	-
Temporary 50% expensing for equipment used in the refining of liquid fuels	(2,113)	(1,626)	(943)	-	-	-	-
Total	10,586	10,555	18,234	19,217	24,572	23,255	22,682

Data source: **Tax expenditure estimates:** Office of Management and Budget, *Budget of the United States Government, Analytical Perspectives*, Fiscal Years 2018, 2019, 2020, 2021, 2022, 2023, and 2024, accessed March 13, 2023. Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (Washington, DC, January 2017), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2017–2021*, JCX-34-18 (Washington, DC, May 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2018–2022*, JCX-81-18, (Washington, DC, October 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2019–2023*, JCX-55-19, (Washington, DC, December 2019), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2020–2024*, JCX-23-20, (Washington, DC, November 2020), Table 1; and, Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2022–2026*, JCX-22-22, (Washington, DC, December 2022), Table 1.

^aThe Biodiesel Producer Tax Credit is the excise tax exemption to the biodiesel and small agri-biodiesel producer tax credits. These tax credits are both listed as footnotes in OMB’s *Analytical Perspectives* tax expenditure table, which includes energy tax expenditures.

^bIn addition, the provision has an outlay effect.

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. The Advanced Energy Manufacturing Facility Investment Tax Credit (also known as the Advanced Energy Property Credit) was allocated by fuel using data from “[Energy Department Announces \\$150 Million in Tax Credits to Invest in U.S. Clean Energy Manufacturing](#),” accessed April 12, 2023. FERC=Federal Energy Regulatory Commission.

Table A3. Quantified energy-specific subsidies and support by type, fiscal years (FY) 2016–22

million 2022 dollars, unless otherwise noted

Year and support type	Coal	Refined coal	Natural gas and petroleum liquids	Nuclear	Renewables	Electricity—smart grid and transmission	Conservation	End use	Total	Share of total subsidies and support
2016										
Direct expenditures	(446)	-	63	40	1,456	1	287	4,159	5,559	31%
Tax expenditures	1,040	864	(1,129)	192	5,567	193	674	3,184	10,586	60%
Research and development	363	-	145	183	347	89	165	349	1,640	9%
DOE Loan Guarantee Program										0%
Total	957	864	(921)	415	7,370	283	1,125	7,857	17,785	100%
Share of total	5%	5%	-5%	2%	41%	2%	6%	44%	100%	
2017										
Direct expenditures	(13)	-	111	11	1,111	5	314	4,089	5,629	32%
Tax expenditures	1,321	1,065	(1,107)	249	5,637	(174)	383	3,181	10,555	60%
Research and development	248	-	58	203	365	21	90	421	1,406	8%
DOE Loan Guarantee Program										-
Total	1,555	1,065	(938)	463	7,113	(148)	787	7,691	17,589	100%
Share of total	9%	6%	-5%	3%	40%	-1%	4%	44%	100%	
2018										
Direct expenditures	4	-	150	31	296	8	298	4,300	5,086	21%
Tax expenditures	1,024	1,251	1,783	104	10,069	(46)	334	3,716	18,234	74%
Research and development	299	-	132	219	265	28	121	262	1,326	5%
DOE Loan Guarantee Program										-
Total	1,327	1,251	2,065	354	10,629	(10)	752	8,278	24,646	100%
Share of total	5%	5%	8%	1%	43%	0%	3%	34%	100%	
2019										
Direct expenditures	1	-	171	27	75	11	381	4,258	4,923	19%
Tax expenditures	678	1,365	2,724	113	10,103	46	306	3,880	19,217	75%
Research and development	356	-	71	173	387	75	100	441	1,602	6%

Year and support type	Coal	Refined coal	Natural gas and petroleum liquids	Nuclear	Renewables	Electricity—smart grid and transmission	Conservation	End use	Total	Share of total subsidies and support
DOE Loan Guarantee Program										-
Total	1,035	1,365	2,966	313	10,565	131	787	8,579	25,742	100%
Share of total	4%	5%	12%	1%	41%	1%	3%	33%	100%	
2020										
Direct expenditures	5	-	166	19	56	0	388	5,304	5,938	18%
Tax expenditures	625	1,380	1,428	112	16,794	45	302	3,886	24,572	76%
Research and development	338	-	107	224	409	49	255	479	1,861	6%
DOE Loan Guarantee Program										-
Total	968	1,380	1,701	355	17,258	94	945	9,669	32,370	100%
Share of total	3%	4%	5%	1%	53%	0%	3%	30%	100%	
2021										
Direct expenditures	2	-	153	22	60	2	355	10,064	10,658	30%
Tax expenditures	536	1,584	1,842	118	14,896	43	290	3,944	23,255	65%
Research and development	500	-	105	423	343	71	194	265	1,900	5%
DOE Loan Guarantee Program										-
Total	1,038	1,584	2,100	563	15,299	116	839	14,273	35,813	100%
Share of total	3%	4%	6%	2%	43%	0%	2%	40%	100%	
2022										
Direct expenditures	3	-	103	21	74	8	823	4,022	5,054	17%
Tax expenditures	590	-	2,080	110	15,266	40	481	4,114	22,682	77%
Research and development	280	-	121	259	250	53	134	365	1,461	5%
DOE Loan Guarantee Program								166	166	1%
Total	873	-	2,304	390	15,589	102	1,438	8,666	29,363	100%
Share of total	3%	0%	8%	1%	53%	0%	5%	30%	100%	
2016 to 2022										
Direct expenditures	(445)	-	915	172	3,127	36	2,846	36,196	42,847	23%
Tax expenditures	5,814	7,510	7,622	999	78,332	148	2,770	25,905	129,099	70%

Year and support type	Coal	Refined coal	Natural gas and petroleum liquids	Nuclear	Renewables	Electricity—smart grid and transmission	Conservation	End use	Total	Share of total subsidies and support
Research and development	2,383	-	739	1,684	2,364	387	1,058	2,583	11,197	6%
DOE Loan Guarantee Program	-	-	-	-	-	-	-	166	166	0%
Total	7,752	7,510	9,276	2,855	83,823	570	6,674	64,849	183,309	100%
Share of total	4%	4%	5%	2%	46%	0%	4%	35%	100%	

Data source: **Tax expenditure estimates:** Office of Management and Budget, *Budget of the United States Government, Analytical Perspectives*, Fiscal Years 2018, 2019, 2020, 2021, 2022, 2023, and 2024, accessed March 13, 2023. Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (Washington, DC, January 2017), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2017–2021*, JCX-34-18 (Washington, DC, May 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2018–2022*, JCX-81-18, (Washington, DC, October 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2019–2023*, JCX-55-19, (Washington, DC, December 2019), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2020–2024*, JCX-23-20, (Washington, DC, November 2020), Table 1; and, Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2022–2026*, JCX-22-22, (Washington, DC, December 2022), Table 1. **Federal direct expenditure and R&D expenditure subsidies:** U.S. Department of the Treasury, USASpending.gov—the official open data source of federal spending information, <https://www.usaspending.gov/>, accessed February 8, 2023. U.S. Department of the Treasury, *1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits*, <https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/1603-program-payments-for-specified-energy-property-in-lieu-of-tax-credits>, accessed February 8, 2023. **Loan guarantee programs credit subsidy:** Computed from data from U.S. Department of Energy, Loan Program Office, <https://www.energy.gov/lpo/portfolio-projects>, accessed May 5, 2023, and Treasury, USASpending.gov, <https://www.usaspending.gov/search>.

Notes: Totals may not equal sum of components due to independent rounding. 0 estimate rounds to zero; - estimate is zero. Energy-specific tax expenditures associated with the renewables production tax credit were allocated based on Joint Committee on Taxation data. Energy subsidies and support excludes “uncategorized” direct and R&D expenditures. DOE=U.S. Department of Energy.

Table A4. Quantified renewable-related energy-specific subsidies and support by type, fiscal years (FY) 2016–22

million 2022 dollars, unless otherwise noted

Year and support type	Renewable electric						Subtotal renewable electric	Biofuels	Total renewables	Share of total renewables subsidies
	Biomass	Geothermal	Hydropower	Solar	Wind	Other				
2016										
Direct expenditures	33	6	9	1,352	13	13	1,425	31	1,456	20%
Tax expenditures	25	0	0	1,502	810	-	2,337	3,230	5,567	76%
Research and development	35	13	16	183	23	23	294	53	347	5%
DOE Loan Guarantee Program	-	-	-	-	-	-	-	-	-	-
Total	94	19	26	3,036	846	36	4,056	3,314	7,370	100%
Share of total renewables	1%	0%	0%	41%	11%	0%	55%	45%	100%	
2017										
Direct expenditures	6	0	12	1,048	14	9	1,090	22	1,111	16%
Tax expenditures	37	18	0	2,272	777	-	3,104	2,533	5,637	79%
Research and development	14	6	71	116	107	33	348	16	365	5%
DOE Loan Guarantee Program	-	-	-	-	-	-	-	-	-	-
Total	57	25	83	3,437	899	42	4,542	2,571	7,113	100%
Share of total renewables	1%	0%	1%	48%	13%	1%	64%	36%	100%	
2018										
Direct expenditures	3	9	11	223	13	15	275	20	296	3%
Tax expenditures	93	93	-	3,723	2,203	-	6,111	3,957	10,069	95%
Research and development	17	25	11	108	33	9	201	64	265	2%
DOE Loan Guarantee Program	-	-	-	-	-	-	-	-	-	-
Total	113	127	22	4,054	2,248	24	6,587	4,042	10,629	100%
Share of total renewables	1%	1%	0%	38%	21%	0%	62%	38%	100%	
2019										
Direct expenditures	0	0	14	22	18	8	62	13	75	1%
Tax expenditures	134	134	0	4,262	3,165	-	7,696	2,408	10,103	96%
Research and development	12	165	21	133	18	23	373	14	387	4%

Year and support type	Renewable electric							Subtotal renewable electric	Biofuels	Total renewables	Share of total renewables subsidies
	Biomass	Geothermal	Hydropower	Solar	Wind	Other					
DOE Loan Guarantee Program	-	-	-	-	-	-	-	-	-	-	-
Total	146	299	35	4,418	3,201	31	8,130	2,435	10,565	100%	
Share of total renewables	7%	1%	1%	7%	36%	3%	54%	46%	100%		
2020											
Direct expenditures	3	0	8	12	10	7	39	16	56	0%	
Tax expenditures	184	92	0	6,841	3,964	-	11,080	5,713	16,794	97%	
Research and development	46	49	38	130	47	50	361	47	409	2%	
DOE Loan Guarantee Program	-	-	-	-	-	-	-	-	-	-	
Total	232	141	46	6,982	4,021	57	11,481	5,777	17,258	100%	
Share of total renewables	4%	2%	2%	38%	41%	2%	88%	12%	100%		
2021											
Direct expenditures	3	0	11	17	12	7	50	10	60	0%	
Tax expenditures	209	105	0	6,877	3,784	-	10,976	3,920	14,896	97%	
Research and development	16	47	42	134	62	30	330	12	343	2%	
DOE Loan Guarantee Program	-	-	-	-	-	-	-	-	-	-	
Total	228	151	53	7,028	3,858	37	11,356	3,943	15,299	100%	
Share of total renewables	1%	1%	1%	33%	19%	3%	58%	42%	100%		
2022											
Direct expenditures	0	0	10	27	12	14	63	11	74	0%	
Tax expenditures	308	308	0	7,401	3,559	-	11,576	3,690	15,266	98%	
Research and development	4	45	31	94	22	35	230	20	250	2%	
DOE Loan Guarantee Program	-	-	-	-	-	-	-	-	-	-	
Total	312	353	41	7,522	3,592	49	11,869	3,721	15,589	100%	
Share of total renewables	1%	1%	1%	33%	19%	3%	58%	42%	100%		

Data source: **Tax expenditure estimates:** Office of Management and Budget, *Budget of the United States Government, Analytical Perspectives*, Fiscal Years 2018, 2019, 2020, 2021, 2022, 2023, and 2024, accessed March 13, 2023. Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (Washington, DC, January 2017), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2017–2021*, JCX-34-18 (Washington, DC, May 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2018–2022*, JCX-81-18, (Washington, DC, October 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax*

Renewable electric

Year and support type	Biomass	Geothermal	Hydropower	Solar	Wind	Other	Subtotal renewable electric	Biofuels	Total renewables	Share of total renewables subsidies
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Expenditures for Fiscal Years 2019–2023, JCX-55-19, (Washington, DC, December 2019), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2020–2024*, JCX-23-20, (Washington, DC, November 2020), Table 1; and, Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2022–2026*, JCX-22-22, (Washington, DC, December 2022), Table 1. **Federal direct expenditure and R&D expenditure subsidies:** U.S. Department of the Treasury, USASpending.gov—the official open data source of federal spending information, <https://www.usaspending.gov/>, accessed February 8, 2023. U.S. Department of the Treasury, *1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits*, <https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/1603-program-payments-for-specified-energy-property-in-lieu-of-tax-credits>, accessed February 8, 2023. **Loan guarantee programs credit subsidy:** Computed from data from U.S. Department of Energy, Loan Program Office, <https://www.energy.gov/lpo/portfolio-projects>, accessed May 5, 2023, and Treasury, USASpending.gov, <https://www.usaspending.gov/search>.

Notes: Totals may not equal sum of components due to independent rounding. 0 estimate rounds to zero; - estimate is zero. Energy-specific tax expenditures associated with the renewables production tax credit were allocated based on Joint Committee on Taxation data. Energy subsidies and support excludes “uncategorized” direct and R&D expenditures. DOE=U.S. Department of Energy.

Table A5. Estimates of energy-specific tax expenditures by beneficiary, fiscal years (FY) 2016–22

million 2022 dollars

Tax provision	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Biofuels	3,230	2,533	3,957	2,408	5,713	3,920	3,690
Alcohol fuel credits	12	24	12	-	-	11	-
Biodiesel and small agri-biodiesel producer tax credits	36	47	23	-	33	43	30
Biodiesel Producer Tax Credit ^a	3,182	2,462	3,923	2,408	5,680	3,867	3,660
Biomass	25	37	93	134	184	209	308
Advanced Energy Property Credit	0	1	-	0	0	0	0
Energy Production Credit	25	36	93	134	184	209	308
Coal	1,040	1,321	1,024	678	625	536	590
Advanced Energy Property Credit	0	1	-	0	0	0	0
Amortization of certain pollution control facilities	600	942	690	452	446	428	400
Capital gains treatment of royalties on coal	180	165	184	170	112	75	50
Credit for investment in clean coal facilities	192	165	104	23	33	-	-
Excess of percentage over cost depletion	-	-	-	-	-	-	50
Exclusion of special benefits for disabled coal miners	36	24	23	23	22	21	20
Expensing of exploration and development costs	-	-	-	-	-	-	60
Mine Rescue Training Credit	2	12	12	11	11	11	10
Partial expensing of investments in advanced mine safety equipment	29	12	12	-	-	-	-
Conservation	674	383	334	306	302	290	481
Advanced Energy Property Credit	1	6	-	1	1	1	1
Credit for energy efficiency improvements to existing homes	636	342	299	271	268	257	450
Qualified Energy Conservation Bonds	36	35	35	34	33	32	30
End use	3,184	3,181	3,716	3,880	3,886	3,944	4,114
Advanced Energy Property Credit	3	12	-	2	2	2	2
Allowance for the deduction of certain energy efficient commercial building property	96	35	46	11	179	225	160
Credit for construction of new energy efficient homes	252	200	138	57	357	396	120
Credit for residential energy efficient property	1,741	1,685	2,186	2,238	2,645	2,774	2,700
Exclusion from income of conservation subsidies provided by public utilities	516	554	495	509	67	64	50

Tax provision	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Tax credit and deduction for clean-burning vehicles	576	695	851	1,063	636	482	1,082
Geothermal	0	18	93	134	92	105	308
Advanced Energy Property Credit	0	0	-	0	0	0	0
Energy Production Credit	-	18	93	134	92	105	308
Hydropower	0	0	-	0	0	0	0
Advanced Energy Property Credit	0	0	-	0	0	0	0
Natural gas and petroleum liquids	(1,129)	(1,107)	1,783	2,724	1,428	1,842	2,080
Alternative Fuel and Fuel Mixture Credit	708	495	817	565	614	1,093	320
Amortize all geological and geophysical expenditures over two years	84	82	265	260	89	118	120
Exception from passive loss limitation for working interests in oil and natural gas properties	72	24	12	11	22	21	10
Excess of percentage over cost depletion	492	518	403	757	658	664	910
Expensing of exploration and development costs	(540)	(766)	1,116	1,051	45	(54)	720
Natural gas distribution pipelines being treated as 15-year property	168	165	115	79	-	-	-
Temporary 50% expensing for equipment used in the refining of liquid fuels	(2,113)	(1,626)	(943)	-	-	-	-
Nuclear	192	249	104	113	112	118	110
Advanced Energy Property Credit	0	2	-	0	0	0	0
Credit for production from advanced nuclear power facilities	-	-	-	-	-	-	-
Nuclear decommissioning	192	247	104	113	112	118	110
Refined coal	864	1,065	1,251	1,365	1,380	1,584	-
Energy Production Credit	864	1,065	1,251	1,365	1,380	1,584	-
Smart Grid and Transmission	193	(174)	(46)	46	45	43	40
Advanced Energy Property Credit	1	3	-	1	1	1	0
Deferral of gain from disposition of transmission property to implement FERC restructuring policy	72	(224)	(92)	-	-	-	-
Transmission property treated as 15-year property	120	47	46	45	45	43	40
Solar	1,502	2,272	3,723	4,262	6,841	6,877	7,401
Advanced Energy Property Credit	6	27	-	5	5	5	5
Credit for holding Clean Renewable Energy Bonds	67	66	64	63	62	60	56
Energy Investment Credit	1,429	2,179	3,658	4,194	6,773	6,812	7,340
Wind	810	777	2,203	3,165	3,964	3,784	3,559

Tax provision	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Advanced Energy Property Credit	1	7	-	1	1	1	1
Credit for holding Clean Renewable Energy Bonds	17	16	16	16	16	15	14
Energy Production Credit	792	754	2,186	3,148	3,947	3,768	3,544
Total	10,586	10,555	18,234	19,217	24,572	23,255	22,682

Data source: **Tax expenditure estimates:** Office of Management and Budget, *Analytical Perspectives, Budget of the United States Government*, Fiscal Years 2018, 2019, 2020, 2021, 2022, 2023, and 2024, accessed March 13, 2023. Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2016–2020*, JCX-3-17 (Washington, DC, January 2017), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2017–2021*, JCX-34-18 (Washington, DC, May 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2018–2022*, JCX-81-18, (Washington, DC, October 2018), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2019–2023*, JCX-55-19, (Washington, DC, December 2019), Table 1; Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2020–2024*, JCX-23-20, (Washington, DC, November 2020), Table 1; and, Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2022–2026*, JCX-22-22, (Washington, DC, December 2022), Table 1.

^aThe Biodiesel Producer Tax Credit is the excise tax exemption to the biodiesel and small agri-biodiesel producer tax credits. These tax credits are both listed as footnotes to OMB’s *Analytical Perspectives* tax expenditure table, which includes energy tax expenditures.

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. The Advanced Energy Manufacturing Facility Investment Tax Credit (also called the Advanced Energy Property Credit) was allocated by fuel using data from “[Energy Department Announces \\$150 Million in Tax Credits to Invest in U.S. Clean Energy Manufacturing](#),” accessed April 12, 2023. FERC=Federal Energy Regulatory Commission.

Table A6. Estimates of energy-specific direct expenditures, fiscal years (FY) 2016–22

million 2022 dollars, unless otherwise noted

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Biofuels	31	22	20	13	16	10	11
U.S. Department of Agriculture	31	21	20	13	16	9	10
Biodiesel—10.306	1	1	1	-	(0)	-	-
Bioenergy Program for Advanced Biofuels—10.867	17	16	16	10	13	5	7
Biomass Crop Assistance Program—10.087	7	1	-	-	-	-	-
Sun Grant Program—10.320	6	3	3	3	3	3	3
Wood Utilization Assistance—10.674	0	-	0	-	-	0	1
U.S. Department of Defense	0	1	-	0	0	1	0
Basic, Applied, and Advanced Research in Science and Engineering—12.630	0	1	-	(0)	-	1	0
Research and Technology Development—12.910	-	-	-	0	0	-	-
U.S. Department of Energy	-	(0)	-	-	-	-	-
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	-	-	-	-	-	-	-
Industrial Carbon Capture and Storage (CCS) Application—81.134	-	-	-	-	-	-	-
Regional Biomass Energy Programs—81.079	-	(0)	-	-	-	-	-
U.S. Department of the Interior	-	-	-	-	-	-	-
Minerals and Mining on Indian Lands—15.038	-	-	-	-	-	-	-
U.S. Environmental Protection Agency	-	-	-	-	-	0	-
National Clean Diesel Emissions Reduction Program—66.039	-	-	-	-	-	0	-
State Clean Diesel Grant Program—66.040	-	-	-	-	-	-	-
Biomass	33	6	3	0	3	3	0
U.S. Department of Agriculture	7	6	3	0	3	3	0
Biomass Crop Assistance Program—10.087	5	4	1	0	0	0	0
Repowering Assistance—10.866	-	-	-	-	-	-	-
Wood Utilization Assistance—10.674	2	1	1	0	3	3	0
U.S. Department of Defense	-	-	(0)	-	0	-	-
Basic, Applied, and Advanced Research in Science and Engineering—12.630	-	-	(0)	-	0	-	-
U.S. Department of Energy	-	(0)	-	-	-	-	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	-	(0)	-	-	-	-	-
U.S. Department of the Interior	0	0	0	-	-	-	(0)
Minerals and Mining on Indian Lands—15.038	0	-	0	-	-	-	(0)
Tribal Energy Development Capacity Grants—15.148	-	0	-	-	-	-	-
U.S. Department of the Treasury	26	-	-	-	-	-	-
Energy Investment Grant	26	-	-	-	-	-	-
U.S. Environmental Protection Agency	-	-	0	-	-	-	-
State Clean Diesel Grant Program—66.040	-	-	0	-	-	-	-
Coal	(446)	(13)	4	1	5	2	3
U.S. Department of Agriculture	-	-	-	-	-	-	3
Wood Utilization Assistance—10.674	-	-	-	-	-	-	3
U.S. Department of Defense	2	3	4	0	3	1	-
Basic, Applied, and Advanced Research in Science and Engineering—12.630	2	3	3	0	2	1	-
Research and Technology Development—12.910	0	0	0	-	1	-	-
U.S. Department of Energy	(448)	(17)	-	-	3	-	-
Carbon Capture and Storage-FutureGen 2.0—81.130	(64)	-	-	-	-	-	-
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	-	-	-	-	-	-	-
Expand and Extend Clean Coal Power Initiative—81.131	(385)	(16)	-	-	3	-	-
Industrial Carbon Capture and Storage (CCS) Application—81.134	0	(0)	-	-	-	-	-
U.S. Department of the Interior	0	0	-	0	-	-	-
Bureau of Ocean Energy Management (BOEM) Environmental Studies (ES)—15.423	-	-	-	0	-	-	-
Energy Cooperatives to Support the National Energy Resources Data System—15.819	0	-	-	-	-	-	-
Minerals and Mining on Indian Lands—15.038	-	0	-	-	-	-	-
U.S. Department of Transportation	-	-	-	-	-	0	0
Air Emissions and Energy Initiative—20.817	-	-	-	-	-	0	0
U.S. Environmental Protection Agency	-	-	0	0	(0)	0	1
National Clean Diesel Emissions Reduction Program—66.039	-	-	0	1	0	0	1
State Clean Diesel Grant Program—66.040	-	-	-	(0)	(1)	-	(0)

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
U.S. Nuclear Regulatory Commission	-	-	-	-	-	0	-
U.S. Nuclear Regulatory Commission Scholarship and Fellowship Program—77.008	-	-	-	-	-	0	-
Conservation	287	314	298	381	388	355	823
U.S. Department of Agriculture	-	1	0	1	0	1	0
Rural Energy Savings Program (RESP)—10.751	-	-	-	-	-	-	-
Wood Utilization Assistance—10.674	-	1	0	1	0	1	0
U.S. Department of Defense	2	2	4	28	12	5	6
Basic, Applied, and Advanced Research in Science and Engineering—12.630	2	2	4	28	5	0	0
Research and Technology Development—12.910	-	-	-	-	7	5	5
U.S. Department of Energy	249	265	247	306	340	304	776
Energy Efficiency and Conservation Block Grant Program (EECBG)—81.128	-	-	-	-	-	-	-
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	1	0	0	0	0	1	3
Environmental Monitoring, Independent Research, Technical Analysis—81.005	-	-	-	-	-	(0)	-
Inventions and Innovations—81.036	-	0	-	-	-	-	-
State Energy Program—81.041	-	-	-	-	-	-	-
State Energy Program Special Projects—81.119	2	4	(0)	2	0	(0)	(0)
State Heating Oil and Propane Program—81.138	-	-	-	-	0	0	0
Weatherization Assistance for Low-Income Persons—81.042	246	260	247	304	339	303	773
U.S. Department of the Interior	-	0	-	-	-	-	-
Minerals and Mining on Indian Lands—15.038	-	0	-	-	-	-	-
U.S. Department of the Treasury	36	47	46	45	33	43	40
Outlay Equivalent for Qualified Energy Conservation Bonds	36	47	46	45	33	43	40
U.S. Department of Transportation	-	-	(1)	(0)	-	-	-
Clean Fuels—20.519	-	-	(1)	(0)	-	-	-
U.S. Environmental Protection Agency	0	0	2	1	2	2	2
National Clean Diesel Emissions Reduction Program—66.039	-	-	1	1	-	-	-
State Clean Diesel Grant Program—66.040	0	0	1	1	2	2	2
End use	4,159	4,089	4,300	4,258	5,304	10,064	4,022
U.S. Department of Agriculture	40	45	42	48	54	34	61

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Assistance to High Energy Cost Rural Communities—10.859	7	13	6	9	7	-	14
Rural Energy for America Program—10.868	32	32	36	39	48	34	46
Rural Energy Savings Program (RESP)—10.751	-	-	-	-	-	-	-
Wood Utilization Assistance—10.674	-	(0)	0	0	-	-	0
U.S. Department of Defense	7	5	21	12	8	4	7
Basic, Applied, and Advanced Research in Science and Engineering—12.630	7	5	21	6	8	4	6
Research and Technology Development—12.910	0	(0)	-	6	1	1	1
U.S. Department of Energy	61	49	59	69	66	65	67
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	11	4	10	5	5	7	4
Industrial Carbon Capture and Storage (CCS) Application—81.134	-	-	-	-	-	-	-
National Industrial Competitiveness through Energy, Environment, and Economics—81.105	-	-	-	-	(1)	-	-
State Energy Program—81.041	47	45	49	62	62	58	62
State Energy Program Special Projects—81.119	3	1	(0)	2	(0)	(0)	(0)
State Heating Oil and Propane Program—81.138	-	-	-	-	0	0	0
U.S. Department of Health and Human Service	4,044	3,988	4,184	4,126	5,175	9,958	3,883
Low-Income Home Energy Assistance—93.568	4,044	3,988	4,184	4,126	5,175	9,958	3,883
U.S. Department of State	-	(0)	-	-	-	-	-
Bureau of Western Hemisphere Affairs (WHA) Grant Programs (including Energy and Climate Partnership for the Americas)—19.750	-	(0)	-	-	-	-	-
U.S. Department of the Interior	0	-	-	-	-	-	3
Bureau of Ocean Energy Management (BOEM) Environmental Studies (ES)—15.423	-	-	-	-	-	-	3
Minerals and Mining on Indian Lands—15.038	0	-	-	-	-	-	-
U.S. Department of Transportation	8	2	(7)	-	-	(0)	-
Air Emissions and Energy Initiative—20.817	0	-	-	-	-	-	-
Capital Assistance Program for Reducing Energy Consumption and Greenhouse Gas Emissions—20.523	7	2	(7)	-	-	-	-
Clean Fuels—20.519	0	-	-	-	-	(0)	-
U.S. Environmental Protection Agency	-	-	1	2	1	2	1
National Clean Diesel Emissions Reduction Program—66.039	-	-	1	2	1	1	0
State Clean Diesel Grant Program—66.040	-	-	-	-	-	1	1

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Geothermal	6	0	9	0	0	0	0
U.S. Department of Defense	-	0	-	-	-	-	-
Basic, Applied, and Advanced Research in Science and Engineering—12.630	-	0	-	-	-	-	-
U.S. Department of Energy	-	-	-	-	-	-	-
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	-	-	-	-	-	-	-
State Energy Program Special Projects—81.119	-	-	-	-	-	-	-
U.S. Department of the Interior	-	-	-	-	-	-	-
Minerals and Mining on Indian Lands—15.038	-	-	-	-	-	-	-
U.S. Department of the Treasury	6	0	9	0	0	0	0
Energy Investment Grant	6	-	9	-	-	-	-
Outlay Equivalent for Clean Renewable Energy Bonds	0	0	0	0	0	0	0
Hydropower	9	12	11	14	8	11	10
U.S. Department of Defense	-	-	-	0	-	1	-
Basic, Applied, and Advanced Research in Science and Engineering—12.630	-	-	-	0	-	0	-
Research and Technology Development—12.910	-	-	-	-	-	1	-
U.S. Department of the Interior	1	1	0	-	-	-	-
Bureau of Ocean Energy Management (BOEM) Environmental Studies (ES)—15.423	1	1	0	-	-	-	-
Minerals and Mining on Indian Lands—15.038	0	-	-	-	-	-	-
U.S. Department of the Treasury	9	11	11	14	8	10	10
Outlay Equivalent for Clean Renewable Energy Bonds	9	11	11	14	8	10	10
Natural gas and petroleum liquids	63	111	150	171	166	153	103
U.S. Department of Defense	-	1	-	-	0	0	0
Basic, Applied, and Advanced Research in Science and Engineering—12.630	-	1	-	-	0	0	0
U.S. Department of Energy	0	5	2	3	0	1	0
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	-	(0)	-	-	-	-	-
Inventions and Innovations—81.036	0	0	-	-	-	-	-
State Heating Oil and Propane Program—81.138	0	0	0	0	0	1	0
Transport of Transuranic Wastes to the Waste Isolation Pilot Plant: States and Tribal Concerns, Proposed Solutions—81.106	-	4	2	3	-	-	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
U.S. Department of the Interior	13	17	14	14	13	12	14
Bureau of Ocean Energy Management (BOEM) Environmental Studies (ES)—15.423	0	(0)	-	-	-	0	0
Federal Oil and Gas Royalty Management State and Tribal Coordination—15.427	13	17	13	14	13	12	14
Louisiana State University (LSU) Coastal Marine Institute (CMI)—15.422	-	(0)	-	-	-	-	-
Minerals and Mining on Indian Lands—15.038	-	-	1	-	-	-	-
U.S. Department of Transportation	2	59	66	61	67	63	59
Air Emissions and Energy Initiative—20.817	-	-	-	-	0	-	-
Clean Fuels—20.519	1	-	-	(0)	-	-	(1)
PHMSA Pipeline Safety Program One Call Grant—20.721	1	(0)	1	1	1	1	1
Pipeline Safety Program State Base Grant—20.700	-	60	64	60	66	62	59
U.S. Environmental Protection Agency	47	29	68	93	85	76	29
National Clean Diesel Emissions Reduction Program—66.039	39	14	49	69	61	53	16
State Clean Diesel Grant Program—66.040	8	15	19	24	24	23	14
U.S. Nuclear Regulatory Commission	-	-	-	-	-	-	-
U.S. Nuclear Regulatory Commission Scholarship and Fellowship Program—77.008	-	-	-	-	-	-	-
Uncategorized	667	778	869	951	1,075	890	677
U.S. Department of Agriculture	15	9	13	13	18	8	18
Rural Telephone Loans and Loan Guarantees—10.851	-	-	-	-	-	-	-
Wood Utilization Assistance—10.674	15	9	13	13	18	8	18
U.S. Department of Defense	559	685	784	877	1,003	821	601
Basic, Applied, and Advanced Research in Science and Engineering—12.630	248	277	293	319	344	312	202
Research and Technology Development—12.910	311	408	491	558	659	510	399
U.S. Department of Energy	22	41	40	43	33	32	31
Energy Efficiency and Conservation Block Grant Program (EECBG)—81.128	-	-	-	-	0	-	-
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	14	21	15	13	12	16	17
Environmental Monitoring, Independent Research, Technical Analysis—81.005	-	-	-	0	2	1	1
Epidemiology and Other Health Studies Financial Assistance Program—81.108	5	16	18	21	16	15	13
Industrial Carbon Capture and Storage (CCS) Application—81.134	-	(0)	-	-	-	-	-
Inventions and Innovations—81.036	0	0	0	0	-	-	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Nuclear Legacy Cleanup Program—81.065	2	3	5	6	1	-	-
State Heating Oil and Propane Program—81.138	-	(0)	(0)	-	0	-	(0)
Transport of Transuranic Wastes to the Waste Isolation Pilot Plant: States and Tribal Concerns, Proposed Solutions—81.106	-	1	1	1	0	0	0
U.S. Department of Housing and Urban Development	(15)	-	-	-	-	-	-
Multifamily Energy Innovation Fund—14.319	(15)	-	-	-	-	-	-
U.S. Department of Labor	(0)	(1)	-	-	(0)	-	-
Program of Competitive Grants for Worker Training and Placement in High Growth and Emerging Industry Sectors—17.275	(0)	(1)	-	-	(0)	-	-
U.S. Department of State	15	9	17	8	12	8	13
Bureau of Western Hemisphere Affairs (WHA) Grant Programs (including Energy and Climate Partnership for the Americas)—19.750	15	9	17	8	12	8	13
U.S. Department of the Interior	9	9	13	10	6	15	6
Bureau of Ocean Energy Management (BOEM) Environmental Studies (ES)—15.423	4	5	5	4	5	6	6
Energy Cooperatives to Support the National Energy Resources Data System—15.819	-	0	0	0	-	-	(0)
Federal Oil and Gas Royalty Management State and Tribal Coordination—15.427	1	-	-	-	-	-	-
Louisiana State University (LSU) Coastal Marine Institute (CMI)—15.422	1	1	0	0	1	(0)	0
Minerals and Mining on Indian Lands—15.038	3	2	7	6	(1)	0	(0)
Tribal Energy Development Capacity Grants—15.148	-	1	0	-	1	9	(0)
U.S. Department of Transportation	55	1	0	(0)	(0)	0	1
Air Emissions and Energy Initiative—20.817	-	-	-	-	-	1	0
Clean Fuels—20.519	1	-	0	(0)	(0)	-	(0)
PHMSA Pipeline Safety Program One Call Grant—20.721	-	1	0	(0)	0	(0)	(0)
Pipeline Safety Program State Base Grant—20.700	54	-	-	(0)	(0)	(0)	1
U.S. Environmental Protection Agency	6	9	2	1	3	2	5
National Clean Diesel Emissions Reduction Program—66.039	1	7	1	1	3	2	1
State Clean Diesel Grant Program—66.040	6	2	1	-	-	0	3
U.S. Nuclear Regulatory Commission	0	15	(1)	(0)	1	4	2
U. S. Nuclear Regulatory Commission Nuclear Education Grant Program—77.006	-	5	-	(0)	-	-	-
U.S. Nuclear Regulatory Commission Minority Serving Institutions Program (MSIP)—77.007	0	1	0	(0)	-	-	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
U.S. Nuclear Regulatory Commission Scholarship and Fellowship Program—77.008	(0)	10	(1)	(0)	1	4	2
Nuclear	40	11	31	27	19	22	21
U.S. Department of Defense	2	2	3	1	-	0	1
Basic, Applied, and Advanced Research in Science and Engineering—12.630	2	2	3	1	-	0	0
Research and Technology Development—12.910	1	-	0	-	-	-	0
U.S. Department of Energy	18	6	10	8	19	6	11
Energy Efficiency and Conservation Block Grant Program (EECBG)—81.128	-	-	-	-	1	-	-
Environmental Monitoring, Independent Research, Technical Analysis—81.005	-	-	-	-	3	1	1
Epidemiology and Other Health Studies Financial Assistance Program—81.108	9	1	-	-	4	4	4
Nuclear Legacy Cleanup Program—81.065	5	4	8	6	5	-	-
State Energy Program—81.041	-	-	-	-	-	-	-
Transport of Transuranic Wastes to the Waste Isolation Pilot Plant: States and Tribal Concerns, Proposed Solutions—81.106	4	2	2	3	6	1	6
U.S. Nuclear Regulatory Commission	19	3	18	17	(0)	16	10
U. S. Nuclear Regulatory Commission Nuclear Education Grant Program—77.006	(0)	1	-	(0)	-	-	-
U.S. Nuclear Regulatory Commission Minority Serving Institutions Program (MSIP)—77.007	1	0	1	1	(0)	-	(0)
U.S. Nuclear Regulatory Commission Scholarship and Fellowship Program—77.008	18	2	18	17	(0)	16	10
Other renewables	13	9	15	8	7	7	14
U.S. Department of Agriculture	3	3	2	2	2	2	10
Rural Energy for America Program—10.868	3	2	2	2	2	2	10
Wood Utilization Assistance—10.674	0	0	0	0	0	-	(0)
U.S. Department of Defense	-	(0)	(0)	-	0	-	-
Basic, Applied, and Advanced Research in Science and Engineering—12.630	-	(0)	(0)	-	0	-	-
U.S. Department of Energy	0	1	0	0	(0)	1	-
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	0	0	0	(0)	-	1	-
State Energy Program Special Projects—81.119	-	1	(0)	0	(0)	-	-
U.S. Department of State	-	-	-	-	-	0	-
Bureau of Western Hemisphere Affairs (WHA) Grant Programs (including Energy and Climate Partnership for the Americas)—19.750	-	-	-	-	-	0	-
U.S. Department of the Interior	0	0	0	(0)	1	-	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Bureau of Ocean Energy Management (BOEM) Environmental Studies (ES)—15.423	0	0	0	-	1	-	-
Minerals and Mining on Indian Lands—15.038	0	0	0	(0)	-	-	-
Tribal Energy Development Capacity Grants—15.148	-	0	-	-	-	-	-
U.S. Department of the Treasury	9	5	12	6	3	4	4
Energy Investment Grant	6	0	8	-	-	-	-
Outlay Equivalent for Clean Renewable Energy Bonds	4	5	5	6	3	4	4
Clean Fuels—20.519	-	-	-	-	-	-	-
Clean Fuels—20.519	-	-	-	-	-	-	-
Smart grid and transmission	1	5	8	11	0	2	8
U.S. Department of Defense	1	5	8	9	1	2	6
Basic, Applied, and Advanced Research in Science and Engineering—12.630	1	3	7	7	-	1	6
Research and Technology Development—12.910	-	2	0	2	1	0	-
U.S. Department of Energy	(0)	-	0	2	-	0	1
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	-	-	-	-	-	-	1
State Energy Program Special Projects—81.119	-	-	0	2	-	0	0
Weatherization Assistance for Low-Income Persons—81.042	(0)	-	-	-	-	-	-
U.S. Department of the Interior	-	-	-	-	-	-	0
Minerals and Mining on Indian Lands—15.038	-	-	-	-	-	-	-
Tribal Energy Development Capacity Grants—15.148	-	-	-	-	-	-	0
U.S. Department of Transportation	-	-	-	-	(0)	-	2
Air Emissions and Energy Initiative—20.817	-	-	-	-	-	-	2
Pipeline Safety Program State Base Grant—20.700	-	-	-	-	(0)	-	-
Solar	1,352	1,048	223	22	12	17	27
U.S. Department of Agriculture	-	-	-	-	-	-	0
Wood Utilization Assistance—10.674	-	-	-	-	-	-	0
U.S. Department of Defense	-	-	1	-	-	1	1
Basic, Applied, and Advanced Research in Science and Engineering—12.630	-	-	1	-	-	1	1
U.S. Department of Energy	(1)	23	(0)	-	(1)	(0)	10
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	(1)	23	(0)	-	(1)	(0)	10

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
U.S. Department of the Interior	0	1	-	-	-	-	-
Minerals and Mining on Indian Lands—15.038	0	0	-	-	-	-	-
Tribal Energy Development Capacity Grants—15.148	-	0	-	-	-	-	-
U.S. Department of the Treasury	1,352	1,024	223	21	13	16	15
Energy Investment Grant	1,339	1,006	206	-	-	-	-
Outlay Equivalent for Clean Renewable Energy Bonds	14	18	17	21	13	16	15
U.S. Environmental Protection Agency	-	0	-	1	-	-	-
National Clean Diesel Emissions Reduction Program—66.039	-	-	-	1	-	-	-
State Clean Diesel Grant Program—66.040	-	0	-	-	-	-	-
Wind	13	14	13	18	10	12	12
U.S. Department of Defense	-	-	-	1	-	-	-
Basic, Applied, and Advanced Research in Science and Engineering—12.630	-	-	-	1	-	-	-
U.S. Department of Energy	1	-	-	-	-	-	-
Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance—81.117	(0)	-	-	-	-	-	-
State Energy Program Special Projects—81.119	1	-	-	-	-	-	-
U.S. Department of the Interior	1	1	-	1	0	(0)	1
Bureau of Ocean Energy Management (BOEM) Environmental Studies (ES)—15.423	1	1	-	1	0	(0)	1
Minerals and Mining on Indian Lands—15.038	-	-	-	-	-	-	-
U.S. Department of the Treasury	11	13	13	16	9	12	11
Energy Investment Grant	1	0	0	-	-	-	-
Outlay Equivalent for Clean Renewable Energy Bonds	10	13	13	16	9	12	11
Total	6,226	6,407	5,955	5,874	7,013	11,547	5,731

Data source: **Federal direct expenditure subsidies**: U.S. Department of the Treasury, USASpending.gov—the official open data source of federal spending information, <https://www.usaspending.gov/>, accessed February 8, 2023. U.S. Department of the Treasury, *1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits*, <https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/1603-program-payments-for-specified-energy-property-in-lieu-of-tax-credits>, accessed February 8, 2023.

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. USASpending.gov was first launched in December 2007 to fulfill provisions of the Federal Funding Accountability and Transparency Act (FFATA) of 2006. USASpending.gov receives and displays data pertaining to obligations (amounts awarded for federally sponsored projects during a given budget period). Appropriations made in a given FY federal agency budget may be obligated and fund programs in subsequent fiscal years.

Table A7. Estimates of energy-specific research and development expenditures, fiscal years (FY) 2016–22

million 2022 dollars, unless otherwise noted

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Biofuels	53	16	64	14	47	12	20
National Science Foundation	9	4	4	5	2	3	6
Engineering Grants—47.041	8	4	4	4	1	2	5
Mathematical and Physical Sciences—47.049	1	-	0	1	1	0	1
U.S. Department of Agriculture	7	(0)	5	0	0	(1)	(0)
Agricultural Research Basic and Applied Research—10.001	0	0	0	0	0	0	(0)
Biomass Research and Development Initiative Competitive Grants Program (BRDI)—10.312	6	(0)	5	-	-	(1)	(0)
U.S. Department of Defense	-	1	0	0	0	-	-
Basic Scientific Research—12.431	-	1	0	0	0	-	-
U.S. Department of Energy	37	12	54	9	45	11	13
Advanced Research Projects Agency—Energy—81.135	4	16	23	7	29	0	5
Conservation Research and Development—81.086	(0)	(1)	2	1	-	2	3
Fossil Energy Research and Development—81.089	0	(0)	-	1	(1)	-	0
Renewable Energy Research and Development—81.087	33	(3)	29	1	16	9	5
U.S. Department of Transportation	-	-	(0)	-	-	-	-
Biobased Transportation Research—20.761	-	-	(0)	-	-	-	-
U.S. Environmental Protection Agency	-	-	-	-	0	0	0
Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	-	-	-	-	0	0	0
Biomass	35	14	17	12	46	16	4
National Science Foundation	3	6	5	3	2	3	2
Engineering Grants—47.041	3	3	3	2	1	2	1
Mathematical and Physical Sciences—47.049	0	3	2	1	1	1	1
U.S. Department of Agriculture	3	1	0	0	1	2	0
Agricultural Research Basic and Applied Research—10.001	1	1	0	0	1	2	0
Biomass Research and Development Initiative Competitive Grants Program (BRDI)—10.312	2	(0)	-	-	-	(0)	-
U.S. Department of Defense	0	0	0	-	-	-	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Basic Scientific Research—12.431	0	0	0	-	-	-	-
U.S. Department of Energy	29	7	12	9	42	11	2
Advanced Research Projects Agency—Energy—81.135	8	0	0	11	4	(0)	0
Conservation Research and Development—81.086	-	-	1	2	-	-	-
Fossil Energy Research and Development—81.089	1	0	1	0	(0)	2	2
Renewable Energy Research and Development—81.087	21	7	9	(4)	39	9	(0)
Coal	363	248	299	356	338	500	280
National Science Foundation	38	33	34	24	33	29	64
Engineering Grants—47.041	20	18	16	17	25	19	43
Mathematical and Physical Sciences—47.049	17	16	18	8	8	10	21
U.S. Department of Agriculture	1	1	1	2	2	5	(0)
Agricultural Research Basic and Applied Research—10.001	1	1	1	2	2	5	(0)
Biomass Research and Development Initiative Competitive Grants Program (BRDI)—10.312	-	(0)	-	-	-	-	-
U.S. Department of Defense	2	2	1	1	0	1	2
Basic Scientific Research—12.431	2	2	1	1	0	1	2
U.S. Department of Energy	319	211	262	328	301	464	213
Advanced Research Projects Agency—Energy—81.135	7	22	8	27	28	45	55
Conservation Research and Development—81.086	3	8	4	5	3	31	3
Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	-	(0)	-	-	-	-	-
Environmental Remediation and Waste Processing and Disposal—81.104	-	-	-	-	-	-	-
Fossil Energy Research and Development—81.089	298	164	225	261	234	325	137
Geologic Sequestration Training and Research Grant Program—81.133	-	-	-	-	-	-	-
Nuclear Energy Research, Development and Demonstration—81.121	-	-	-	-	-	-	-
Renewable Energy Research and Development—81.087	10	18	24	34	34	61	18
University Coal Research—81.057	(0)	-	-	-	2	2	1
U.S. Department of the Interior	1	-	-	(0)	-	-	-
Safety and Environmental Enforcement Research and Data Collection for Offshore Energy and Mineral Activities—15.441	1	-	-	(0)	-	-	-
U.S. Department of Transportation	-	(0)	-	-	-	-	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
PHMSA Pipeline Safety Research and Development Other Transaction Agreements—20.723	-	(0)	-	-	-	-	-
U.S. Environmental Protection Agency Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	2	1	1	1	1	1	0
Conservation	165	90	121	100	255	194	134
National Science Foundation Engineering Grants—47.041	5	4	3	5	5	5	4
Mathematical and Physical Sciences—47.049	3	3	2	3	3	3	2
U.S. Department of Agriculture Agricultural Research Basic and Applied Research—10.001	1	1	1	2	2	3	3
U.S. Department of Defense Basic Scientific Research—12.431	1	2	5	5	3	4	0
U.S. Department of Energy Advanced Research Projects Agency—Energy—81.135	2	2	3	9	2	2	2
Conservation Research and Development—81.086 Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	2	2	3	9	2	2	2
U.S. Department of Energy Advanced Research Projects Agency—Energy—81.135	156	80	109	77	242	181	124
Conservation Research and Development—81.086 Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	5	3	1	-	3	2	(1)
U.S. Department of Energy Conservation Research and Development—81.086 Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	138	68	104	71	232	178	124
U.S. Department of Energy Conservation Research and Development—81.086 Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	(0)	(0)	-	-	-	-	-
U.S. Department of Energy Conservation Research and Development—81.086 Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	-	0	0	0	0	1	1
U.S. Department of Energy Conservation Research and Development—81.086 Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	-	-	-	0	0	0	(1)
U.S. Department of Energy Conservation Research and Development—81.086 Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	-	-	-	-	1	-	0
U.S. Department of Energy Conservation Research and Development—81.086 Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	13	9	4	5	5	0	1
U.S. Department of Transportation PHMSA Pipeline Safety Research and Development Other Transaction Agreements—20.723	-	-	-	-	-	-	-
U.S. Environmental Protection Agency Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	-	-	-	-	-	-	-
U.S. Environmental Protection Agency Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	2	1	0	3	2	3	3
U.S. Environmental Protection Agency Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	2	1	0	3	2	3	3
U.S. Nuclear Regulatory Commission U.S. Nuclear Regulatory Commission Office of Research Financial Assistance Program—77.009	0	-	-	-	-	-	-
U.S. Nuclear Regulatory Commission U.S. Nuclear Regulatory Commission Office of Research Financial Assistance Program—77.009	0	-	-	-	-	-	-
End use	349	421	262	441	479	265	365

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
National Science Foundation	56	57	55	59	55	52	95
Engineering Grants—47.041	50	46	45	50	47	38	70
Mathematical and Physical Sciences—47.049	6	11	11	9	8	14	24
U.S. Department of Agriculture	1	1	2	0	3	3	0
Agricultural Research Basic and Applied Research—10.001	1	1	2	0	3	3	0
U.S. Department of Defense	8	13	6	30	19	5	9
Basic Scientific Research—12.431	8	13	6	30	19	5	9
U.S. Department of Energy	284	349	199	351	402	205	261
Advanced Research Projects Agency—Energy—81.135	158	129	58	181	191	87	132
Conservation Research and Development—81.086	76	41	61	115	133	84	46
Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	3	2	3	2	6	-	-
Energy Policy and Systems Analysis—81.250	0	0	-	-	(0)	(0)	-
Fossil Energy Research and Development—81.089	22	16	21	6	10	22	6
Minority Economic Impact—81.137	-	-	-	-	-	-	-
Nuclear Energy Research, Development and Demonstration—81.121	(0)	-	-	-	-	-	-
Renewable Energy Research and Development—81.087	24	161	56	47	62	12	77
University Coal Research—81.057	(0)	-	-	-	1	(0)	-
U.S. Environmental Protection Agency	1	0	0	0	-	0	0
Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	1	0	0	0	-	0	0
Geothermal	13	6	25	165	49	47	45
National Science Foundation	1	1	1	0	1	1	2
Engineering Grants—47.041	1	1	0	0	1	1	1
Mathematical and Physical Sciences—47.049	-	-	1	-	-	0	0
U.S. Department of Energy	12	5	24	165	48	46	43
Advanced Research Projects Agency—Energy—81.135	-	-	1	11	(1)	-	8
Conservation Research and Development—81.086	-	0	-	-	-	16	(15)
Fossil Energy Research and Development—81.089	1	-	2	-	-	-	3
Renewable Energy Research and Development—81.087	11	5	22	154	49	29	47
Hydropower	16	71	11	21	38	42	31

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
National Science Foundation	4	4	2	1	1	1	3
Engineering Grants—47.041	1	3	1	0	1	1	3
Mathematical and Physical Sciences—47.049	2	1	1	1	1	0	0
U.S. Department of Agriculture	0	0	0	0	0	0	-
Agricultural Research Basic and Applied Research—10.001	0	0	0	0	0	0	-
U.S. Department of Defense	0	0	0	-	-	-	-
Basic Scientific Research—12.431	0	0	0	-	-	-	-
U.S. Department of Energy	13	67	8	20	37	40	28
Advanced Research Projects Agency—Energy—81.135	3	0	-	-	-	34	-
Conservation Research and Development—81.086	-	-	-	1	-	-	-
Renewable Energy Research and Development—81.087	10	66	8	19	37	7	28
Natural gas and petroleum liquids	145	58	132	71	107	105	121
National Science Foundation	13	8	11	6	9	5	14
Engineering Grants—47.041	12	8	9	6	7	4	12
Mathematical and Physical Sciences—47.049	1	0	3	0	1	1	2
U.S. Department of Agriculture	0	0	0	0	0	0	-
Agricultural Research Basic and Applied Research—10.001	0	0	0	0	0	0	-
U.S. Department of Defense	3	3	2	1	2	0	1
Basic Scientific Research—12.431	3	3	2	1	2	0	1
U.S. Department of Energy	126	45	115	62	86	98	99
Advanced Research Projects Agency—Energy—81.135	28	4	6	11	13	21	29
Conservation Research and Development—81.086	2	1	5	10	6	11	13
Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	-	-	2	(2)	-	-	-
Energy Policy and Systems Analysis—81.250	-	-	-	-	-	-	-
Fossil Energy Research and Development—81.089	97	40	100	44	62	62	57
Nuclear Energy Research, Development and Demonstration—81.121	(0)	1	(0)	-	-	-	-
Renewable Energy Research and Development—81.087	-	0	3	(1)	6	4	-
University Coal Research—81.057	-	-	(0)	(0)	-	-	-
U.S. Department of the Interior	1	1	-	-	-	7	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Marine Gas Hydrate Research Activities—15.428	(0)	-	-	-	-	-	-
Safety and Environmental Enforcement Research and Data Collection for Offshore Energy and Mineral Activities—15.441	1	1	-	-	-	7	-
U.S. Department of Transportation	2	0	2	1	10	(7)	7
PHMSA Pipeline Safety Research and Development Other Transaction Agreements—20.723	2	0	2	1	10	(7)	7
U.S. Environmental Protection Agency	-	-	1	-	-	-	-
Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	-	-	1	-	-	-	-
Uncategorized	3,617	3,713	3,736	3,582	3,944	4,138	3,313
National Science Foundation	2,619	2,554	2,751	2,670	2,795	2,819	2,384
Engineering Grants—47.041	953	958	1,020	955	1,041	1,056	791
Mathematical and Physical Sciences—47.049	1,666	1,596	1,732	1,715	1,754	1,763	1,592
U.S. Department of Agriculture	205	146	216	196	226	253	40
Agricultural Research Basic and Applied Research—10.001	205	146	216	196	226	253	40
Biomass Research and Development Initiative Competitive Grants Program (BRDI)—10.312	-	-	1	-	-	-	-
U.S. Department of Defense	559	498	483	439	488	560	435
Basic Scientific Research—12.431	559	498	483	439	488	560	435
U.S. Department of Energy	183	472	226	224	381	453	386
Advanced Research Projects Agency—Energy—81.135	-	44	6	6	11	43	16
Conservation Research and Development—81.086	-	-	1	-	1	-	-
Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	4	27	31	10	23	2	5
Energy Policy and Systems Analysis—81.250	4	2	0	0	1	2	0
Environmental Monitoring/Cleanup, Cultural and Resource Management, Emergency Response Research, Outreach, Technical Analysis—81.214	29	29	34	29	35	27	32
Environmental Remediation and Waste Processing and Disposal—81.104	16	266	18	15	20	24	17
Fossil Energy Research and Development—81.089	9	4	34	30	39	37	11
Minority Economic Impact—81.137	1	2	0	2	4	1	31
Nuclear Energy Research, Development and Demonstration—81.121	14	15	25	53	75	215	200
Renewable Energy Research and Development—81.087	105	84	77	78	169	99	73
University Coal Research—81.057	-	(0)	(0)	(0)	4	4	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
U.S. Department of the Interior	-	0	(0)	-	(0)	-	0
Marine Gas Hydrate Research Activities—15.428	-	0	(0)	-	(0)	-	-
Offshore Research Technology Center (OTRC) Texas Engineering Experiment Station (TEES)—15.425	-	-	-	-	-	-	0
Safety and Environmental Enforcement Research and Data Collection for Offshore Energy and Mineral Activities—15.441	-	-	-	-	-	-	-
U.S. Department of Transportation	0	(0)	10	10	11	4	0
PHMSA Pipeline Safety Research and Development Other Transaction Agreements—20.723	0	(0)	10	10	11	4	0
U.S. Environmental Protection Agency	50	43	50	44	43	49	68
Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	50	43	50	44	43	49	68
U.S. Nuclear Regulatory Commission	0	0	0	(0)	(0)	(0)	0
U.S. Nuclear Regulatory Commission Office of Research Financial Assistance Program—77.009	0	0	0	(0)	(0)	(0)	0
Nuclear	183	203	219	173	224	423	259
National Science Foundation	18	20	20	23	23	30	40
Engineering Grants—47.041	1	2	2	1	1	2	1
Mathematical and Physical Sciences—47.049	17	18	18	22	22	28	39
U.S. Department of Agriculture	0	0	0	-	0	(0)	(0)
Agricultural Research Basic and Applied Research—10.001	0	0	0	-	0	(0)	(0)
Biomass Research and Development Initiative Competitive Grants Program (BRDI)—10.312	(0)	-	-	-	-	-	-
U.S. Department of Defense	0	1	2	1	0	1	0
Basic Scientific Research—12.431	0	1	2	1	0	1	0
U.S. Department of Energy	163	181	195	149	201	392	218
Advanced Research Projects Agency—Energy—81.135	1	2	10	20	15	0	33
Conservation Research and Development—81.086	-	-	-	-	1	2	1
Energy Policy and Systems Analysis—81.250	-	0	-	-	-	-	-
Environmental Monitoring/Cleanup, Cultural and Resource Management, Emergency Response Research, Outreach, Technical Analysis—81.214	-	-	-	1	3	9	4
Environmental Remediation and Waste Processing and Disposal—81.104	13	8	9	1	1	2	1
Fossil Energy Research and Development—81.089	-	-	(0)	-	-	-	3

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Nuclear Energy Research, Development and Demonstration—81.121	149	171	168	124	178	377	177
Renewable Energy Research and Development—81.087	-	-	8	3	3	3	-
U.S. Department of Transportation	-	-	1	-	-	-	-
PHMSA Pipeline Safety Research and Development Other Transaction Agreements—20.723	-	-	1	-	-	-	-
U.S. Nuclear Regulatory Commission	1	0	1	0	0	0	0
U.S. Nuclear Regulatory Commission Office of Research Financial Assistance Program—77.009	1	0	1	0	0	0	0
Other renewables	23	33	9	23	50	30	35
National Science Foundation	13	8	1	3	5	3	8
Engineering Grants—47.041	13	7	1	3	3	2	6
Mathematical and Physical Sciences—47.049	0	1	0	-	1	1	2
U.S. Department of Agriculture	0	-	0	(1)	0	0	0
Agricultural Research Basic and Applied Research—10.001	0	-	0	-	0	0	0
Biomass Research and Development Initiative Competitive Grants Program (BRDI)—10.312	-	-	(0)	(1)	-	-	-
U.S. Department of Defense	0	(0)	0	0	0	-	-
Basic Scientific Research—12.431	0	(0)	0	0	0	-	-
U.S. Department of Energy	10	25	7	21	45	27	27
Advanced Research Projects Agency—Energy—81.135	3	15	0	15	39	4	23
Conservation Research and Development—81.086	(0)	5	3	2	1	4	1
Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	3	-	-	-	-	-	(0)
Fossil Energy Research and Development—81.089	(0)	-	-	-	-	-	2
Nuclear Energy Research, Development and Demonstration—81.121	-	-	-	-	-	-	-
Renewable Energy Research and Development—81.087	4	5	3	4	6	20	1
Smart grid and transmission	89	21	28	75	49	71	53
National Science Foundation	19	10	16	10	13	38	19
Engineering Grants—47.041	18	8	13	8	10	37	8
Mathematical and Physical Sciences—47.049	1	2	3	2	3	1	10
U.S. Department of Agriculture	1	1	1	1	1	3	-
Agricultural Research Basic and Applied Research—10.001	1	1	1	1	1	3	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
U.S. Department of Defense	1	1	0	0	3	1	0
Basic Scientific Research—12.431	1	1	0	0	3	1	0
U.S. Department of Energy	69	10	11	64	32	29	35
Advanced Research Projects Agency—Energy—81.135	29	3	8	53	13	13	15
Conservation Research and Development—81.086	-	-	-	-	2	1	18
Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	39	4	3	5	2	(0)	(0)
Environmental Remediation and Waste Processing and Disposal—81.104	-	-	-	-	-	1	1
Fossil Energy Research and Development—81.089	-	-	0	-	0	0	0
Minority Economic Impact—81.137	-	-	-	-	-	-	-
Nuclear Energy Research, Development and Demonstration—81.121	-	-	-	-	-	-	-
Renewable Energy Research and Development—81.087	1	3	(0)	6	15	14	0
University Coal Research—81.057	-	-	-	-	-	-	-
Solar	183	116	108	133	130	134	94
National Science Foundation	80	79	75	66	49	61	51
Engineering Grants—47.041	21	22	13	19	19	11	9
Mathematical and Physical Sciences—47.049	59	57	62	47	31	50	42
U.S. Department of Agriculture	0	0	0	0	0	-	-
Agricultural Research Basic and Applied Research—10.001	0	0	0	0	0	-	-
U.S. Department of Defense	1	1	3	0	0	-	-
Basic Scientific Research—12.431	1	1	3	0	0	-	-
U.S. Department of Energy	102	36	29	67	80	72	44
Advanced Research Projects Agency—Energy—81.135	22	3	1	6	2	1	2
Conservation Research and Development—81.086	0	2	1	-	0	0	3
Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	-	-	-	-	-	-	-
Fossil Energy Research and Development—81.089	1	1	0	-	-	(0)	-
Renewable Energy Research and Development—81.087	79	30	27	61	77	71	39
U.S. Environmental Protection Agency	0	0	-	-	-	-	-
Surveys, Studies, Research, Investigations, Demonstrations, and Special Purpose Activities Relating to the Clean Air Act—66.034	0	0	-	-	-	-	-

Beneficiary, department and program—CFDA number	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Wind	23	107	33	18	47	62	22
National Science Foundation	8	10	7	5	8	7	14
Engineering Grants—47.041	8	10	7	5	7	7	13
Mathematical and Physical Sciences—47.049	-	-	-	0	1	0	0
U.S. Department of Agriculture	-	0	0	1	0	0	0
Agricultural Research Basic and Applied Research—10.001	-	0	0	1	0	0	0
U.S. Department of Defense	0	0	0	0	0	0	0
Basic Scientific Research—12.431	0	0	0	0	0	0	0
U.S. Department of Energy	15	97	25	12	39	54	8
Advanced Research Projects Agency—Energy—81.135	8	1	-	6	15	1	1
Conservation Research and Development—81.086	-	-	-	-	-	7	-
Electricity Delivery and Energy Reliability, Research, Development and Analysis—81.122	-	-	4	-	-	-	-
Renewable Energy Research and Development—81.087	8	96	21	7	24	47	7
Total	5,257	5,119	5,063	5,185	5,805	6,038	4,774

Data source: **Federal R&D expenditure subsidies**: U.S. Department of the Treasury, USASpending.gov—the official open data source of federal spending information, <https://www.usaspending.gov/>, accessed February 8, 2023.

Notes: Totals may not equal sum due to independent rounding. 0 estimate rounds to zero; - estimate is zero. USASpending.gov was first launched in December 2007 to fulfill provisions of the Federal Funding Accountability and Transparency Act (FFATA) of 2006. USASpending.gov receives and displays data pertaining to obligations (amounts awarded for federally sponsored projects during a given budget period). Appropriations made in each FY federal agency budget may be obligated and fund programs in subsequent fiscal years.

Appendix B. Analytic Approach

This appendix presents a brief overview of the estimation terminology and procedures used in this report.

Goals, scope, sources, and methodology

This report compiles subsidies using federal government outlays for the U.S. Department of the Treasury (Treasury), reported budget obligations for all other federal departments, and an estimated outlay-equivalent value for tax expenditure estimates and the subsidy cost value of DOE loan guarantees (Table 5). All of the within-scope federal activities are assigned to one or more of 14 energy types within the U.S. energy system (for example, biomass, coal, end use) in this report.¹⁵

Goals

The primary goal of this report is to provide data that helps people understand the different types of federal expenditures that support specific elements of the U.S. energy system ('energy types'). Consistent with this goal, our final report tables are as user-friendly as possible, despite the complexity of the data and the necessary analytic procedures. As noted in the [Overview](#) section, we have made only limited observations of the scale, trends, and relationships within the data and the report tables.

Scope

This report is limited to a defined set of federal activities. To meet the criteria for this report, these activities must:

- Be provided by the federal government
- Provide a financial benefit with an identifiable federal budget impact
- Be targeted at energy markets

Identifiable federal budget impact means an outlay or tax expenditure. This scope excludes regulatory or legal actions that can provide a financial benefit without a budget impact, for example, liability limits or rule exemptions. Regulation involves no outlay by the government or direct loss of income to the Treasury, but it does involve costs to some producers or consumers and benefits to others. Although we don't count them as subsidies in this report, energy regulations significantly affect U.S. energy markets. The scope of this report also excludes a range of more indirect or shared activities that provide financial benefits to energy market participants or beneficiaries. Providing security for general infrastructure or implementing tax provisions that apply to wide sets of equipment (that is, applicable to both energy-related and non-energy-related uses) are examples of federal activities that are not within this report's scope. This report also excludes federal activities performed by federal staff or contractors, which can include R&D and direct energy purchases, and state and local energy-directed programs.

Previous EIA studies and updates

Since 1992, we have periodically updated this report in response to specific requests. The timing of these requests determined what fiscal year data we included. Prior reports and supporting materials are available on our website at <https://www.eia.gov/analysis/requests/subsidy/>.¹⁶

¹⁵ We use 14 energy types in this report: biofuels, biomass, coal, refined coal, conservation, end use, geothermal, hydropower, natural gas and petroleum liquids, nuclear, other renewables, smart grid and transmission, solar, and wind. Amazon Comprehend also classified an uncategorized type as something other than an energy type.

¹⁶ U.S. Energy Information Administration, [Analysis and Projections: Subsidy](#), accessed May 15, 2023.

Data sources

We relied on several official governmental data sources as the initial report inputs. We used distinct data sources for tax expenditures, direct expenditures, and R&D expenditures, as well as amounts for subsidy costs of energy-related loan guarantees (Table B1).

Table B1. Data sources used for energy-related subsidies and supports

Subsidies and supports	Primary data sources
Direct and research and development expenditures	<ul style="list-style-type: none"> USASpending.gov, a website hosted by the U.S. Department of the Treasury reporting on entities or organizations receiving federal funds SAM.gov, a website hosted by the General Services Administration containing the <i>Catalog of Federal Domestic Assistance</i> (CFDA) U.S. Department of the Treasury, <i>1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits</i>; the Treasury has responsibilities pursuant to the American Recovery and Reinvestment Act of 2009 (Recovery Act). Among those responsibilities are several programs, including the <i>1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits</i>.
Tax expenditure estimates	<ul style="list-style-type: none"> <i>Budget of the United States Government, Analytical Perspectives, Fiscal Years 2018–2024</i> Congressional Joint Committee on Taxation, <i>Estimates of Federal Tax Expenditures for 2016–22, 2017–2021, 2018–2022, 2019–2023, 2020–2024, and 2022–2026</i>
DOE loan guarantees	<ul style="list-style-type: none"> U.S. Department of Energy’s (DOE) Loan Programs Office, which administers Sections 1703, 1705, 1706, and Advanced Technology Vehicles Manufacturing (ATVM) loan programs USASpending.gov, a website that also reports on credit subsidy costs

Data source: U.S. Energy Information Administration

Budget terminology

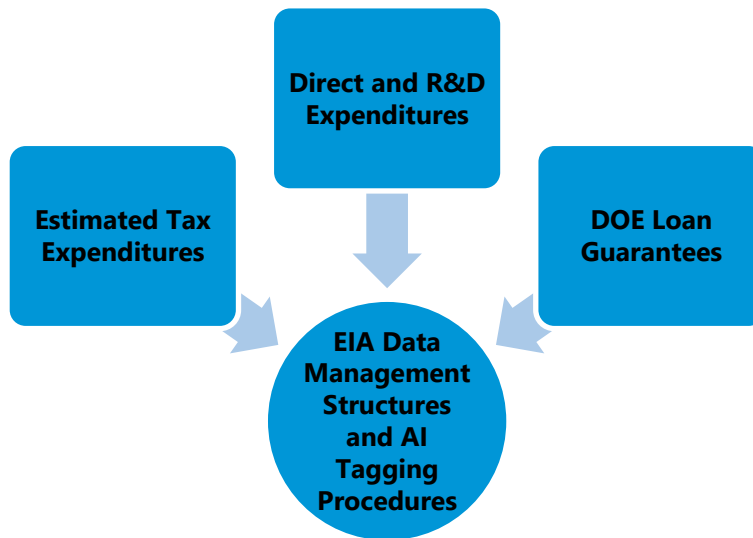
Appropriations, obligations, and outlays are the primary phases of the U.S. government budget control system. Congress enacts appropriations that provide federal agencies and programs the budget authority to make financial commitments (that is, obligations) to spend funds. Obligations are legally binding agreements to purchase items or services, which is one of the budget phases captured in USASpending.gov. Obligations could commit an agency to spend money immediately or in the future. Outlays are actual payments made by the federal government for services performed, and they offset or liquidate outstanding obligations.

We use the definitions of tax expenditures incorporated in federal budget documents and the associated tax expenditures estimated by Treasury that are itemized in various sections of the Office of Management and Budget’s *Budget of the United States Government, Analytical Perspectives*. To a lesser extent, this report includes data estimates by the Joint Committee on Taxation (JCT). Some tax expenditures that benefit the energy industry may also support non-energy related activities, such as accelerated depreciation schedules. We only included tax provisions that are narrowly targeted to the energy sector and are quantified by the other federal sources discussed here.

Custom classification with Amazon Comprehend¹⁷

Classifying documents and related information such as federal budgetary transactions is typically manual work which is both time-consuming and imperfect. Machine learning (ML), a variety of artificial intelligence (AI), has provided new and useful capabilities for this problem. Text classification and information extraction using ML tools has dramatically reduced costs and time and also minimized error rates. Our updated data acquisition and processing structure for this report is shown in [Figure B1](#).

Figure B1. Automated tagging and data procedures performed on USASpending.gov award assistance data



Source: U.S. Energy Information Administration

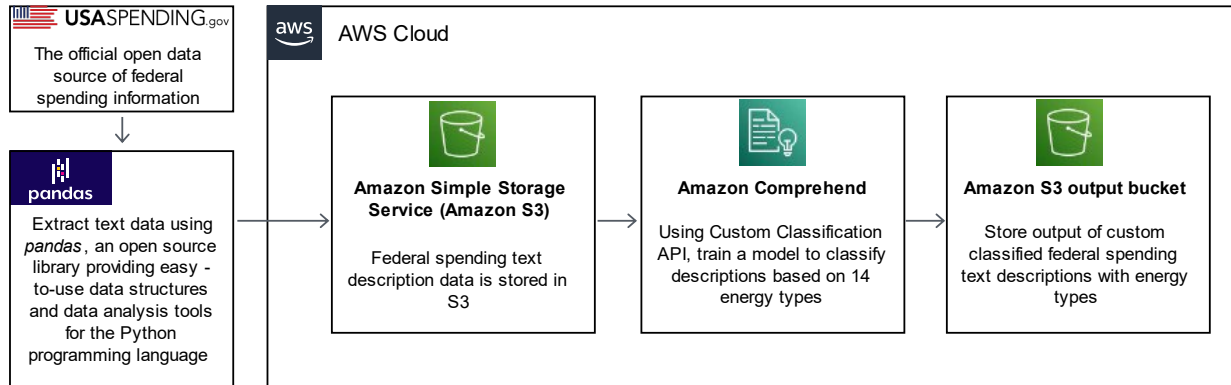
Note: R&D=Research and Development, DOE=U.S. Department of Energy.

For this report, we developed a new machine learning model that categorizes award obligations reported through USASpending.gov.¹⁸ This model uses transaction descriptions as input and assigns the corresponding beneficiaries or support categories. Model inputs include two types of awards:

- **Procurement awards.** According to the Federal Procurement Data System (FPDS) data dictionary, the award description is a brief, summary-level, Plain Language description of the contract, award, or modification.
- **Financial assistance awards.** The award description is a Plain Language description of the federal award purpose; activities to be performed; deliverables and expected outcomes; intended beneficiaries; and subrecipient activities, if known and specified at the time of award.

¹⁷ Amazon Comprehend uses natural language processing (NLP) to extract insights about the content of documents.

¹⁸ [USASpending.gov](#) is a database website owned by the U.S. Department of the Treasury that identifies recipients of federal funds. It was created as part of the Federal Funding Accountability and Transparency Act (FFATA) of 2006.

Figure B2. AI tagging procedures of federal direct and R&D expenditures

Source: U.S. Energy Information Administration

Note: R&D=Research and Development.

For this report, we employed Amazon Comprehend, using ML to find insights and relationships in federal awards text descriptions. For direct expenditures, including R&D, we incorporated extensive changes to automate data processing when assigning energy-specific categories or beneficiaries. For awards data, automated tagging, or classification, initially encompassed nearly 80 million discrete federal budgetary award transactions across the seven fiscal years that were downloaded from USASpending.gov. Of these, the four million FY 2016 transactions were given further tagging, which, in turn, enabled automated pre-binning and aggregation of transactions that met specific criteria to create Amazon Comprehend training data. The new ML model was trained with 15,000 examples (that is, around 1,000 examples per energy type) of awards from FY 2016, the last fiscal year that we had previously analyzed. This approach allowed us to determine the accuracy of the AI processing in Amazon Comprehend and continue training rounds with revised input data. Once trained, we ran the model on 118,000 energy-related transactions (based on a modified set of codes from the Catalog of Federal Direct Assistance from FY 2016) for FY 2016–22 and categorized them into this report’s energy types. Our subject matter experts then reviewed the categorizations.

Obligation data come from Treasury’s USASpending.gov, a comprehensive public database that summarizes all federal budget obligations. In this report, similar to the FY 2016 report update, direct expenditures including R&D expenditures for federal agencies come from USASpending.gov, except for noted Treasury programs offering grants in lieu of tax credits. In addition, DOE’s Loan Guarantee program (that is, CFDA 81.126 - Federal Loan Guarantees for Innovative Energy Technologies) results in a loan subsidy cost included in USASpending.gov data.¹⁹

Data availability, accuracy, and variation

For measuring subsidies and support, we serve as a data aggregator from non-EIA federal data sources. Although those federal sources have the primary responsibility for data quality and control issues, we have made extensive inquiries and evaluations over the many years of this report series and continue to

¹⁹ Loan Subsidy Cost has a direct budgetary impact and is factored into obligations and outlays when it is positive. Subsidy costs can be positive (indicating that the government is likely to lose money on the loan) or negative (indicating that the government is likely to make money on the loan). A positive Loan Subsidy Cost is usually smaller than the corresponding Face Value, but in certain edge cases it can be over 100% of the face value if the entire loan is written off and the government paid fees to a bank to issue the loan (which are also included in the subsidy cost).

monitor data-related issues.²⁰ Tax expenditure estimates data are, in most cases, specific and accurate because tax provisions included in this report typically are targeted at specific energy-related activities and are accounted for on a tax-year basis by Treasury. As a result, we could isolate several tax provisions and the corresponding energy system categories. We used estimation procedures, however, for a subset of tax expenditure data.

Each year Treasury estimates tax expenditures for the upcoming fiscal year budget. These estimates appear in the Office of Management and Budget's (OMB) *Budget of the United States Government, Analytical Perspectives*. Tax expenditure figures are our estimates for historical fiscal years.²¹ For example, we obtained tax expenditure data for FY 2022 from *Analytical Perspectives* for FY 2024. The methodology Treasury uses to estimate tax expenditures is also subject to periodic modification, and they don't always apply these changes to revisions of all historical tax expenditure data. At this time, Treasury does not process or publish tax provision data that could be made available, such as the specific types of renewable energy reported when a credit is taken. For those few tax expenditures that we needed more detail on than available in OMB's *Analytical Perspectives*, we relied on estimates made by the Joint Committee on Taxation (JCT).

This report presents energy tax expenditure estimates for FY 2016 through FY 2022. Sizable changes in the dollar value of expenditures over time often reflect changes in their use due to changes in the IRC, in key interpretations of the IRC, or in other relevant market and policy drivers. Treasury does not revise any of the tax expenditure data presented in this report, however.

The data on USASpending.gov are updated daily.²² Agencies are required to submit data files within 30 days after awarding a subsidy or after modifying or conducting a transaction to an award, except for the U.S. Department of Defense, which delays its submission by 90 days to protect operations. However, the timing of when specific records are displayed on USASpending.gov depends on when the agency submits files to the data source sites and the processing time required by that site. Postings could lag one to three days before the files are processed and uploaded to USASpending.gov.

If an agency reports a modification or transaction to an award from a previous fiscal year, the modification or transaction data are displayed in the fiscal year in which the modification or transaction occurred, not in the fiscal year that the original award occurred.

²⁰ For an example of a recent external evaluation see United States Government Accountability Office, *DATA ACT: Quality of Data Submissions Has Improved but Further Action Is Needed to Disclose Known Data Limitations*, GAO-20-75, November 2019, accessed April 29, 2023.

²¹ Tax expenditures describe revenue losses attributable to provisions of federal tax laws that allow a special exclusion, exemption, or deduction from gross income or that provide a special credit, a preferential rate of tax, or a deferral of tax liability. These exceptions are often viewed as alternatives to other policy instruments, such as spending or regulatory programs. For further details on tax expenditures, see the U.S. Department of Treasury's Office of Tax Policy description on revenue losses attributable to provisions of federal tax laws, <https://home.treasury.gov/policy-issues/tax-policy>, accessed May 15, 2023.

²² See USASpending.gov for [more details on agency submission statistics](#).

Appendix C. Other Energy Subsidy Studies

Select Energy Subsidy Studies

Debate continues over the scope, role, and effectiveness of energy policy measures, and several studies addressing energy subsidies appear each year from various sources and use different definitions and methods; we do not endorse other parties' reports and includes these for reference. Some examples within the past five years include:

1. Bipartisan Policy Center. [“Inflation Reduction Act Summary: Energy and Climate Provisions.”](#) August 4, 2022.
2. Coleman, Clayton and Emma Dietz. [“Fossil Fuel Subsidies: A Closer Look at Tax Breaks and Societal Costs.”](#) Environmental and Energy Study Institute, July 29, 2019.
3. Parry, Ian W.H., Simon Black, and Nate Vernon. [“Still Not Getting Energy Prices Right: A Global and Country Update of Fossil Fuel Subsidies.”](#) International Monetary Fund, September 24, 2021.
4. Penn Wharton Budget Model. [“Update: Budgetary Cost of Climate and Energy Provisions in the Inflation Reduction Act.”](#) April 27, 2023.
5. Vahlsing, Candace. [“OMB Analysis: The Social Benefits of the Inflation Reduction Act’s Greenhouse Gas Emission Reductions.”](#) The White House, August 23, 2022.

Several of these reports and others in the literature seek to draw conclusions about policy issues related to energy subsidies.

This report focuses on developing data to provide information that others can use to conduct their own analyses. Along with EIA, the Congressional Research Service (CRS), the Congressional Budget Office (CBO), and the Government Accountability Office (GAO) also issue occasional reports on the scope and nature of federal energy subsidies that mainly or exclusively focus on data. Recent CRS, CBO, and GAO reports include:

1. Congressional Budget Office. [“Estimated Budgetary Effects of H.R. 5376, the Inflation Reduction Act of 2022.”](#) Updated August 9, 2022.
2. Sherlock, Molly F. [“The Energy Credit or Energy Investment Tax Credit \(ITC\).”](#) *In Focus* 10479. Congressional Research Service, updated April 23, 2021.
3. Sherlock, Molly F. [“The Value of Energy Tax Incentives for Different Types of Energy Resources: In Brief.”](#) Congressional Research Service, updated May 18, 2017.
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Combined, the extensive literature on subsidies provides examples of how differing definitions and methods can yield a wide range of estimates and interpretations.