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EXECUTIVE SUMMARY

Federally funded research, specifically through the U.S. Department of Energy (DOE), plays a crucial role in equipping the nation to tackle energy challenges. Within the DOE, the Office of Energy Efficiency and Renewable Energy (EERE) has been a driving force in advancing clean energy solutions and improving energy-efficient technologies. In this report, the Government Finance Research Center at the University of Illinois Chicago reviews the history of EERE research funding and contextualizes observed funding shifts.

Aggregate R&D research funding by EERE can be divided into three distinct periods. Prior to the American Recovery and Reinvestment Act (ARRA), the first period (2002–2008) mostly consists of decreases in year-over-year obligations with only two years exhibiting an increase. The second period (2009–2011), overlapping ARRA-driven obligations, averages $3.8 billion compared to $734 million in the prior period. The last period (2012–2021) averages $611 million and exhibits relatively regular funding cyclicality.

Examining funding by technology area, hydrogen R&D appears to be driven by the Bush administration's priorities. Appropriations in response to the Great Recession provided transformational funding through EERE to energy efficiency and renewable energy R&D in general, but especially to projects focused on vehicle, bioenergy, buildings energy efficiency, and solar energy technologies. In the period that followed, renewable energy R&D, including solar energy, geothermal, wind energy, and water power, was propelled as it aligned with the Obama administration's priorities. With the shift to the first Trump administration, EERE R&D funding priorities shifted again to reprioritize bioenergy and hydrogen, although obligations for vehicle, solar energy, and manufacturing energy efficiency projects were maintained at similar levels.

Having established that the main drivers behind funding priority shifts within EERE are policy responses to crises and administration changes reflecting varying priorities, interviews with former EERE staff provided further contextualization. These confirmed that EERE R&D funding is cyclical, with spikes catalyzed by crises and periods of calm shaped by administrative and congressional priorities. Industry trends and perspectives, advocacy efforts, and the global competitive environment are incorporated into these priorities, either through the political agenda or multi-year planning documents. Markedly, collaboration within EERE, and DOE more broadly, strengthened during the period of analysis, starting at practically absent and ending at formalized efforts leading to multiple energy earth shots.

Key insights from this retrospective analysis include that restructuring offices, an activity that administrations often undertake to preserve the ability to influence R&D funding decisions, is disruptive and does not always represent a pareto improvement. Instead, increased efforts for institutionalized collaboration can be more productive. Further, adopting a holistic approach to R&D funding, one that accounts for manufacturing capacity, infrastructure, workforce skills, regulatory landscape, market demand, and other factors, would better guarantee success.

1. Introduction

Since the mid-1940s, federal funding has facilitated fundamental research, recognizing that the generation, distribution, and application of knowledge is worthwhile even if not immediately monetized (Rowberg, 1998). In the specific context of energy research, the U.S. Department of Energy (DOE) has been crucial in developing and improving many of the technologies commonly used today (U.S. Department of Energy, 2018a). Specifically, the Office of Energy Efficiency and Renewable Energy (EERE), a unit within DOE, has been instrumental in advancing clean energy technologies, as well as energy-efficient technologies in transportation, buildings, and manufacturing, over the past two decades (Office of Energy Efficiency and Renewable Energy, 2024a). In fact, EERE was the second biggest funder of project grants and cooperative agreements among program offices in FY 2023 (see Table A.1 in the appendix).

Federal funding for energy research has mainly been spurred by national security concerns (Rowberg, 1998). However, economic conditions, public interest, and advocacy efforts also played a role in motivating funding priorities (Dresser, 1999; Allison, 2015; Hoxby, 2015). Given the vital role of federally funded research in ensuring that the nation can face expected and unforeseen energy challenges, examining EERE's funding history and the factors that empirically drove its decisions contribute to increased federal funding accountability and transparency as well as better informed current and future energy initiatives.

For background, DOE consists of staff and program offices (see Figure A.1 in the appendix). In addition, it includes laboratories and technology centers, operations (or field) offices, power marketing administrations, and agencies. For the most part, staff offices do not directly fund research. Instead, program offices, such as EERE, receive appropriations and oversee research funding that is aligned with DOE priorities. A portion of these allocations flow to lab and technology centers. Similarly, the funding of field offices interplays with that of program offices.

The oldest DOE program office, the Office of Federal Energy Management Program, was created in 1973 (U.S. Department of Energy, 2023a), while the newest, the Office of Critical and Emerging Technology, was started in 2023 (U.S. Department of Energy, 2023b). Notably, these program offices are often in flux; after being established, they are commonly renamed, reorganized, or merged, and sometimes dissolved. Our examination of EERE begins in 2002, the year in which the office implemented a comprehensive restructuring of its operations (National Academy of Public Administration, 2003).

This report highlights contemporary research funding priority changes within EERE through secondary data collection and analysis and then contextualizes the findings by (1) reviewing budget documents, legislation, and news articles, and (2) interviewing EERE personnel who witnessed these moments of change. The interviews elucidate the mechanisms by which EERE research and development (R&D) priorities are determined and the complex dynamics among the stakeholders influencing their formulation.

For context, most assessments examining the formation and development of research funding agencies have often been commissioned by Congress or other governmental entities (Rowberg, 1998; National Research Council, 2014). To illustrate, the first government reports to recommend an R&D agenda appeared within weeks of the 1973 oil embargo (National Research Council, 2001). This was followed by President Ford creating the Energy Research and Development Administration (ERDA) in 1975, consolidating under one umbrella existing R&D energy programs from several agencies, which in 1977 became part of the newly created DOE (Buck, 1982). More recently, in a Congressional Research Service review of DOE funding for renewable energy compared with funding for other energy technologies, e.g., nuclear or fossil, the energy crisis of the 1970s is credited with spurring the government to broaden its focus to include renewable energy and energy efficiency (Clark, 2018).

In addition, studies on federal funding for research typically focus on a specific topic or office for a set time period. For example, the U.S. Government Accountability Office reviewed federal funding from 2010 to 2017 to examine the extent to which reports on such funding are clearly linked to federal fiscal exposure to climate change, as well as the prevalence of fragmentation, overlap, or duplication of programs primarily focused on climate change (U.S. Government Accountability Office, 2018). Similarly, federal investment in R&D and its interplay with U.S. competitiveness has also been examined through a programmatic lens (The Pew Charitable Trusts, 2015). Moreover, historical examinations often focus on the formation, development, or restructuring of specific governmental departments and offices, for example, the ERDA (Buck, 1982), the Advanced Research Projects Agency-Energy (Beaton & Khosla, 2017), the National Renewable Energy Laboratory (Nemett & Adams, 2022; Engel-Cox, 2024), and the reorganization of EERE (National Academy of Public Administration, 2003).

In the 2000s, there was a concern that R&D investments in the energy sector had been on a declining trend since the mid-1990s (Nemet & Kammen, 2007). More recently, the U.S. Government Accountability Office found that federal R&D funding has increased since 2012—mainly because of COVID-19 stimulus funding. Five agencies obligated most federal R&D funding: the Department of Defense, the Department of Health and Human Services, the Department of Energy, the National Aeronautics and Space Administration, and the National Science Foundation (U.S. Government Accountability Office, 2022).

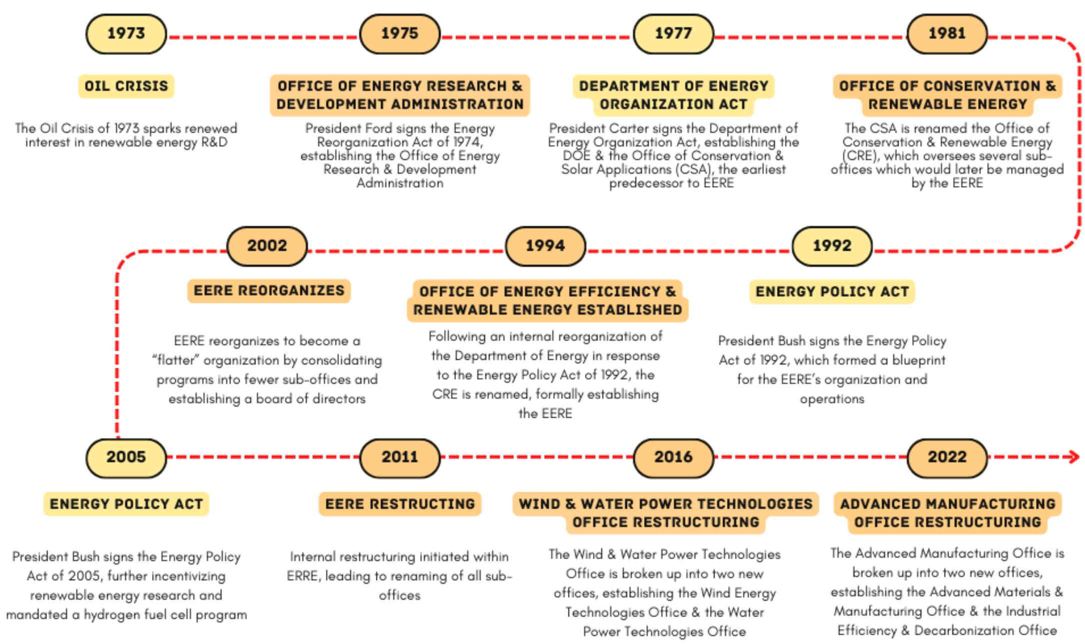
Building on this prior work, Section 2 overviews the history of EERE and its technology offices. Then, Section 3 illustrates and discusses aggregate EERE obligations for research. Section 4 delves into funding trends by EERE technology area. Section 5 adds context derived from in-depth interviews, which deepened our understanding of funding inflection points and stakeholder roles. Finally, Section 6 synthesizes the findings and situates this analysis within the broader contemporary energy research funding landscape. Ultimately, this report aims to inform policymakers and other stakeholders as they shape future energy R&D strategies. Understanding the contextual factors driving change in energy research funding, as well as the institutional dynamics and decision-making processes within EERE, can contribute to enhanced and effective government funding.

2. History of Technology Offices

Although EERE was formally established in 1994 following an internal reorganization within the DOE, most energy research activities nested within the office trace their lineage back to 1973, when President Nixon established the Office of Energy Conservation, which at the time was part of the Department of the Interior (Nixon, 1973). The following year, the Office of Energy Conservation would be absorbed into the Federal Energy Administration (FEA) until the DOE Organization Act of 1977, which consolidated the FEA and ERDA into one department, hosting several programs, some of which would later be reorganized under EERE (Department of Energy Organization Act, 1977). In addition, this act called for dividing DOE programming among several assistant secretaries who would oversee a variety of operations, including "the responsibility for policy and management of research and development of all aspects of solar energy resources; geothermal energy resources; recycling energy resources," setting the stage for the establishment of the Office of Conservation and Solar Applications (CSA) (Department of Energy Organization Act, 1977, p. 570).

The CSA, which acted as a predecessor to EERE, was later renamed the Office of Conservation and Solar Energy following the National Energy Conservation Policy Act of 1978 (Office of Energy Efficiency and Renewable Energy, n.d.-a). In 1981, this office was folded into the Office of Conservation and Renewable Energy (CRE) until 1994, when it transitioned into the contemporary EERE, following a wider restructuring of DOE (González, 2024). At the time, EERE's operations were distributed among several subprograms managed by the Utility Technologies, Industrial Technologies, Transportation Technologies, and Building Technologies Offices.

Figure 1. Overview of EERE History, CY 1973–2022



Note: The authors created this figure using information from the historical review discussed in this section.

In 2002, EERE restructured itself in response to the *President's Management Agenda* by the Bush administration. This agenda directed federal organizations to become flatter and more streamlined, which led EERE to reduce layers between program managers and top managers, require multiyear plans from each of the program offices, and establish a board of directors (Office of Energy Efficiency and Renewable Energy, 2002). As of 2024, EERE maintained ten technology offices, each with its own rich history of R&D funding. These technology offices are currently grouped under three thematic areas (*Sustainable Transportation & Fuels, Renewable Energy, and Buildings & Industry*), each with a deputy assistant secretary to oversee activities (Office of Energy Efficiency and Renewable Energy, 2024b). The following subsections overview the history of technology offices.

2.1. Sustainable Transportation & Fuels

2.1.1. Bioenergy

The Bioenergy Technologies Office (BETO) supports research, development, and demonstration of technologies aimed at converting organic material and biomasses into affordable, sustainable biofuels and bioproducts (Bioenergy Technologies Office, n.d.). BETO's operations are split between four program areas: Renewable Carbon Resources; Conversion R&D; Systems Development & Integration; and Data, Modeling, & Analysis (Office of Energy Efficiency and Renewable Energy, 2023). The office has focused on a variety of different biofuels throughout its history, ranging from food waste to microalgae (Perlack et al., 2005; Office of Energy Efficiency and Renewable Energy, 2009).

Historically, BETO traces its origins to the 1975 creation of the Federal Fuels from Biomass Program in the wake of the 1973 oil crisis. Due to a growing interest in developing alternative fuel sources, funding for the original biomass program grew rapidly from $0.6 million in FY 1975 to $26.9 million in FY 1979 (Klass, 1979). In 1977, the program was transferred from ERDA's Division of Solar Energy to the DOE and later renamed the Biomass Energy Technology Division (BETD) (Division of Solar Energy, 1976). Throughout much of the 1980s, BETD functioned as a loosely coordinated partnership between several different DOE offices (Stevens, 1994). In 1990, BETD's operations were split into new programs under the purview of the Offices of Utility Technologies, Transportation Technologies, and Industrial Technologies (Stevens, 1994).

When the EERE was formally founded in 1994, the biomass programs remained nested within larger suboffices, namely the Office of Utility Technologies' Office of Solar Thermal, Biomass Power, and Hydrogen Technologies Office (Office of Energy Efficiency and Renewable Energy, 1996). By the late 1990s, renewed interest in biomass energy emerged as a potential solution to address fluctuating oil prices and energy independence concerns. In 1999, President Bill Clinton signed Executive Order 13134, which called for the tripling of American bioenergy by 2010. This order called for new national bio-based products and a Bioenergy Coordination Office to be established to consolidate research efforts carried out by both the Department of Energy and the Department of Agriculture (The White House, 1999). The subsequent Biomass Research and Development Act of 2000 formally established this new board, allocating $10 million to the R&D of biomass energy with a focus on the production of plastics, chemicals, paint, and other consumer goods (GreenBiz Editors, 2000). When EERE was restructured in 2002, the program became known as the Biomass Energy Program (National Academy of Public Administration, 2003). In 2012, the program was renamed BETO (Office of Audits and Inspections, 2013).

2.1.2. Hydrogen & Fuel Cell

The Hydrogen & Fuel Cell Technologies Office (HFTO) focuses on research, development, and demonstration of hydrogen production, delivery, and storage, as well as fuel cell technologies to enable clean and affordable hydrogen use across multiple sectors (Hydrogen and Fuel Cell Technologies Office, n.d.). HFTO's operations are divided into five program areas: Hydrogen; Fuel Cells; Systems Development & Integration; Systems Analysis; and Safety, Codes & Standards (Office of Energy Efficiency and Renewable Energy, 2024c).

HFTO traces its origins to the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976, which established a Hydrogen Program managed by the National Science Foundation and later transferred to the DOE in 1990 (Department of Energy, n.d.-a). The program saw increased attention following the Energy Policy Act of 1992, which called upon the DOE to "develop and implement a comprehensive program of research, development, and demonstration of fuel cells and related systems for transportation applications" (Energy Policy Act of 1992, 1992, p. 3065).

Following the EERE's creation in 1994, the Hydrogen Program became a sub-program of the Office of Utility Technologies, while the Fuel Cell Program fell under the Office of Transportation Technologies (Peterson & Farmer, 2017). During the 2002 restructuring of EERE, the Hydrogen Program consolidated with other programs working on fuel cell research to create the Hydrogen, Fuel Cells, and Infrastructure Technologies Program (HFCIT). In 2011, the program was renamed the Fuel Cell Technologies Office (FCTO) during a reorganization of EERE offices (Klebanoff et al., 2014). In 2020, the name was changed to the Hydrogen and Fuel Cell Technologies Office (HFTO) (Hydrogen and Fuel Cell Technologies Office, 2020).

2.1.3. Vehicle

The Vehicle Technologies Office (VTO) funds research, development, demonstration, and deployment of low-cost, efficient, and clean transportation solutions (Vehicle Technologies Office, 2024). VTO's operations are divided into seven program areas: Battery R&D; Electrification; Decarbonization of Off-Road, Rail, Marine, and Aviation; Energy Efficient Mobility Systems; Materials Technology; Vehicle Analysis; and Technology Integration (Office of Energy Efficiency and Renewable Energy, 2025a).

The VTO traces its origins back to 1968 when the Department of Health, Education, and Welfare (HEW) commissioned a study on air pollutants across the country and their associated health risks, with a specific focus on vehicular emissions, which were growing rapidly at the time (U.S. Department of Health, Education, and Welfare, 1968). Additionally, HEW studied hybrid heat engines and electric vehicle technology before the program was transferred to the Energy Research & Development Administration (ERDA) in 1975 (Office of Energy Efficiency and Renewable Energy, 2006). During this time, the program, named the Transportation Energy Conservation Program, primarily focused on reducing energy usage, specifically through petroleum savings, and later on hybrid vehicle research, as called for in the Electric Vehicle & Hybrid Electric Vehicle RD&D Act of 1976 (94th Congress, 1976).

Upon the program's transfer to DOE, it became known as the Office of Transportation Systems (OTS), whose operations fell within the CSA and then CRE (Office of Transportation Systems, 1990). Following the EERE's creation in 1994, the program became known as the Office of Transportation Technologies (OTT), which was divided into several sub-programs, including the Office of Advanced Automotive Technologies, which focused on light-duty vehicles, the Office of Heavy Vehicle Technologies, the Office of Fuels Development, and the Office of Technology Utilization (Office of Energy Efficiency and Renewable Energy, 1996). One of OTT's biggest impacts has been through its Graduate Automotive Technology Education (GATE) Centers, which were established at nine universities in 1998 to foster automotive research and skilled workforce development (Vehicle Technologies Office, n.d.-a).

The OTT was restructured again in 2002 into the FreedomCAR and Vehicle Technologies Program (OFCVT), which ushered in the creation of longstanding programming such as the Clean Cities Coalition, a public-private partnership aiming to reduce petroleum consumption in transportation at the local level (Vehicle Technologies Office, n.d.-b). In 2011, the Department of Energy moved away from the FreedomCAR initiative in favor of the new U.S. DRIVE program, leading to the modern iteration of the Vehicle Technologies Office (Garman, 2014).

2.2. Renewable Energy

2.2.1. Geothermal

The Geothermal Technologies Office (GTO) works to increase the deployment of geothermal energy resources through research, deployment, and demonstration of geothermal exploration and production technologies (Geothermal Technologies Office, n.d.). Specifically, the GTO operates in six focus areas: Exploration & Categorization; Surface Accessibility; Subsurface Enhancement & Sustainability; Resource Maximization; Data, Modeling, & Analysis; Geothermal Integration & Awareness (Office of Energy Efficiency and Renewable Energy, 2022a).

While in the early 1970s, geothermal energy research was still in its infancy in the U.S., the oil crisis of 1973 sparked a desire to explore the potential of geothermal resources, thus Congress passed the Geothermal Energy Research, Development, and Demonstration Act of 1974, which provided the framework for DOE's geothermal program (Office of Energy Efficiency and Renewable Energy, 2010). The act mandated federal involvement in geothermal energy research, which led to the creation of the Geothermal Energy Coordination and Management Project, which would then morph into the Division of Geothermal Energy, initially operated under ERDA but later transferred to the DOE's CSA upon its creation in 1977 (Geothermal Energy Research, Development, and Demonstration Act, 1974). The division would retain its name until the 1985 restructuring which sought to improve management efficiency and renamed the office as the Geothermal Technology Division (Geothermal Technology Division, 1985).

In 1994, when EERE was created, the Geothermal Technology Division fell under the Utility Technologies suboffice (Office of Energy Research, 1995). By 1995, the Enhanced Geothermal

Systems (EGS) initiative was designed to overcome the limitations of traditional geothermal energy extraction. It built upon the reservoir engineering research developed during the 1970s through the Hot Dry Rocks initiative, which had explored techniques to tap into geothermal energy from hot rock formations. The EGS initiative aimed to create sustainable and economically viable geothermal reservoirs, ultimately paving the way for more widespread adoption of geothermal energy (Kennedy et al., 2010).

In 1996, the office was restructured and renamed the Office of Geothermal Energies (Office of Geothermal Technologies, 1996). In 2002, the office was reorganized and renamed the Geothermal Technologies Program during the wider restructuring of EERE (Office of Management and Budget, 2001). In 2011, the program was restructured again into the modern iteration that is the Geothermal Technologies Office (Geothermal Technologies Office, 2012).

2.2.2. Solar Energy

The Solar Energy Technologies Office (SETO) supports research, development, demonstration, and deployment assistance for solar energy (Solar Energy Technologies Office, n.d.-a). To accomplish this, SETO's goals focus on (1) lowering the costs of electricity from PV, and (2) rapid deployment by growing the U.S. solar industry and opening new markets (Office of Energy Efficiency and Renewable Energy, 2021).

Like most EERE sub-offices, SETO traces its history, prior to the founding of the CSA and EERE, to 1975 and the establishment of the Solar Energy Development Program within ERDA (Energy Research & Development Administration, 1976). Following its transfer to the DOE's CSA, it became known as the Solar Heat Technologies Program (Solar Buildings Technology Division, 1988). By the late 1980s, the DOE's solar program extended over a variety of subprograms focused on different aspects of solar energy, including the Solar Buildings Technology Program, Concentrating Solar Power Program, and Photovoltaics Program. Upon the EERE's creation in 1994, these subprograms became known as the Office of Solar Energy Conversion, which was a suboffice within the Office of Utility Technologies (Office of Energy Research, 1995). During the 2002 EERE restructuring, the existing solar program became the Solar Energy Technology Program (Solar Energy Technologies Program, 2002). In 2012, the program was reorganized as the Solar Energy Technologies Office (SETO) (Solar Energy Technologies Office, 2020).

2.2.3. Wind Energy

The Wind Energy Technologies Office (WETO) invests in research, development, and demonstration that supports the advancement of offshore, land-based, and distributed wind energy, as well as integration with the electric grid (Wind Energy Technologies Office, n.d.). WETO operates in six fields, including offshore wind, land-based wind, distributed wind, siting & environmental challenges, system integration, and modeling & analysis (Office of Energy Efficiency and Renewable Energy, 2020).

WETO has one of the longest histories of any EERE office, tracing its founding back to 1973 as the Federal Wind Energy Program, which was initially managed under the National Science Foundation's Research Applied to National Needs Program (RANN) and later transferred to

ERDA in 1975 (Federal Wind Energy Program, 1978). Upon the creation of the DOE in 1977, the program was transferred to the CSA, and to the EERE in 1994, when it would become known as the Office of Photovoltaic and Wind Technologies, a suboffice within the Office of Utility Technologies (U.S. Department of Energy, 1997).

During the 2002 restructuring of EERE, the name was changed to the Wind and Hydropower Technologies Program, combining the DOE's wind and hydropower research into one office (Office of Energy Efficiency and Renewable Energy, 2002). In 2008, the program was renamed the Wind and Water Power Technologies Program, with two subdivisions focusing on wind and water power, respectively. In 2011, the EERE renamed the office again to the Wind and Water Power Technologies Office (WWPTO) until 2016, when the wind power and hydropower subdivisions split into two separate offices, creating the modern Wind Energy Technologies Office (WETO). This reorganization gave wind power its own dedicated office within the EERE once again (Water Power Technologies Office, 2019).

2.2.4. Water Power

The Water Power Technologies Office (WPTO) focuses on research, development, and testing of technologies that advance marine energy, next-generation hydropower, and pumped storage system technologies (Water Power Technologies Office, n.d.). WPTO's programming is divided into two subcategories: (1) the Marine Energy Program that covers foundational R&D; technology-specific system design & validation; reducing barriers to testing; and data access, analytics, and workforce; and (2) the Hydropower Program encompassing innovations for low-impact hydropower growth; grid reliability, resilience, & integration; fleet modernization, maintenance, & cybersecurity; environmental & hydrologic systems science; and data access, analytics, & workforce development (Office of Energy Efficiency and Renewable Energy, 2022b).

Although DOE had conducted research on water power since its inception, this research was dispersed under a variety of different offices for much of its history. The Small Hydropower Program was DOE's first major investment into water power research, which began with the DOE's formation in 1977 and ended in the early 1980s (Smith et al., 2017). In the 1990s, the DOE's Hydropower Program was managed by the Office of Geothermal Technologies within the EERE (Idaho National Engineering & Environmental Laboratory, 1997). During the 2002 restructuring of EERE, the Wind and Hydropower Technologies Program was a continuation of the Federal Wind Energy Program, with a new emphasis on the intersection of wind and hydropower (Office of Energy Efficiency and Renewable Energy, 2002). However, it would take until the Energy Independence and Security Act of 2007 (EISA), which directed the DOE to create an office focused on hydropower research and development, for there to be an increased importance placed on hydropower research, which had been defunded by FY 2006 (Wind and Water Power Program, 2011). In 2008, the office was reorganized into the Wind and Water Power Program, which had two subdivisions focusing on wind and water power, respectively. During the 2011 restructuring of EERE, the program was renamed the Wind and Water Power Technologies Office (WWPTO). In 2016, the wind and water power offices were formally split into two separate entities, with the hydropower office becoming the Water Power Technologies Office (WPTO) (Water Power Technologies Office, 2019).

2.3. Buildings & Industry

2.3.1. Advanced Materials & Manufacturing

The Advanced Materials & Manufacturing Technologies Office (AMMTO) is dedicated to improving the energy and material efficiency, productivity, and competitiveness of manufacturers across the industrial sector through research, development, demonstration, technical assistance, and workforce development (Office of Energy Efficiency & Renewable Energy, 2016a). AMMTO operates in three main areas: Secure & Sustainable Materials, Next Generation Materials & Processes, and Energy Technology Manufacturing & Workforce (Advanced Materials & Manufacturing Technologies Office, n.d.).

AMMTO's origins predate both the EERE and CSA, tracing its history back to the Federal Non-Nuclear Energy Research and Development Act of 1974, which mandated the creation of a program aimed at improving energy efficiency within the industrial sector through the research and development of high-risk, innovative technologies (Industrial Technologies Program, 2008). Following the 1977 creation of the Department of Energy, the program was placed within the CSA and renamed the Office of Industrial Processes (OIP), which later transitioned into the Office of Industrial Technologies (OIT) in the early 1990s and became a part of EERE in 1994 (Energy Materials Coordinating Committee, 1994). In 2002, OIT was renamed the Industrial Technologies Program (ITP) during the broader EERE restructuring that year (Office of Energy Efficiency and Renewable Energy, 2002).

In 2011, the ITP changed its name to the Advanced Manufacturing Office (AMO) to pivot its focus towards the advancement of high-tech material technologies and processes (Chemical Processing, 2011). In 2022, the EERE announced that AMO would be broken into two offices to provide better attention to each of the AMO's key areas of operation, both of which had seen a significant increase in interest over the past decade. The Advanced Materials & Manufacturing Technologies Office (AMMTO) would focus on innovation in manufacturing techniques, while the Industrial Efficiency & Decarbonization Office (IEDO) would focus on reducing industrial greenhouse gas emissions and increasing resource efficiency (Advanced Materials & Manufacturing Technologies Office, 2022).

2.3.2. Building

The Building Technologies Office (BTO) conducts research, development, and demonstration activities to develop innovative, cost-effective energy-saving solutions for buildings (Building Technologies Office, n.d.). The BTO divides its work into three main areas consisting of research and development, market stimulation, and codes & standards (Office of Energy Efficiency and Renewable Energy, 2016b).

The BTO predates the EERE and CSA, tracing its origins to the formation of ERDA in 1975, when it was known as the Office of Buildings and Community Systems. Upon the formation of the DOE, the office was transferred to the DOE's CSA and retained the same name until the early 1980s, when it briefly reorganized into the Office of Building Energy Research and Development, with four sub-offices (Office of Building Energy Research & Development, 1984). In 1985, the name was reverted back to the Office of Buildings and Community Systems until April 1990, when it was renamed the Office of Building Technologies (Farhar et al., 1990). The program would see renewed interest following the Energy Policy Act of 1992, which called for the establishment of energy efficiency standards for most residential buildings and provided grants for research and development through regional energy efficiency demonstration centers (Energy Policy Act of 1992, 1992). In 1994, the program was transferred to EERE and later renamed the Office of Building Technology, State and Community Programs (Office of Energy Efficiency and Renewable Energy, 1998). The office would change its name once again to the Building Technologies Program during EERE's 2002 restructuring and would retain this name until the early 2010s when it adopted the contemporary Building Technologies Office name (Office of Energy Efficiency and Renewable Energy, 2002; Office of Energy Efficiency and Renewable Energy, 2014c)

2.3.3. Industrial Efficiency & Decarbonization

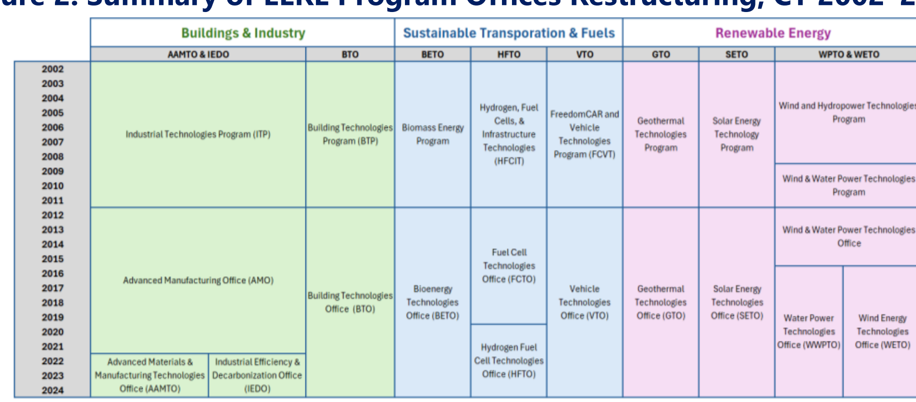
The Industrial Efficiency & Decarbonization Office (IEDO) invests in research, development, pilot-scale demonstrations, and technical assistance and workforce development to increase competitiveness of the U.S. industrial base in global markets, specifically through three main areas: Cross-Sector Technologies, Energy- & Emissions-Intensive Industries, and Technical Assistance & Workforce (Industrial Efficiency & Decarbonization Office, n.d.).

Unlike most EERE sub-offices, the IEDO's history began recently with the 2022 AMO restructuring, which split the AMO into two new offices. AMMTO inherited most of AMO's previous work and retained a narrower focus on advanced materials and manufacturing techniques, while the IEDO directed its focus solely toward industrial innovation (Advanced Materials & Manufacturing Technologies Office, 2022).

2.4. Organizational Structure

Since 2002, EERE has undergone several organizational restructurings, as discussed in prior sections and summarized in Figure 2. As of February 2024, EERE consisted of 14 offices, three of which are focused on operations and managed under the purview of a deputy assistant secretary (Office of Operations, n.d.). These are the Golden Field Office, the Office of Business Services Management, and the Budget Office, as seen in Figure 3.

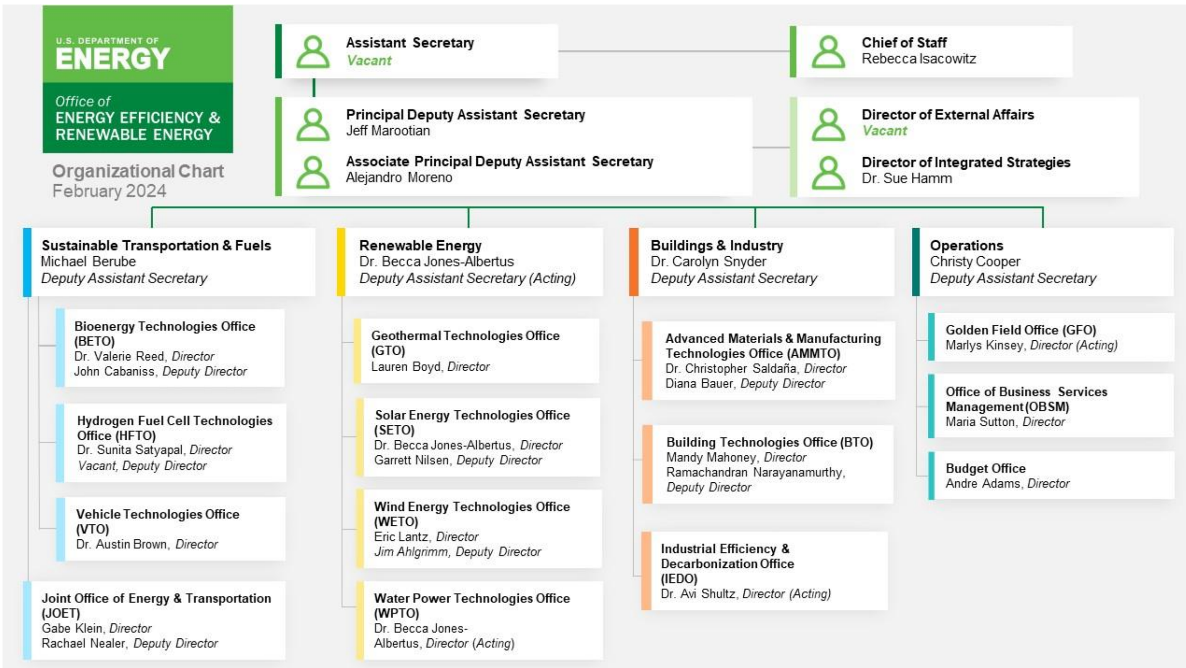
Figure 2. Summary of EERE Program Offices Restructuring, CY 2002–2024



Note: The authors created this figure using information from the historical review discussed in this section.

In addition, as previously mentioned, nine program offices within EERE are grouped into three thematic areas: *Sustainable Transportation & Fuels* (BETO, HFTO, and VTO), *Renewable Energy* (GTO, SETO, WETO, and WPTO*)*, and *Buildings & Industry (AMMTO, BTO, and IEDO*). The history of these was examined in the prior sections. One additional office is nested under *Sustainable Transportation & Fuels*, the Joint Office of Energy and Transportation (JOET).

Figure 3. EERE Organizational Chart, February 2024



Note: U.S. Department of Energy (2024), *EERE Organizational Chart*. https://www.energy.gov/eere/eere-leadership

JOET was formed in 2021 following the passage of the Bipartisan Infrastructure Law (BIL) and supports several programs focusing on areas such as electric vehicle charging station development and zero-emission school bus deployment (Joint Office of Energy and Transporation, n.d.-a). Its goal is to facilitate cooperation between the DOE and the Department of Transportation's programs and to accelerate cross-agency R&D efforts in zero-emission transportation infrastructure and electric vehicle technologies (Joint Office of Energy and Transportation, n.d.-b). Although the joint office is nested with EERE, it receives additional funding and support from multiple other offices. Therefore, given its recency and diverse funding sources, we have excluded it from this report's analysis.

3. Research Funding Over the Last Two Decades

With this background on EERE program history established, in this section, we focus on EERE research funding. This office offers a variety of awards, both competitive and noncompetitive, which provide funding for both the public and private sectors' renewable energy and energy efficiency R&D. The majority of EERE funding is awarded through competitive grants and cooperative agreements (Office of Energy Efficiency & Renewable Energy, 2011a). Grants are typically awarded through a process that begins with a funding opportunity announcement

(FOA) posted on EERE's Funding Opportunity eXCHANGE website (Office of Energy Efficiency & Renewable Energy, n.d.-b). FOAs often seek grant applicants in a certain research or technology area, who are chosen based on merit and relevance to the program area. In addition to grants, EERE also enters into cooperative agreements on a competitive basis. These are similar to grants but require a greater degree of federal control and oversight of the project. Laboratory subcontracts are also typically awarded competitively.

Other financial awards are distributed on a noncompetitive basis through programs such as the Weatherization Assistance Program (WAP), State Energy Program (SEP), and Energy Efficiency and Conservation Block Grant Program (EECBG). The funding formula for these is predetermined by the federal government (Office of Energy Efficiency & Renewable Energy, 2011a). Notably, in 2023, these programs, which historically made up the largest segment of noncompetitive funding opportunities by the office, were transferred outside of EERE to new offices. Other noncompetitive opportunities take the form of unsolicited proposals as well as cooperative research and development agreements (CRADAs) (Office of Energy Efficiency and Renewable Energy, n.d.-b).

3.1. Appropriations Process

Funding for EERE, which allows the office to issue awards, follows the annual appropriations process by which the President proposes a budget to Congress. This budget includes a specified amount for EERE. Then, Congress deliberates and authorizes appropriations. The funds are allocated to DOE, which then allots amounts to its units like EERE. Funding fluctuations occur from year to year based on administration priorities, economic conditions, and legislative directives. In addition to their annual allotment, EERE receives funding through specific congressional initiatives or national packages, e.g., economic recovery legislation.

In more detail, EERE's primary funding source is the Energy and Water Deployment and Related Agencies (EWD) appropriations bill, which is one of twelve appropriations bills debated and enacted by Congress each fiscal year. Previously, EERE appropriations had been divided between both the EWD and the Interior and Related Agencies Appropriations bill until all DOE programs were consolidated within the EWD in 2005 (House Appropriations Committee, 2005). The EWD contains proposed budgets for various government programs, including EERE, and is influenced by a variety of actors before the final budget resolution is enacted. The budget proposal process begins with the White House's Office of Management and Budget (OMB), which drafts its annual budget proposal reflecting the priorities of the President and his administration. OMB's draft proposal is then typically sent to DOE, which reviews and negotiates the budget proposal to match its departmental needs. The DOE's Chief Financial Officer (CFO) acts as the main point of contact between OMB and DOE and makes recommendations for modifications to the proposed budget if necessary, in addition to supporting departmental officials testifying during congressional budget hearings (U.S. Department of Energy, 2021).

Although the OMB and DOE communicate on the proposed budget, OMB is not required to accept DOE's requested modifications before submitting the President's budget proposal to Congress. Once submitted, the House and Senate Appropriations Committees begin reviewing the proposed budget, with the Energy and Water Development Subcommittee responsible for reviewing the EWD appropriations (U.S. Senate Committee on Appropriations, n.d.). The subcommittee uses the President's recommendations along with congressional hearings, often involving DOE officials, to draft their own budget resolution.

Oftentimes, the final appropriations bill does not follow the White House's recommendations due to conflicting goals between the President, Congress, and DOE. For example, during President Trump's first term, the White House proposed significant cuts to EERE appropriations, including a nearly 80% cut between FY 2017 and 2018; however, following extensive congressional hearings, EERE's enacted appropriations instead were modestly increased each year of the first Trump administration (Congressional Research Service, 2017). Because congressional budget resolutions are concurrent resolutions, meaning they do not require Presidential approval, they cannot be vetoed nor filibustered, simply requiring a majority vote to pass Congress (Center on Budget and Policy Priorities, 2024).

In addition to annual appropriations bills, EERE can receive funding from congressional legislation, such as 2009's American Recovery & Investment Act (ARRA), which provided the office with $16.8 billion (Congressional Research Service, 2009a). Often, this supplemental funding is passed in response to recessions or other wider economic needs. Another example is the Infrastructure Investment and Jobs Act (IIJA) of 2021, which authorized a $1.2 trillion investment in infrastructure and transportation improvements across various government agencies (U.S. Department of Transportation, 2023). These irregular appropriations bills produce spikes in funding, as seen in subsequent sections.

3.2. Awards Data

To examine EERE's use of funding, specifically awards for research purposes, our first data source is USAspending, a repository of information from various government systems, including agency financials and governmentwide awards (USAspending, 2024). These federal spending data are made public in accordance with the Digital Accountability and Transparency Act, signed into law in 2014. It includes information on financial assistance, which is distributed in many forms, including grants and cooperative agreements.

Using these financial assistance data, we relied on Assistance Listing Numbers (ALN), previously known as the Catalog of Federal Domestic Assistance (CFDA) numbers, to identify spending by EERE for research activities. These are five-digit numbers assigned to federal awards and used for governmental reporting and auditing. ALNs are agency-specific, and EERE has exclusively used 12 of these since it was established, with some currently archived (see Table A.2 in the appendix). Table 1 lists the share of EERE awards and corresponding obligated amounts across

ALNs for FY 2002–2021. All monetary amounts in this report are expressed in 2022 dollars using the Government Consumption Expenditures and Gross Investment price deflator (Federal Reserve Bank of Saint Louis, 2024).

Over 51% of the number of awards made by EERE were focused on R&D; specifically, over 31% were obligated to renewable energy and over 19% to conservation. Notably, when we examine the share of obligated amounts by ALN, Weatherization Assistance for Low-Income Persons emerges as the program to which most of the funds are allocated at about 35%. Renewable energy and conservation R&D are the second and fourth most funded categories. In terms of the obligated amounts during FY 2002–2021, about 35% funded R&D projects.

Table 1. Awards and Obligated Funds by ALN, All EERE Awards, FY 2002–2021

Assistance Listing Number	Title	Share of Awards	Share of Obligated Amount
81.036	Inventions and Innovations	1.55%	0.64%
81.041	State Energy Program	4.81%	15.91%
81.042	Weatherization Assistance for Low-Income Persons	4.38%	34.74%
81.079	**Regional Biomass Energy Programs**	0.35%	0.26%
81.086	**Conservation Research and Development**	19.33%	13.48%
81.087	**Renewable Energy Research and Development**	31.43%	21.09%
81.105	National Industrial Competitiveness through Energy, Environment, and Economics	0.17%	0.05%
81.117	Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance	11.40%	1.74%
81.119	State Energy Program Special Projects	8.17%	0.44%
81.127	Energy Efficient Appliance Rebate Program	0.46%	0.73%
81.128	Energy Efficiency and Conservation Block Grant Program (EECBG)	17.82%	10.85%
81.129	**Energy Efficiency and Renewable Energy Technology Deployment, Demonstration and Commercialization**	0.14%	0.07%
Total		12,444 Awards	$65.9 Billion

Note: In bold are ALN titles associated with research funding. These results are calculated by the authors using information from USAspending (2025*), Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

As our focus in this project is research funding, we exclude ALNs that do not explicitly mention research, development, or demonstration. Therefore, we remove awards, predominantly providing assistance to governmental units, that are part of (1) the *Weatherization Assistance for Low-Income Persons* (about 35% of obligations during FY 2002–2021), (2) *State Energy Program* (about 16%), (3) *Energy Efficiency and Conservation Block Grant Program* (about 11%), (4) *Energy Efficient Appliance Rebate Program* (less than 1%), and (5) *State Energy Program Special Projects* (less than 0.5%). Excluding these awards administered through assistance programs is in line with recent EERE restructuring, as explained in Section 3.3.

3.3. Assistance Programs

The Weatherization Assistance Program (WAP) is a longstanding DOE program, tracing its foundation to the Energy Conservation and Production Act of 1976, which promotes energy savings and efficiency through monetary assistance to low-income households for home repairs (National Association for State Community Services Programs, n.d.). For most of its history, WAP was nested within EERE and its predecessor, the Office of Conservation and Solar Applications (CSA). During its time with EERE, WAP was organized within the broader Weatherization and Intergovernmental Programs Office (WIP), which also oversaw the DOE's Tribal Energy Program, State Energy Program (SEP), and Energy Efficiency Conservation Block Grant (EECBG) (Weatherization & Intergovernmental Program, 2010).

The Tribal Energy Program, called for in the Energy Policy Act of 1992, provided financial assistance to promote energy efficiency and weatherization in Native American communities (Office of Indian Energy Policy, n.d.). The SEP is another longstanding program dating back to the DOE's founding in the wake of the 1970s energy crisis. SEP provides financial and technical assistance to states and territories to promote energy efficiency through state-specific programming. Unlike most EERE programs, SEP funding is distributed without a specific mandate to state energy offices, who then determine how the money should be allocated to best meet the needs of their state (Weatherization & Intergovernmental Programs Office, 2019). As of FY 2018, 43% of SEP funding was spent on policy, planning, and energy security, 27% on buildings, 9% each on energy education, industry, and electric power and renewable energy, and 3% on transportation (Weatherization & Intergovernmental Programs Office, 2019). Lastly, EECBG is a relatively new program, which was established by EISA and saw its first significant funding in 2009 (American Recovery and Reinvestment Act of 2009, 2009). Similarly, EECBG aims to support state, local, and tribal governments to improve energy efficiency and reduce emissions through the distribution of block grants, which provide recipients with significant flexibility in determining how funds should be used.

Throughout the decades, WIP programs have made up a large portion of EERE's total budget. During the Great Recession, WAP was EERE's highest-funded program, receiving $5 billion from ARRA, with WAP programming making up over 60% of EERE's total budget for FY 2009 and 2010 (American Recovery and Reinvestment Act of 2009, 2009). Additionally, $3.2 billion was pledged to the EECBG program and $3.1 billion to SEP. However, WIP's programs faced the threat of elimination during President Trump's first term (U.S. Department of Energy, 2022a). From FY 2018 to 2021, the President's budget requests proposed $0 in funding for WIP as part of a wider effort to drastically reduce the scope of EERE programming to focus solely on early-stage R&D projects (Congressional Research Service, 2017). Ultimately, Congress chose to continue to provide slight increases in funding for WIP programming each year of the first Trump administration (Congressional Research Service, 2021). In FY 2023, DOE reorganized its programming, leading to the transfer of WIP and its programs from EERE (U.S. Department of Energy, 2022a). WAP, SEP, and EECBG were transferred to the new Office of State and

Community Energy Programs (SCEP), while the Tribal Energy Program was transferred to the newly created Office of Indian Energy.

In addition to these programs, the State Energy Efficient Appliance Rebate Program (SEEARP) also does not fund research; therefore, it falls outside the scope of our project. SEEARP was a program within the Building Technologies Office (BTO), created using funding provided by ARRA, which aimed to promote energy savings and improve economic output by incentivizing the replacement of inefficient appliances with new energy-efficient units (Building Technologies Office, n.d.). During its operational years, SEEARP, which was America's first national residential appliance rebate program, issued over 1.7 million rebates totaling $264.3 million across all 56 states and territories (Building Technologies Office, 2015).

3.4. Trends During FY 2002 to 2021

By removing assistance programs and focusing on programs funding R&D, we include four ALNs in this analysis:

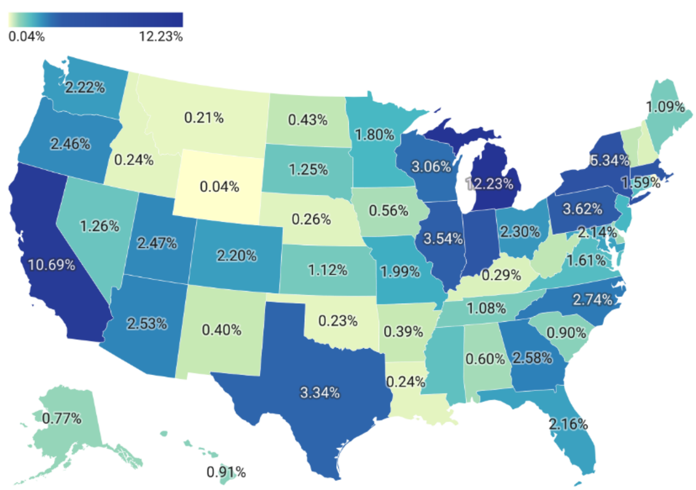
1. 81.079 Regional Biomass Energy Programs (ALN archived in 2021): "to help meet the goal of significantly increasing America's use of fuels, chemicals, materials, and power made from domestic biomass on a sustainable basis" (U.S. General Services Administration, 2018, p. 856) with use guidelines specifying "assistance may be used to **develop** and transfer any of several biomass energy technologies to the scientific and industrial communities" (U.S. General Services Administration, 2018, p. 856).
2. 81.086 Conservation Research and Development: "to conduct a balanced, long-term **research** effort in Buildings Technologies, Vehicle Technologies, Solid State Lighting Technologies, Advanced Materials and Manufacturing Technologies, and Industrial Efficiency and Decarbonization" (U.S. General Services Administration, 2024a, para. 1).
3. 81.087 Renewable Energy Research and Development: "to conduct balanced **research** and **development** efforts in the following energy technologies: solar, biomass, hydrogen and fuel cells, wind, hydropower, and geothermal" (U.S. General Services Administration, 2024b, para. 1).
4. 81.129 Energy Efficiency and Renewable Energy Technology Deployment, Demonstration and Commercialization: "for the technology deployment, **demonstration**, and commercialization of Energy Efficiency and Renewable Energy technologies" (U.S General Services Administration, 2018, p. 879).

In addition to awards made through assistance programs, we exclude from this analysis a small number of research awards that were in collaboration with offices outside of EERE. These include *Inventions and Innovations* (less than 1%) and *National Industrial Competitiveness through Energy, Environment, and Economics* (less than 0.1%) awards. The obligated amount listed for an award funded through collaboration does not indicate the share per collaborating office, so we opt to remove these awards and focus on ones solely awarded by EERE. In addition, we remove awards categorized as *Energy Efficiency and Renewable Energy Information Dissemination,* *Outreach, Training and Technical Analysis/Assistance* (less than 2% of obligations during FY 2002–2021). Table A.3 in the appendix includes detailed steps taken to create the dataset used for analysis.

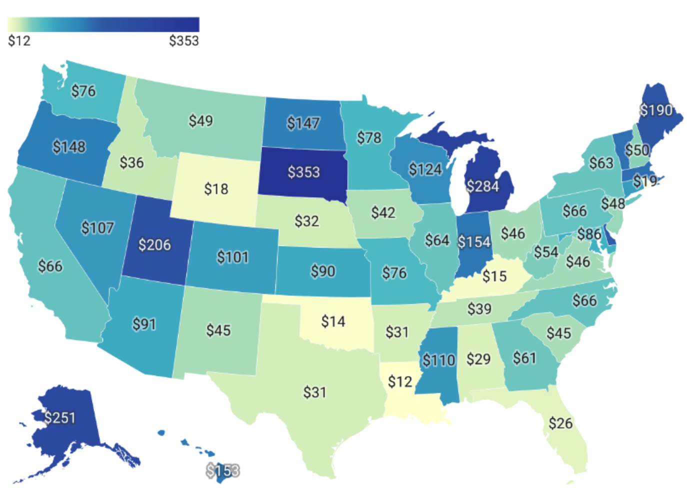
Figure 4 maps the spatial distribution of EERE research awards across states. As a share of total obligated funds, Michigan (12%), California (11%), New York (5%), Massachusetts (4.5%), and Indiana (4%) emerge as the top recipients (see Panel A). When examining obligated funds per capita, Michigan retains its placement among the highest awarded states (at $291 per capita), only surpassed by South Dakota ($353) (see Panel B). Similar sparsely populated states, Alaska ($251), Utah ($206), and Maine ($190), round out the top 5 awarded states on a per capita basis.

Figure 4. Map of Obligated Funds, EERE Research Awards, FY 2002–2021

Panel A. Share of Total



Panel B. Per Capita



Note: These results are calculated and mapped by the authors using information from USAspending (2025*), Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

Table 2 lists the share of EERE R&D awards and corresponding obligated amounts across types of recipients for FY 2002 to 2021. About 38% of awards are received by higher education institutions (public and private), and about 24% by for-profit entities. Notably, when we examine the share of obligated amounts by types of recipients, these for-profit entities emerge as the type to which most of the funds are allocated at about 45%. Higher education institutions are the second highest category in terms of obligated amounts, at a share of 24%. Unlike awards made through assistance programs, governments (state, county, city or township, special district) receive a low share of R&D funding at 4%. Similarly, Indian/Native American Tribal institutions (governments, housing authorities, organizations) receive only 1% of research awards (as defined in this report). These results are in line with estimates that industry, universities, and colleges receive most of the external federal R&D obligations (U.S. Government Accountability Office, 2022).

Table 2. Awards and Obligated Funds by Recipient, EERE Research Awards, FY 2002–2021

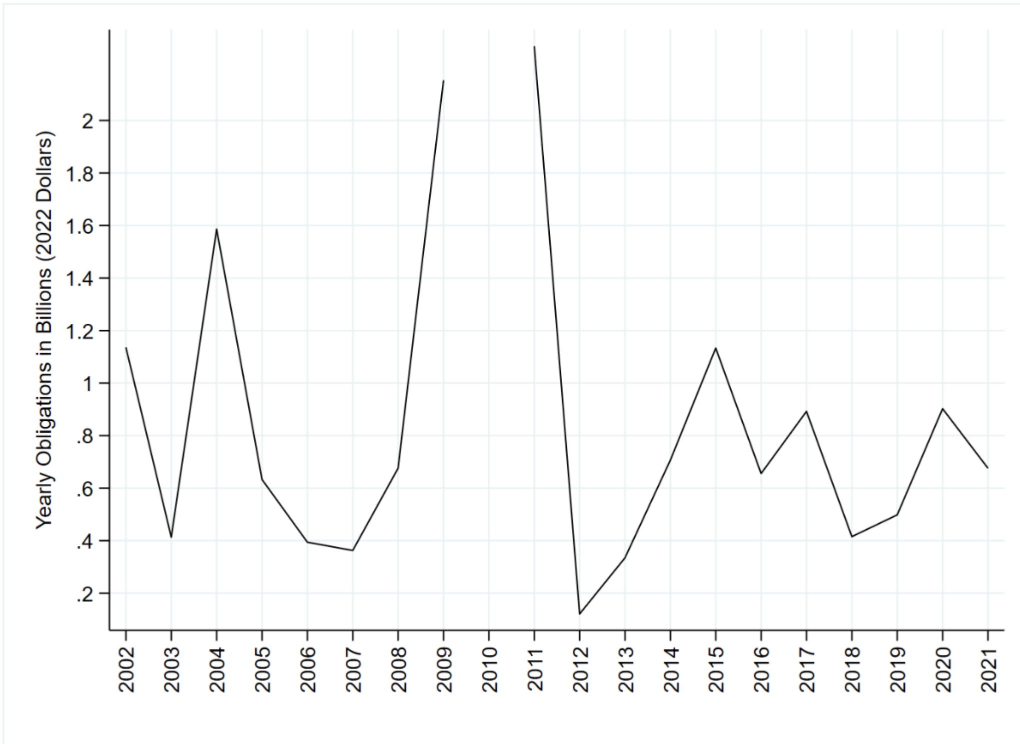
Title	Share of Awards	Share of Obligated Amount
Higher Education Institution	37.64%	24.39%
For-Profit	23.65%	44.82%
Small Business	14.54%	12.49%
Nonprofit	12.58%	11.94%
Government	5.96%	4.27%
Indian/Native American Tribal Institutions	4.50%	1.04%
Other (e.g., Individual, Regional Organization)	1.14%	1.06%
Total	6,377 Awards	$23.52 Billion

Note: These results are calculated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

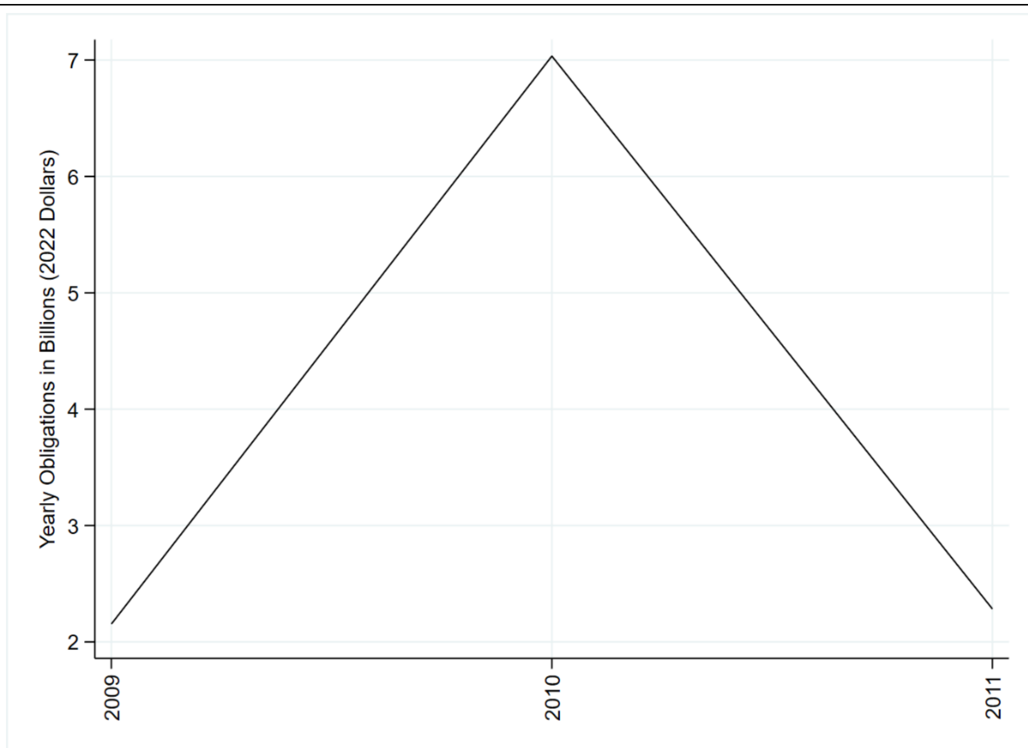
Figure 5 illustrates research funding from FY 2002 to 2021, in two panels. Panel A begins at $1.1 billion awarded for research purposes in 2002 and decreases to $676 million by 2008. Panel B zooms in on years 2009 to 2011 where yearly obligations averaged $3.8 billion compared to $743 million in the period ending in 2008. The lowest funding level during FY 2002 to 2008 is in 2007 at $363 million and the highest is about $1.6 billion in 2004. This period mostly consists of decreases in year-over-year obligations with only two years exhibiting an increase: 2004 and 2008. The lowest funding level in Panel B is about $2.2 billion in 2009 and the highest is about $7 billion in 2010. Returning to Panel A, $121 million were awarded in 2012, a substantial decrease from the $2.3 billion awarded in 2011 and the lowest level seen beyond 2011. Panel A ends at $676 million in 2021. The highest funding level after 2011 is in 2015 at over $1.1 billion. This last period, averaging $634 million, mostly exhibits cyclical funding. In general, throughout the FY 2002 to 2021 period examined, EERE research funding displays cyclicality. However, these cycles are irregular and do not follow a fixed pattern; rather, the duration and levels of funding fluctuate substantially, reflecting other drivers than administrative changes.

Figure 5. EERE R&D Obligations

Panel A. FY 2002–2021



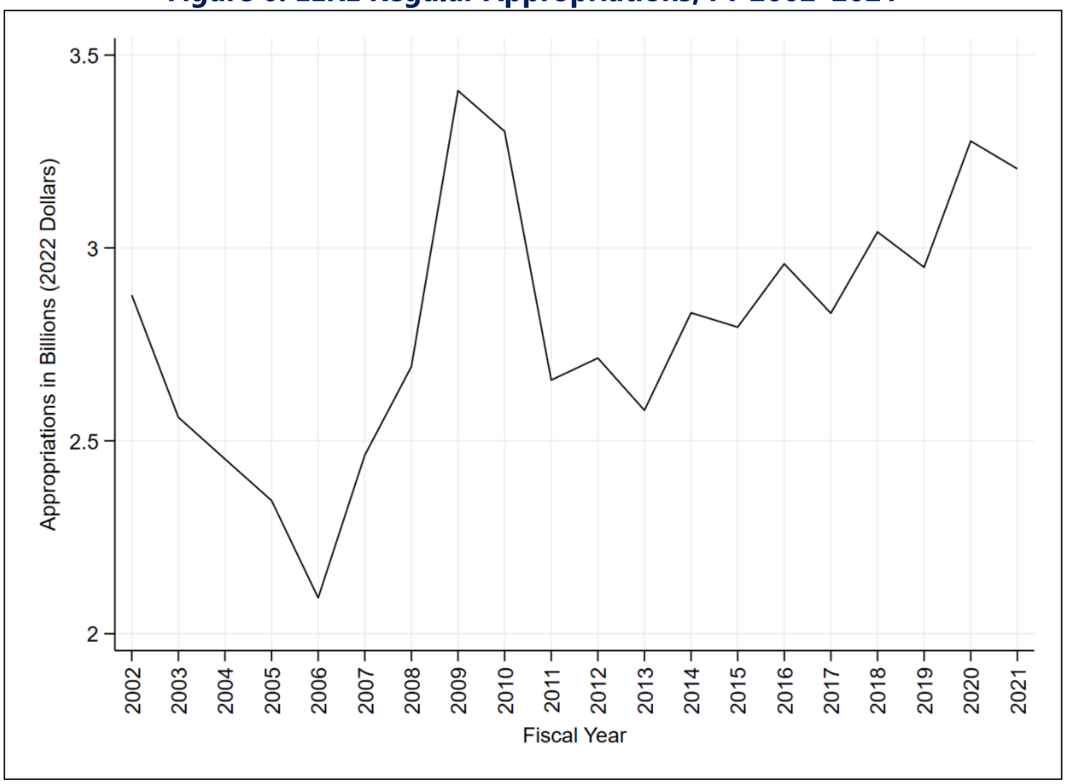
Panel B. FY 2009–2011



Note: These results are calculated and illustrated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

The trend observed for research obligations (Figure 5) differs from the regular appropriations trend seen in Figure 6. To clarify, the appropriations in Figure 6 include all EERE activities, which encompasses, for example, grants to states for the weatherization of low-income homes, while the obligations illustrated in Figure 5 are exclusively capturing research activity (as defined in this report). For regular appropriations, Figure 6 begins at $2.9 billion in 2002 and follows a downward trend until 2007, when it begins to increase until it peaks at $3.4 billion in 2009. Prior to 2009, yearly appropriations averaged about $2.5 billion, while the post-2011 average was about $2.9 billion.

Figure 6. EERE Regular Appropriations, FY 2002–2021



Note: Not shown in the figure is the ARRA obligations in 2009 that provided an additional $26.3 billion to EERE in 2022 dollars. These results are calculated and illustrated by the authors using information from the Office of Energy Efficiency and Renewable Energy (2023*), EERE Budget*.
https://web.archive.org/web/20230815000939/https://www7.eere.energy.gov/office_eere/program_budget_formulation.php

3.5. Administration Changes, Crises, & Market Dynamics

The timeline examined in this report begins in 2002, which coincides with a significant restructuring of EERE that stemmed from newly inaugurated President George W. Bush's Presidential Management Agenda, announced in August 2001 (Congressional Research Service, 2009b). The agenda laid out five government-wide initiatives: strategic management of human capital, competitive sourcing, improved financial performance, expanded electronic government, and budget & performance integration (Office of Management and Budget, 2001). To comply with these guidelines, EERE announced its own restructuring and published its 2002 Strategic

Plan, which called for several reforms, including a flatter management structure, greater focus on results, and elimination of inefficiencies and overlapping functions (Office of Energy Efficiency and Renewable Energy, 2002). The stated concern at the time was that EERE had an inefficient "stovepipe structure" characterized by many managerial layers and a lack of horizontal communication (National Research Council, 2005). These inefficiencies were brought to light by a 2000 National Academy of Public Administration management review of EERE, which identified four key problem areas: organizational fragmentation, emphasis on process rather than results, poor communication, and weak decision-making processes (Messner et al., 2003). Once the restructuring was concluded, EERE reduced the number of deputy assistant secretaries to one and consolidated program offices (National Research Council, 2005). Further, during the 2002 restructuring, the Distributed Energy and Electricity Reliability Program was relocated from EERE to the Office of Electricity within DOE.

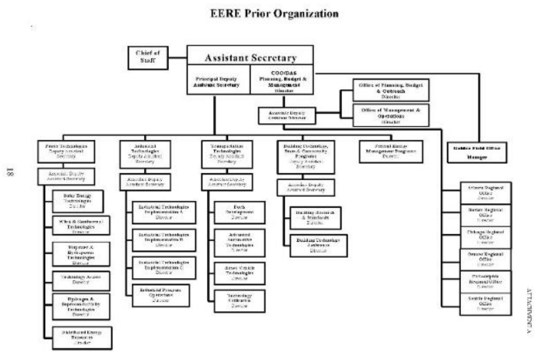
In addition, at the time, there was a perception that stakeholders often complained of financial inefficiency and a lack of results from EERE-funded research projects (Messner et al., 2003). The 2002 restructuring aimed to address these concerns through the consolidation of all financial assistance and project management activities into the Golden Field Office, which allowed the organization to improve monitoring capabilities (Messner et al., 2003). Another factor that drove the 2002 restructuring was the National Energy Policy Development Group's May 2001 National Energy Policy report, which discussed America's burgeoning energy shortage, the worst it had seen since the 1970s oil crisis (National Energy Policy Development Group, 2001).

Markedly, when discussing the 2002 restructuring in interviews with EERE staff, the motivation was described as a push by political appointees to wrest control from the highest-level civil servants. The three deputy assistant secretaries at the time – industry, transportation, and buildings – were described in the interviews as having significant institutional memory as well as key congressional and industry stakeholders' support. This limited the implementation of major, politically driven changes to the funding (e.g., closing the geothermal power office, reducing funding for solar, increasing funding for hydrogen, and closing the industrial efficiency office). After the restructuring, the three former deputy assistance secretaries were elevated to a Board of Directors, which one interviewee described as "being put out to pasture."

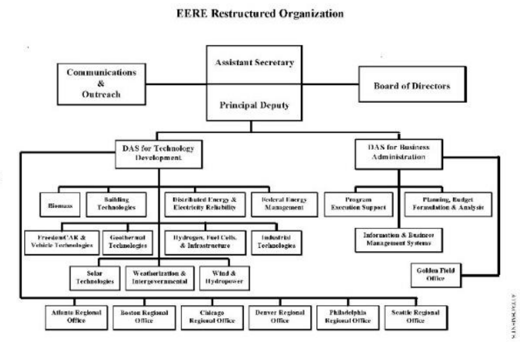
Figure 7 provides four snapshots of EERE's organizational structure, pre- and post-2002 restructuring, as well as in 2014 and 2021, where this report's period of analysis ends. Notably, EERE gradually returned to its prior structure. By 2007, duties were divided between two deputy assistant secretaries instead of one. Then, by 2014, EERE reverted to three deputy assistant secretary positions. Section 5, which synthesizes findings from interviews with EERE staff, provides additional context for some of these decisions. However, we note here the challenges of the restructuring that were discussed in the interviews included the lack of adequate capacity to manage a $2 billion a year program with diverse investments with only one deputy assistant secretary. One interviewee described the division of duties between two deputy assistant secretaries as a "big relief" and added that "political management has determined that too much concentration is self-defeating."

Figure 7. EERE Organizational Structure over Time

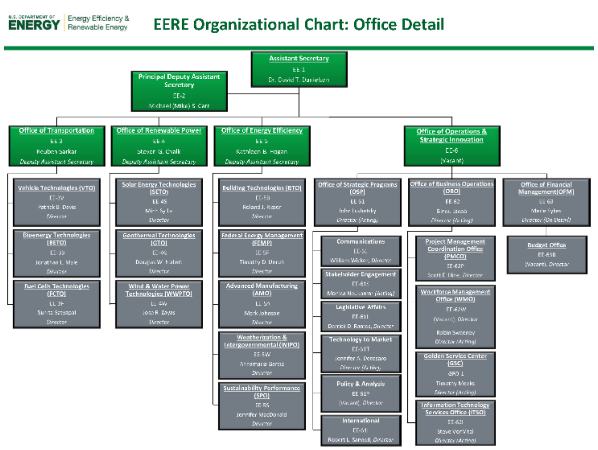
Panel A. Prior to 2002 Restructuring



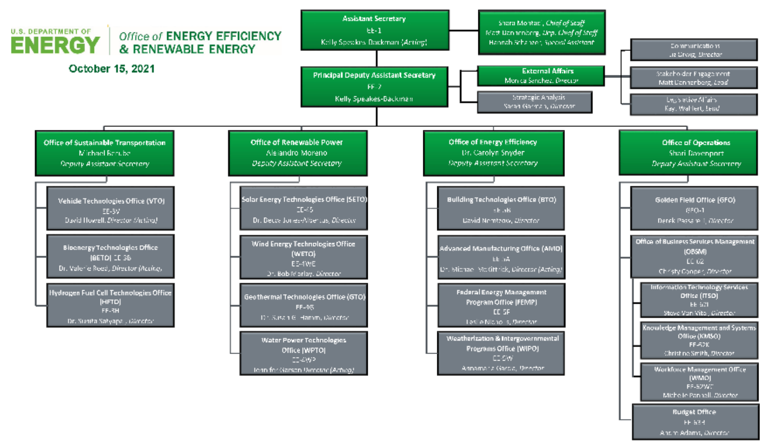
Panel B. Post 2002 Restructuring



Panel C. 2014



Panel D. 2021



Note: Panels A & B are from the National Academy of Public Administration (2003), *The Reorganization of The Office of Energy Efficiency and Renewable Energy*. https://www.energy.gov/eere/analysis/articles/reorganization-office-energy-efficiency-and-renewable-energy-preliminary. Panel C is from the U.S. Department of Energy (2014), *EERE Organizational Chart: Office Detail*. https://www.energy.gov/sites/prod/files/2014/10/f18/doe_eere_organization_chart_09_18_2014_0.pdf. Panel D is from the U.S. Department of Energy (2021), *EERE Organizational Chart*. https://www.energy.gov/sites/default/files/2021-10/eere-org-chart-10152021_0.pdf

During the 2002 to 2021 period, which spanned four presidents, EERE R&D funding experienced recurring fluctuations. These mirrored transitions between administrations and growing partisan divides in federal funding priorities for energy research. Also reflected in funding were crises ranging from geopolitical to public health. Throughout the two decades, EERE R&D funding decisions were driven by an interest in strengthening energy independence and security, maintaining U.S. competitiveness in global markets, and the energy transition.

As previously mentioned, Bush's administration (2001–2009) began with a focus on government efficiency and reduced spending. In terms of energy policy, market dynamics, and business interests played a role in shaping the administration's initial priorities. In fact, the administration emphasized domestic energy production, e.g., opening the Arctic National Wildlife Refuge for drilling, and was perceived to favor the oil industry (Allen, 2000; Klare, 2003; Raoier, 2021). Notably, in the interviews with EERE staff, one participant noted that "EERE were completely shut out of the [administration's] energy strategy development [and] forced to review final drafts of the report that were produced by outsiders, with little opportunity to make substantive edits."

Nevertheless, the geopolitical crises of the time led to increased support for energy efficiency and renewable energy through legislation. One interviewee noted that the administration "with the appointment of Secretary Sam Bodman and Assistant Secretary Andy Karsner made a near U-turn from trying to downsize EERE and move all funding into Hydrogen [in its first term]" to "crafting the Energy Policy Act of 2005 [and] revitalizing the EERE budget to more than $2 billion in annual appropriations in 2006 or 2007 [in its second term]." The interviewee described this period as "a golden era of bipartisanship in energy policy that has rarely been seen again."

Spurred by high energy prices and a desire to decrease dependence on foreign oil, the Energy Policy Act of 2005 (EPAct) was the first comprehensive energy legislation enacted in more than a decade, and it reflected competing priorities focused on energy security, environmental quality, and economic growth (Holt & Glover, 2006). The act included tax incentives, such as tax credits for wind, solar, and biofuels; increased production on federal lands; updates to the Energy Star program and federal efficiency standards, e.g., the Renewable Fuel Standard (RFS) that included support for ethanol and biofuels, and other practical provisions (Energy Policy Act Of 2005, 2005). In addition, the act authorized funding for R&D programs, including ones focused on biomass, bioenergy, biofuels, hydrogen & fuel cells, vehicles (diesel fueled, hybrid), geothermal, solar, wind, and hydropower. It also allocated R&D funding to new programs for low-cost renewable hydrogen, electric vehicle batteries, renewable energy in public buildings, integrated systems, kinetic hydro turbines, technology transfer centers, advanced lighting, and building standards.

EISA followed with a narrower focus on energy efficiency and renewable energy. Similar to the EPAct, the motivation was global energy prices climbing to record levels, with oil prices reaching $150 per barrel in mid-2008 (Malliaris & Ramaprasad, 2011). In addition to standards and incentives, EISA included R&D funding for biofuels and relevant infrastructure; hydrogen; lightweight vehicle materials; geothermal; solar energy; marine & hydrokinetic renewable energy; advanced manufacturing processes, materials, and infrastructure for renewable energy technologies; processes, technologies, and operating practices and techniques to improve energy efficiency of energy-intensive industries; green buildings; insulation, and lighting (Congressional Research Service, 2008).

By late 2007, the American economy was slowing down as the effects of the subprime mortgage crisis began to materialize (Schumer & Maloney, 2007). Specifically, December 2007 marked the beginning of the Great Recession, America's most severe economic downturn since the Great Depression (Rich, 2013). As a result, President Bush signed The Economic Stimulus Act of 2008 and the Emergency Economic Stabilization Act of 2008. However, these acts did not center federal funding for energy R&D (Economic Stimulus Act of 2008, 2008; Emergency Economic Stabilization Act of 2008, 2008).

Figure 5 illustrates that the years during the Bush administration mostly consisted of decreases in year-over-year aggregate EERE research obligations. The two years exhibiting an increase (2004 and 2008) reflect higher levels of appropriations resulting from the 2003 Hydrogen Fuel Initiative, EPAct, and EISA. In Section 4, we better assess the connections between obligations and acts, as well as initiatives, through an examination of obligations by technology area.

In the midst of the Great Recession, the Obama administration (2009–2017) began its tenure and leveraged ARRA to provide transformational-level funding for programs focused on energy efficiency and renewable energy R&D. This was in line with the administration's priorities that were influenced by advocacy efforts for reducing greenhouse gas emissions and addressing climate change (CBS News, 2008; Phys, 2013). Similar to the ties between the Bush administration and the oil industry, the Obama administration was perceived to have strong connections to Silicon Valley and the technology sector (MIT Technology Review Editors, 2017; Levy, 2017).

Although ARRA was primarily meant to address economic stagnation in the wake of the Great Recession, it also provided funding for R&D in technology, transportation, environmental protection, and other programmatic areas (Congressional Research Service, 2009b). The importance of ARRA's energy efficiency goals can be observed in its opening legislative language, which reads: "An act making supplemental appropriations for job preservation and creation, infrastructure investment, energy efficiency and science, assistance to the unemployed, and State and local fiscal stabilization, for the fiscal year ending September 30, 2009, and for other purposes" (American Recovery and Reinvestment Act of 2009, 2009, p. 115). Most of the funding received by EERE was awarded through assistance programs. Nonetheless, funds were earmarked for R&D, specifically focusing on biomass, advanced battery and battery system components, transportation electrification, geothermal, solar, wind, and the efficiency of information and communications technology.

By the time President Barack Obama left office in January 2017, the U.S. economy had largely recovered from the Great Recession, and the energy landscape had significantly transformed, with increased renewable energy deployment, reduced carbon emissions, and a domestic oil and gas boom (Environmental and Energy Study Institute, 2015; Rapier, 2016; Environment America, 2017). Notably, the administration joined the Paris Agreement, committing the U.S. to reduce emissions by 26–28% in 2025 relative to 2005 (Hu, 2025).

Figure 5 illustrates that the years of the Obama administration mostly consisted of a period of expansionary spending on energy R&D. This pattern in the data is driven by the transformational nature of ARRA funding. In Section 4, we delve into the connection between technology areas and specific ARRA provisions, as well as initiatives and administration goals and priorities during this period.

During the first Trump administration (2017–2021), there was a renewed focus on deregulation and increased domestic production of traditional energy sources. However, although the administration repeatedly called for decreased funding for EERE, Congress kept appropriations levels constant (Noll & Krishnaswami, 2018). Similar to the priorities shift observed during the Bush administration and spurred again by a crisis, although of a different nature, the first Trump administration supported energy efficiency and renewable energy R&D through legislation. For added context, during the first Trump administration, the COVID-19 pandemic spread worldwide and sparked a severe economic downturn (Brooks & Harris, 2024). In response, the Coronavirus Aid, Relief, and Economic Security (CARES) Act was passed in March 2020, allocating significant funds to healthcare and economic relief programs (CARES Act, 2020). As the pandemic highlighted the need for resilient infrastructure, the federal government began emphasizing clean energy and energy efficiency as pillars for rebuilding a sustainable economy, thus leading to the Energy Act of 2020 (Urpelainen, 2022).

The Energy Act of 2020 allocated funds for R&D for sustainable transportation through BETO, HFTO, and VTO, blue hydrogen, integrating renewable energy and electric vehicles onto the electric grid, geothermal, solar energy, wind energy, marine energy & hydropower, and energy-efficient technologies for industry, and building-to-grid integration (Energy Act of 2020, 2020). The act had a broader focus that also included nuclear energy, carbon management & removal, and critical minerals, among other themes. Figure 5 illustrates that the years of the first Trump administration exhibited fluctuations in year-over-year aggregate research obligations. We examine these in detail in Section 4.

Notably, Congress authorizes funds through appropriations bills for one fiscal year, multiple fiscal years, or indefinitely (Congressional Research Service, 2024a). EPAct, EISA, and the Energy Act of 2020 funds were authorized until expended (Energy Policy Act Of 2005, 2005; Energy Independence and Security Act of 2007, 2007; Energy Act of 2020, 2020). On the other hand, most ARRA appropriations needed to be obligated by the end of FY 2010 (American Recovery and Reinvestment Act of 2009, 2009). Given that the Energy Act of 2020 passed in FY 2021 and did not bind obligations, it is not unlikely that its impact is fully captured in this period of analysis.

Further, toward the end of the period of analysis, the Biden administration (2021–2025) prioritized infrastructure investment and climate initiatives. Given the lag between appropriations and obligations, as previously discussed, it is unlikely that this administration's priorities are fully reflected in the funding observed in this report. Thus, we do not discuss these in detail. Nonetheless, we note that this administration supported transformational funding for clean energy R&D, including EERE programs, through landmark legislation such as the Inflation Reduction Act (Inflation Reduction Act of 2022, 2022).

Throughout the period of analysis, market dynamics interplayed with federal energy research priorities. The feedback mechanism between the two contributed to a decrease in the cost of renewable energy technologies, particularly solar and wind, due to innovations and economies of scale (Ritchie, 2024; Reuters, 2025). In addition, it led to increased corporate and consumer adoption, often spurred by government incentives (Frey et al., 2023). Similarly, demand for energy efficiency also grew, fueled by rising energy prices, advancements in efficient technologies, and government standards (International Energy Agency, 2022).

4. Research Funding by Technology Office

To examine EERE's use of funding by theme, we must first match awards or obligations to their respective technology offices. Starting in 2018, program activities are comprehensively reported for each award, making it simple to identify the relevant technology office funding a specific project. However, this information is not consistently available for prior years, so we undertook a multi-tiered approach to assign awards to technology offices. The first tier assigned a project to a technology office based on the information included within program activities. For example, if the program activities variable listed, *0001: VEHICLE TECHNOLOGIES*, the award was assigned to VTO. When program activities listed multiple technologies, e.g., *0003: HYDROGEN & FUEL CELL TECHNOLOGIES; 0104: GEOTHERMAL TECHNOLOGIES*, we coded the project as a collaboration within EERE. Using tier 1 classification, about 39% of projects were assigned to a technology office, with less than 1% assigned as a joint effort within EERE.

The second tier for categorization relied on information available through DOE's Office of Scientific and Technical Information (OSTI), which collects and makes available R&D results emanating from DOE funding. The information available through OSTI includes a DOE contract number that can be used to match projects with the USAspending data. OSTI information also includes a listing of the sponsoring organization, e.g., *USDOE OFFICE OF SOLAR ENERGY TECHNOLOGIES PROGRAM*. Similar to the first tier classification, if multiple technology offices were listed, then the project in question was coded as a collaboration within EERE. About 8% of projects are classified using the tier 2 approach, with less than 0.5% assigned as a collaboration.

For projects for which we could not assign a technology office through the first two tiers of categorization, we extracted keywords from the transaction description. These keywords determine the technology office assigned to a project (see Table A.4 in the appendix). In some instances, in this tier 3 classification, some projects were difficult to classify. This sometimes required us to investigate on a case-by-case basis and then assign projects to technology offices based on the information in publicly available deliverables. To illustrate, one transaction description included *Solar* and *Hydrogen*. This was assigned to the HFTO since the EERE contact person listed on the project's progress report was associated with this technology office. Another project that listed the same two terms was assigned to SETO since that was the funding source explicitly mentioned in the final project report. Thus, an additional 28% of awards were categorized at this stage.

Finally, we assigned the remaining 25% of awards to technology offices based on a review of publicly available information that included final reports, presentations, project profiles, patent waivers, and National Environmental Policy Act (NEPA) determinations, among other sources. In total, about 2% of awards (116) were not assigned to a technology office. These awards used vague language in the description field, had a recipient that can operate in multiple technology areas, e.g., higher education institutions, and/or did not have publicly available information to support categorization under a specific technology area. To illustrate, one award to a college included the description "conduct a feasibility study for potential application of renewable energy tech;" however, no additional information was available to support matching the funding to a specific office. In this section's analysis, uncategorized and joint effort awards (<3% of total) are not included.

In general, the trends seen in Figures 8–16 reflect evolving energy policies, technological advancements, and shifting economic priorities. Across these figures, research obligations reflect cyclicality, similar to what is observed for regular appropriations (see Figure 6). This cyclicality is likely due to biennial appropriations and multi-year funding authorizations that create uneven disbursements, depending on which programs award larger sums one year and less the next. Thus, in this section, we focus on discussing substantial funding changes beyond regular cyclicality. In addition, as we discuss funding trends, we use the most recent name of an EERE unit focused on a specific technology area, although the name of the unit might have been different in the focus year, as discussed in Section 2.

Further, for each technology office, we list four averages of obligations: under the Bush administration and before ARRA (pre–2009), in the ARRA-driven period (2009–2011), post-ARRA under the Obama administration (2012–2017), and under the first Trump administration (2018–2021). Note that the periods used to calculate the averages do not perfectly match administrations' tenure as the integration of a newly elected president's priorities into the federal budget spans several months. Upon taking office, the President inherits a budget proposal for the upcoming fiscal year that was largely developed by the previous administration, as the budget process starts approximately 18 months prior to the fiscal year it covers (Congressional Research Service, 2022).

4.1. Sustainable Transportation & Fuels

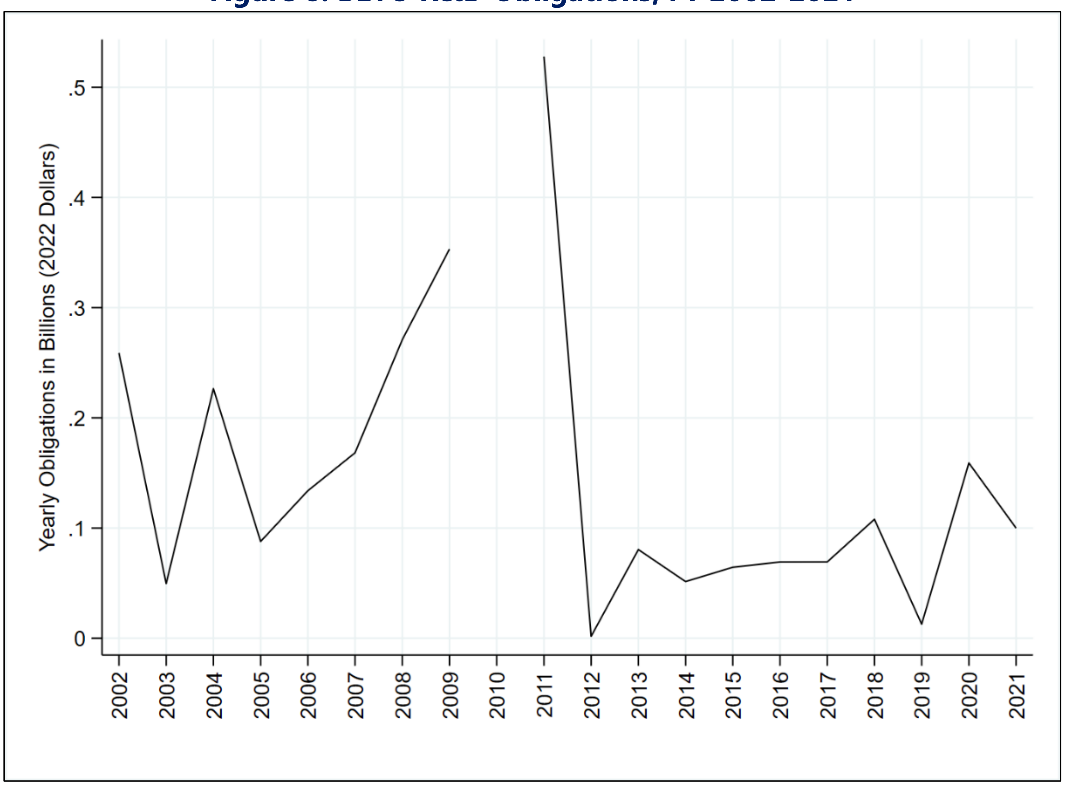
4.1.1. Bioenergy

Figure 8 illustrates bioenergy research funding across FY 2002–2021, beginning at $259 million in 2002. After an initial period of fluctuations, obligations follow an upward trend, starting in

2006 and peaking in 2010 at $1.18 billion. Prior to 2009, yearly obligations averaged $171 million. Annual obligations by BETO averaged over $686 million from 2009 to 2011, $56 million from 2012 to 2017, and $95 million from 2018 to 2021. Mostly, the post-ARRA period exhibits stable funding at lower levels.

In 2000, legislation such as the Biomass Research and Development Act underscored the federal commitment to advancing biomass technologies (U.S. Senate, 2002; Charrière & Zhang, 2014). Specifically, during the Bush administration, to “increase domestic energy security, improve rural economies, and help the environment,” BETO’s activities centered on (1) biopower involving co-firing biomass with coal or gasifying biomass for combustion to produce electricity, and (2) biofuels, which transforms agricultural and other feedstocks into ethanol (U.S. Senate, 2002, p. 58).

Figure 8. BETO R&D Obligations, FY 2002–2021



Note: Not shown in the figure is the 2010 peak at $1.18 billion. BETO yearly obligations are calculated by the authors using information from USAspending (2025*), Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

The expansionary BETO spending period that started in 2006 began with funding appropriated through the EPAct (Energy Policy Act Of 2005, 2005). The Bush administration’s commitment to bioenergy was further emphasized through the President’s 2006 Advanced Energy Initiative, which had an aggressive target of “production of biofuels equivalent to 30 percent of today’s gasoline consumption” and to render “ethanol practical and competitive within six years” (Office of Energy Efficiency & Renewable Energy, 2006, p. 3). Higher BETO research spending was then bolstered by EISA, which built on the 2007 Twenty in Ten Initiative and expanded biofuel research and production targets (Energy Independence and Security Act of 2007, 2007; The White House, 2007). In addition, the Food, Conservation, and Energy Act of 2008 strengthened funding for research focused on advanced biofuels and biomass conversion technologies (Food, Conservation, and Energy Act of 2008, 2008). Allocations through these acts combined with ARRA appropriations drove BETO obligations to the peak level observed in 2010 (American Recovery and Reinvestment Act of 2009, 2009). However, once this funding was obligated, the subsequent decade witnessed a decline in awards from BETO.

Technical challenges in scaling bioenergy technologies and competition from other renewable energy sources contributed to a change in priorities that accompanied the administration change from Bush to Obama and subsequent reductions in federal investments through BETO (Somma, Lobkowicz, & Deason, 2010; Brown, 2019). To illustrate, DOE's FY 2015 congressional budget request did not allocate any funding for the Biopower Program (Office of Energy Efficiency and Renewable Energy, 2014a). In addition, there was criticism regarding BETO's lack of near-term research goals, with R&D efforts focused primarily on long-term cellulose research (U.S. Senate Subcommittee on the Committee of Appropriations, 2008). In response, BETO shifted to more diversified explorations, including light-duty hydrocarbon and algae-based biofuels (Reed, 2012).

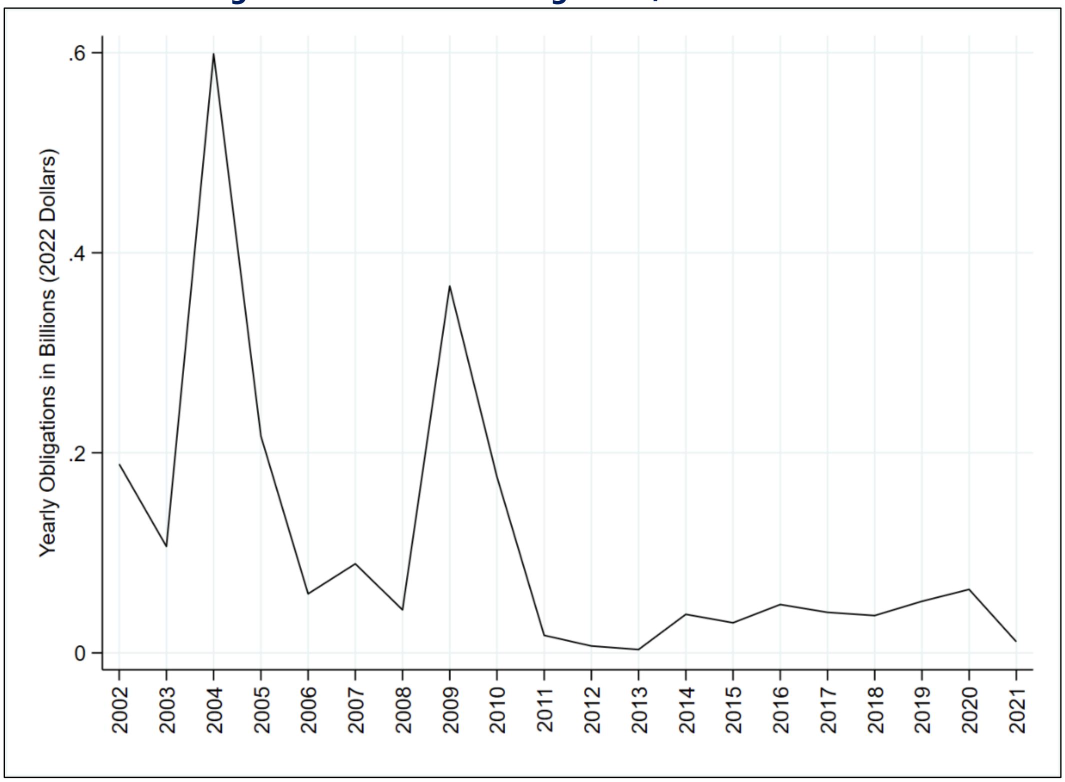
With another administration change, there was relatively renewed interest in bioenergy as a component of the nation's energy strategy. In requesting funding for BETO to support R&D, the first Trump administration's goal was "enabling industry to demonstrate and deploy high performing drop-in biofuels at $3 per gallon gasoline equivalent" (U.S. Department of Energy, 2019, p. 12). This was reflected through an increase in 2020 obligations, amplified by the Energy Act of 2020 (Energy Act of 2020, 2020). Interest in this technology seemed to be motivated by the geographic placement of bioenergy activities "in rural and underserved communities" (U.S. Department of Energy, 2023c, para. 3). In fact, ethanol plants are concentrated in the Midwest, California, and Texas (Moriarty et al., 2024).

In parallel with the period of analysis, biofuel production has experienced substantial growth over the past two decades. In 2002, the country produced approximately 2.1 billion gallons of fuel ethanol, which by 2022 had surged to around 15.4 billion gallons, with most of the growth occurring by 2010 when production reached 13.3 billion gallons (U.S. Department of Agricultrure Economic Research Service, 2025). However, this remains below the 30% target that the Bush administration had set in 2006. In fact, total biofuel consumption accounted for about 6% of total U.S. transportation sector energy consumption in 2022 (U.S. Energy Information Administration, 2023). In addition, domestic biomass accounted for 5% of all renewable energy consumed in 2011, an increase from 3% in 2002 (U.S. Energy Information Administration, 2012; U.S. Energy Information Administration, 2003). By 2023, the share of renewable energy consumed from biomass remained at 5% (U.S. Energy Information Administration, 2024a).

4.1.2. Hydrogen & Fuel Cell

Figure 9 illustrates hydrogen and fuel cell research funding across FY 2002–2021, beginning at $189 million in 2002. This funding exhibits two peaks, one at $599 million in 2004 and the other at $367 million in 2009. After 2011, obligations remained stable over time. Notably, this funding trend does not exhibit the stark spike associated with ARRA funding for bioenergy and other technology areas. The annual obligations by HFTO averaged $186 million before 2009, $187 million from 2009 to 2011, $28 million from 2012 to 2017, and $41 million from 2018 to 2021.

Figure 9. HFTO R&D Obligations, FY 2002–2021



Note: HFTO yearly obligations are calculated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

In the early 2000s, there was growing interest in hydrogen as a potential clean energy carrier, leading to increased federal investments in related research. Specifically, in January 2003, President Bush announced his Hydrogen Fuel Initiative, providing $1.2 billion for hydrogen fuel cell-specific research over five years (The White House, 2003). This initiative led to a peak in awards by HFTO in 2004 (see Figure 9). In addition, EPAct authorized additional funding for hydrogen and fuel cell programs (U.S. Department of Energy, 2005). Higher HFTO research spending was supported further by the 2006 Advanced Energy Initiative and EISA, which expanded hydrogen research, specifically for storage, distribution, and utilization (The White House, 2006; Energy Independence and Security Act of 2007, 2007). The United States Energy Storage Competitiveness Act of 2007 also included funding for hydrogen as an energy storage medium (United States Energy Storage Competitiveness Act of 2007, 2007). Funding through these legislations was reflected in a second lower spike in 2009.

Once these appropriations were exhausted by 2010, there were no other significant allocations for HFTO. In fact, the Obama administration was focused on more immediate renewable energy solutions, such as wind and solar, leading to a de-prioritization of hydrogen-specific funding (Talus & Martin, 2022). Some of the successes touted by HFTO from this period of analysis include an 80% reduction in the capital cost of proton exchange membrane electrolyzer systems between 2005 and 2020, a 70% reduction in the cost of fuel cell systems for automotive applications from 2008 to 2020; and a 30% reduction in the cost of advanced compressed onboard hydrogen storage systems since 2013 (Office of Energy Efficiency and Renewable Energy, 2024c). However, widespread adoption of Fuel Cell Electric Vehicles remains limited by the lack of adequate infrastructure and is practically constrained to California (Hawkins, 2024).

During the first Trump administration, the National Defense Authorization Act for Fiscal Year 2020 and the Energy Act of 2020 included funding for the hydrogen & fuel cell program (National Defense Authorization Act for Fiscal Year 2020, 2019; Energy Act of 2020, 2020). In addition, the 2020 Hydrogen Program Plan and 2021 Hydrogen Shot Initiative suggest a new federal emphasis on hydrogen (U.S. Department of Energy, 2020a; Hydrogen and Fuel Cell Technologies Office, 2021).

4.1.3. Vehicle

Figure 10 illustrates vehicle research obligations across FY 2002–2021, over two panels. Panel A begins at $246 million awarded for research purposes in 2002 and decreases to $53 million by 2008. Panel B focuses on the years 2009 to 2011 where yearly obligations averaged over $1.6 billion compared to $106 million in the prior period. In the subsequent period (see Panel A), annual obligations by VTO averaged about $132 million from 2012 to 2017 and $109 million from 2018 to 2021.

In a hearing to discuss the 2002 budget request during President Bush's first term, DOE Secretary Abraham Spencer noted the need to improve transportation efficiency by stating: "Transportation today accounts for 67% of the nation's oil use, and our vehicles remain 95% dependent on a single fuel—petroleum. Transportation's need for oil has brought our country to the point that it uses 4.7 million more barrels of oil per day—just for cars and trucks—than it produces" (U.S. Senate, 2002, p. 16). That same year, Secretary Spencer announced the FreedomCAR Initiative which focused on "collaborative, pre-competitive, high-risk research to develop the component technologies necessary to provide a full range of affordable car and light trucks that will free the nation's personal transportation system from petroleum dependence and from harmful vehicle emissions" (Alternative Fuels Data Center, 2002, p. 1).

However, in the interviews with EERE staff, one participant noted that “the Bush administration cut funding for hybrid and diesel vehicle technologies that had been elevated by VP Gore in the Partnership for Next Generation Vehicles…[and] elevated the FreedomCAR hydrogen fuel initiative as a fig leaf.” The interviewee added “the hydrogen vehicle was touted as truly zero emissions vehicle…this was misdirection at best.”

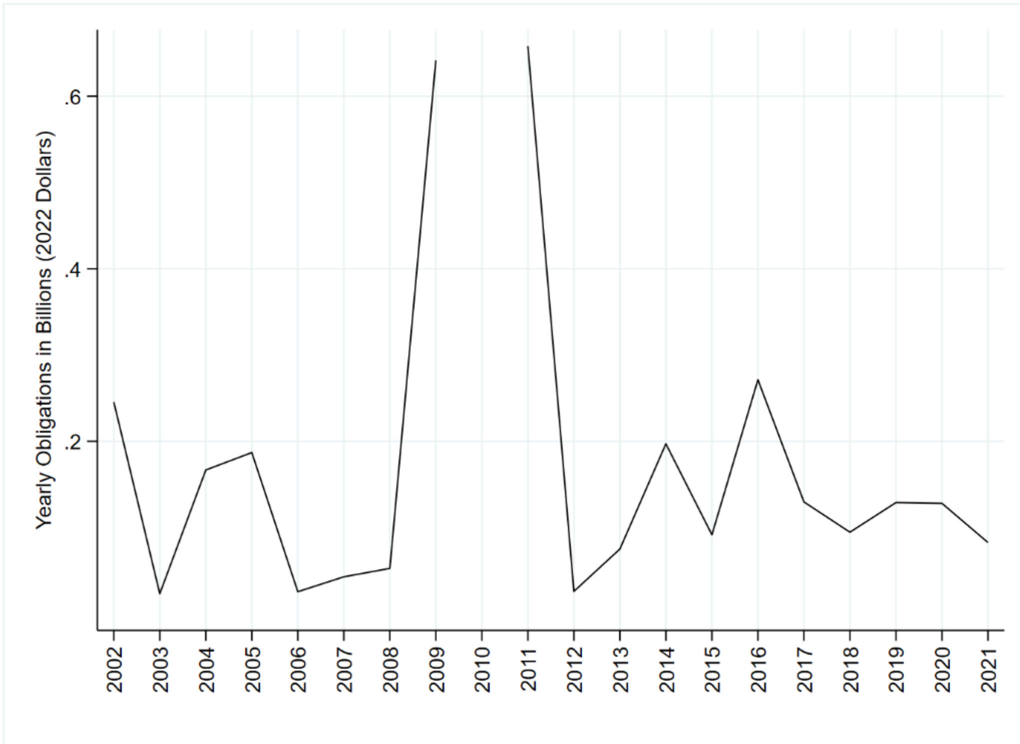
During the second Bush term, Assistant Secretary Karsner reduced funding for the hydrogen and fuel cell initiative, restored funding for other renewables, and strengthened battery and hybrid funding while also negotiating the EPACT of 2005. In August 2005, President Bush signed EPAct, which provided a framework for EERE’s programming over the next several years. This act is notable for appropriating funding to advance the energy efficiency of vehicles through a research program focused on hybrid vehicles as well as by establishing a grant program for demonstration projects (Alternate Fuels Data Center, 2005; Energy Policy Act Of 2005, 2005). The focus on hybrid vehicles was reaffirmed in the 2006 Advanced Energy Initiative, announced in Bush’s 2006 State of the Union speech, where he stated, “We need to press on with battery research for plug-in and hybrid vehicles, and expand the use of clean diesel vehicles” (Office of Energy Efficiency and Renewable Energy, 2007, p. III). Then, EISA, which built upon the 2007 Twenty in Ten Initiative, provided additional funding for improved vehicle fuel economy (The White House, 2007; Energy Independence and Security Act of 2007, 2007). The United States Energy Storage Competitiveness Act of 2007 also allocated funding for the vehicle energy storage demonstration program (United States Energy Storage Competitiveness Act of 2007, 2007).

These appropriations, in addition to the passage of ARRA in February 2009, propelled VTO to record-level obligations from 2009 to 2011 (see Figure 9, Panel B). In fact, ARRA accounted for more than half of the federal investment in electric vehicles prior to the passage of the Infrastructure Investment and Jobs Act and the Bipartisan Infrastructure Law (Burget, 2022). Funding through VTO was in line with the Obama administration priorities, reflected in DOE Secretary Steven Chu’s plan to deprioritize hydrogen fuel cells, which had been the focus through much of the early 2000s, in favor of vehicular technologies with more immediate promise (U.S. Department of Energy, 2009).

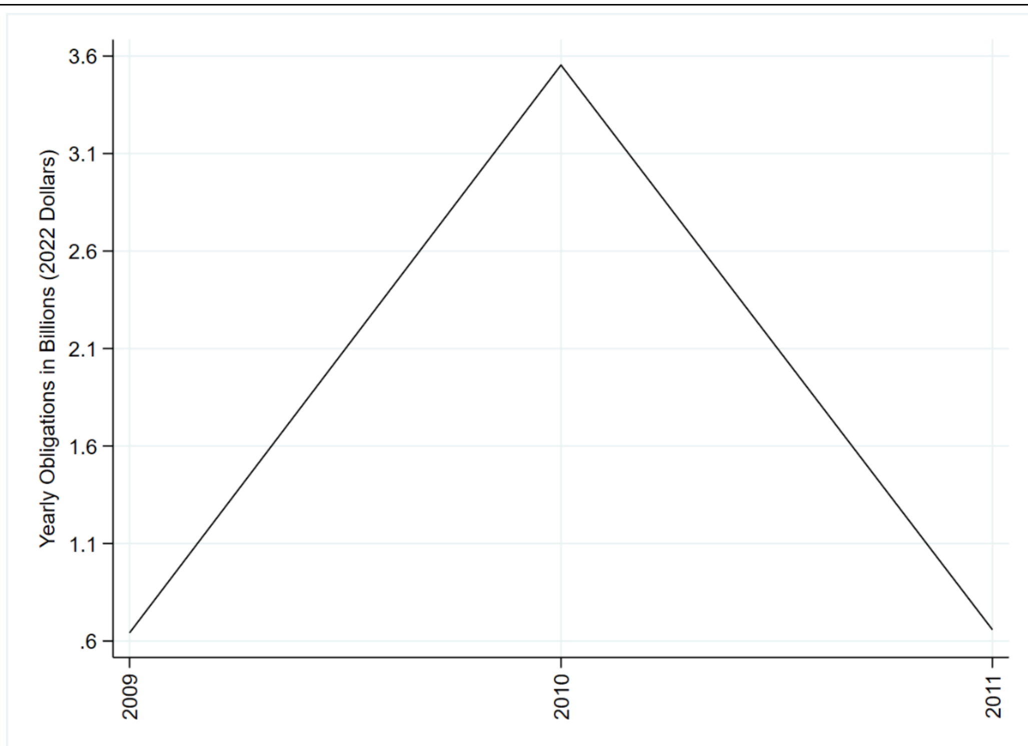
In May 2011, the FreedomCAR program evolved into the new U.S. DRIVE program, which comprised of DaimlerChrysler Corporation, Ford Motor Company, and General Motors Corporation, with the addition of the Electric Power Research Institute and Tesla Motors (Garman, 2014). Funding for VTO during this time supported initiatives such as the EV Everywhere Grand Challenge, which had the goal of making electric vehicles as affordable as gasoline-powered vehicles within the next 10 years (U.S. Department of Energy, 2013).

Figure 10. VTO R&D Obligations

Panel A. FY 2002–2021



Panel B. FY 2009–2011



Note: VTO yearly obligations are calculated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

Post ARRA, the Obama administration continued to provide ample funding for vehicle technologies R&D. In 2014, funding focused on batteries & electric drive technology as well as vehicle & system simulation & testing (Office of Energy Efficiency and Renewable Energy, 2013). Then, in 2016, funding supported research for vehicle electrification and grid infrastructure as well as co-optimization of fuels and engines (Office of Energy Efficiency and Renewable Energy, 2015). In addition, the administration funded SuperTruck II, an initiative "to develop and demonstrate cost-effective technologies that more than double the freight efficiency of Class 8 trucks, commonly known as 18-wheelers" (U.S. Department of Energy, 2016, para. 2).

Although the first Trump administration was more focused on traditional energy policies and skeptical of the promise of 'all-electric', VTO retained its position as the highest funded technology office within EERE in the post-ARRA period, which was reflected in stable obligations starting in 2018 (Office of Energy Efficiency and Renewable Energy, 2017; Halvorson, 2019). During this administration's tenure, VTO funding was bolstered by the Energy Act of 2020 (Energy Act of 2020, 2020). Notably, over the period of analysis, VTO's share of total R&D obligations (as defined in this report) equaled 31%, greatly exceeding all other technology offices.

As of 2024, combined U.S. sales of hybrid vehicles, plug-in hybrid electric vehicles, and battery electric vehicles equaled 19% of total sales, compared to about 3% in 2014 (U.S. Energy Information Administration, 2024b). In addition, by 2022, more than 3 million EVs were registered with motor vehicle departments compared to less than 100,000 EVs in 2012 (U.S. Energy Information Administration, 2024c).

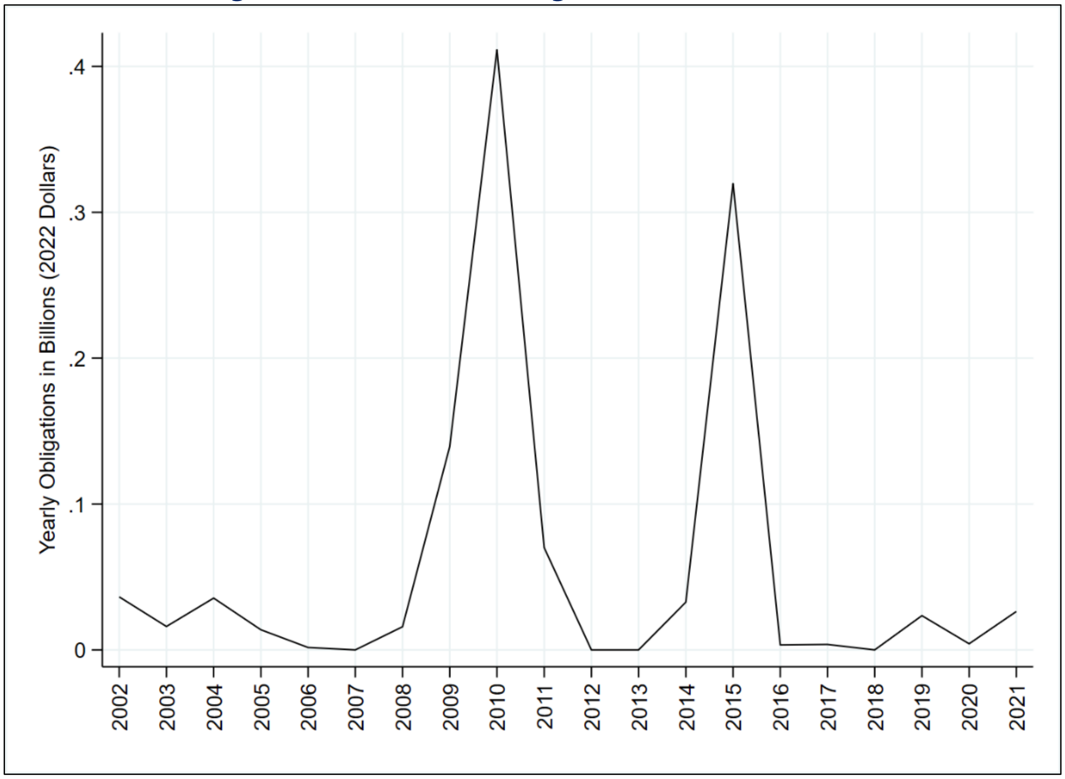
4.2. Renewable Energy

4.2.1. Geothermal

Figure 11 illustrates geothermal research funding across FY 2002–2021, beginning at $36 million in 2002. This funding exhibits two peaks, one at over $411 million in 2010 and the other at $320 million in 2015. Since then, obligations have been stable. GTO is one of three technology offices that did not seem to obligate awards every year, with no R&D awards (as defined in this report) obligated in 2007, 2012, 2013, and 2018. The annual obligations by GTO averaged $17 million before 2009, $207 million from 2009 to 2011, $60 million from 2012 to 2017, and $18 million from 2018 to 2021.

In the early 2000s, GTO's goals included (1) doubling the number of states with geothermal electric power facilities to eight by 2006, (2) reducing the levelized cost of generating geothermal power to 3-5 cents per kilowatt-hour (kWh) by 2007, and (3) supply the electrical power or heat energy needs of 7 million homes and businesses in the United States by 2010 (U.S. Department of Energy, 2001). During this period, funding also supported EGS R&D (Office of Energy Efficiency and Renewable Energy, 2010). By 2004, geothermal energy costs dropped from 10-16 cents per kWh to 5-8 cents per kWh (U.S. Energy Information Administration, 2008). Although both EPAct and EISA included geothermal as eligible for funding allocations, the Bush administration stopped requesting funding for GTO starting in 2007, as it did not consider the technology to be “broadly applicable” and have “readily accelerated public benefits” (Office of Energy Efficiency & Renewable Energy, 2006, p.15).

Figure 11. GTO R&D Obligations, FY 2002–2021



Note: GTO yearly obligations are calculated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

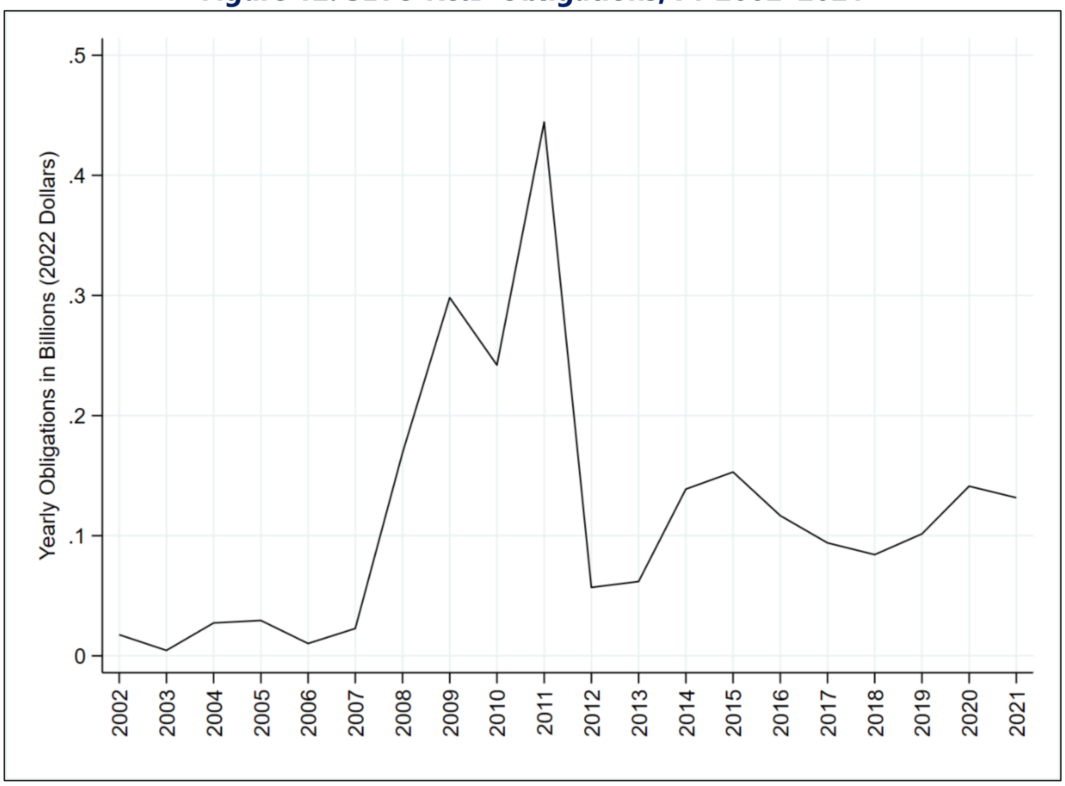
The program would remain defunded until President Obama’s FY 2009 budget request, which reopened it in the wake of the Great Recession (Office of Energy Efficiency & Renewable Energy, 2008). In parallel, ARRA appropriated funding for geothermal technologies. For the first term of the Obama administration, the emphasis was primarily on solar and wind energy. During the second term, the new DOE Secretary Ernest Moniz stressed during his confirmation hearing the need to revisit the “forgotten renewables,” including geothermal and hydropower technologies (Ling, 2013). This led to a budget increase for GTO moving into FY 2015 (Geothermal Technologies Office, 2015). During this report’s period of analysis, there have been no other substantial initiatives focused on geothermal, except during the first Trump administration when the Energy Act of 2020 allocated funding to geothermal R&D (Energy Act of 2020, 2020).
In 2023, the U.S. had geothermal power plants in seven states, which produced about 0.4% of total utility-scale electricity generation (U.S. Energy Information Administration, 2024d). In terms of the share of renewable energy consumption, geothermal was at 1% in 2023, a decrease from 2% in 2011 (U.S. Energy Information Administration, 2012; U.S. Energy Information Administration, 2024a). Geothermal was a minor share of renewable energy consumption in 2002 (U.S. Energy Information Administration, 2003).

Notably, one interviewee explained "the ups and downs of budget request by the administration in power reflect gamesmanship in addition to strategic priorities…[there are examples where] the OMB request would zero out [a program]…then Congress would restore [funding for the program in question]…this type of gamesmanship allows the administration to have its cake and eat it too but is very frustrating for stakeholders that have to spend scarce political capital just to keep a steady stream of funding. Geothermal funding is a great example [of this gamesmanship at play]."

4.2.2. Solar Energy

Figure 12 illustrates solar energy research funding across FY 2002–2021, beginning at $18 million in 2002. Obligations for solar energy technology projects did not begin to substantially increase until 2008, when obligations equaled $169 million and then continued on an upward trend until they peaked in 2011 at over $444 million. After this expansionary funding period, obligations remained stable, although at a higher level than the period prior up to 2009. The annual obligations by SETO averaged $40 million before 2009, $328 million from 2009 to 2011, $104 million from 2012 to 2017, and $115 million from 2018 to 2021.

Figure 12. SETO R&D Obligations, FY 2002–2021



Note: SETO yearly obligations are calculated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

The early 2000s saw growing domestic business interest in Solar photovoltaics (PV), with a manufacturer beginning production of thin-film PV panels in Ohio at a capacity of 100 megawatts annually, a substantial increase of the standard manufacturing capacity at the time

(Office of Energy Efficiency and Renewable Energy, 2025b). Notably, PVs developed within a highly globalized framework and experienced a major activity boom in emerging economies, especially China (Binz, Tang, & Huenteler, 2017). This emerges later in interviews with EERE staff as a driver for some of the federal investments in this technology (see Section 5).

The Bush administration was not a proponent of additional research spending on geothermal, wind, and solar, arguing that the technologies were mature and, instead, the tax code could be used to incentivize market deployment (U.S. Senate, 2002). Here again, EPAct included solar energy as eligible for funding allocations, but the Bush administration did not prioritize this technology. One EERE staff interviewed noted, "arguments that some technologies were mature must be taken with a grain of salt. First, the arguments were hypocritical because the administration had no intention of proposing policy and regulatory enhancements to promote wind, solar, geothermal, etc., despite the growing global need as highlighted consistently by the United Nations Framework Convention on Climate Change (UNFCCC) negotiations. Second, the need for technology R&D doesn't end when technologies become market ready, it evolves. For example, as solar PV panels come down in price, EERE R&D began to focus on balance of system costs [and] as wind turbines became successful, industry began clamoring for larger turbines…." With the changing geopolitical landscape of the time, the administration pivoted and, by 2006, launched the Advanced Energy Initiative, proposing funding for public and private sector solar R&D (Office of the Press Secretary, 2006). In addition, EISA, which built on the Twenty in Ten Initiative, included robust support for solar energy R&D (Sissine, 2007).

This increase in funding was further extended by ARRA, primarily meant to address economic stagnation in the wake of the Great Recession, which was leveraged by the Obama administration to substantially fund solar energy R&D (American Recovery and Reinvestment Act of 2009, 2009). ARRA is credited as a factor, alongside economies of scale as well as other economic and societal changes in decreasing the cost of utility-scale solar PV installations (The White House, 2016a). After ARRA funding was obligated, the Obama administration continued to robustly support solar energy R&D, with SETO announcing the SunShot Initiative in 2011 (Solar Energy Technologies Office, 2011). This Initiative was one of EERE's key programs for the remainder of the decade (Solar Energy Technologies Office, n.d.-b). By 2016, the U.S. surpassed one million solar installations (Office of Energy Efficiency and Renewable Energy, 2025b).

SETO obligations are similar to VTO's in that they remained at a similar funding level during the first Trump administration to what was observed during the second term of the Obama administration. President Trump's first term focused heavily on energy independence, although through higher production of oil, coal, and natural gas (The White House, 2020). Nonetheless, during this period, funding for solar energy focused on decreasing "the cost of next-generation photovoltaics toward the 2030 target of $0.03/kWh for utility-scale solar power without subsidies" (U.S. Department of Energy, 2019, p. 13). Notably, the Energy Act of 2020 allocated funding to solar energy R&D (Energy Act of 2020, 2020).

During the period of analysis, the SunShot Initiative met its 2020 cost target for utility-scale solar systems three years early when, in 2017, the levelized cost of electricity benchmarks without subsidies fell to $0.06 (NREL, 2017). Currently, solar energy as a share of total renewable energy consumption is 11% compared to 2% in 2011 (U.S. Energy Information Administration, 2024; U.S. Energy Information Administration, 2012). Solar energy was a minor share of renewable energy consumption in 2002 (U.S. Energy Information Administration, 2003).

4.2.3. Wind Energy

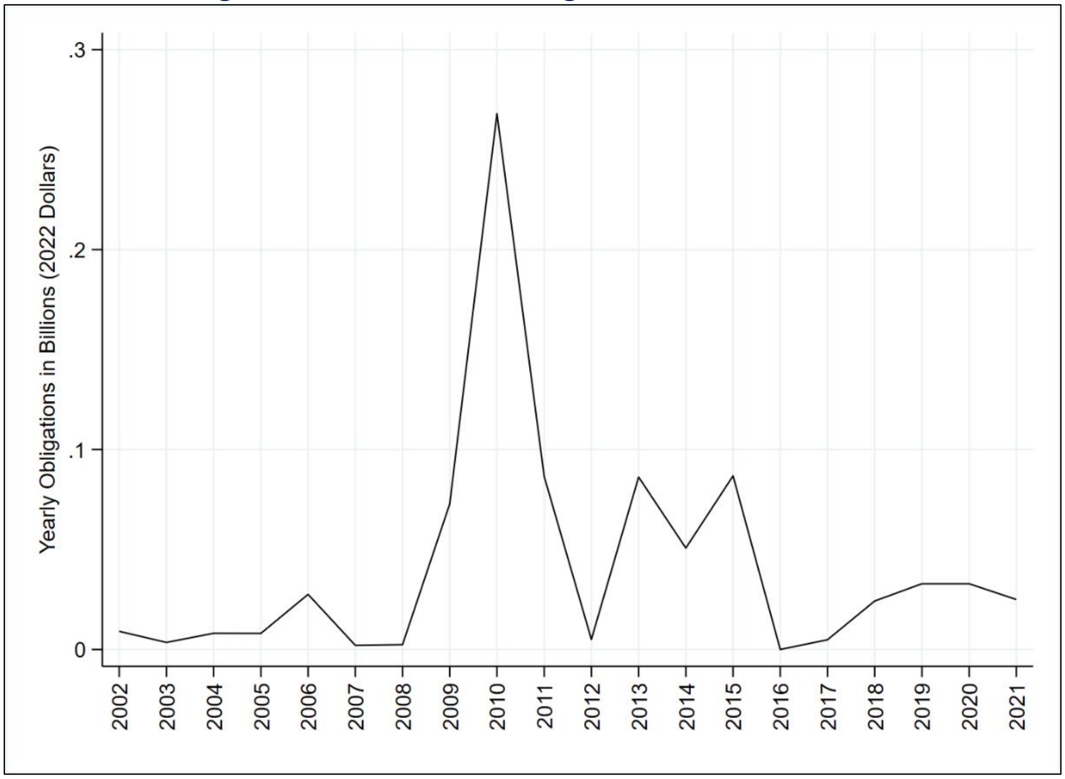
Figure 13 depicts wind energy R&D funding from FY 2002 to 2021, starting at $9 million in 2002. Funding began increasing in 2008 and surged to a peak of $290 million in 2010. Following this spike, obligations remained considerable through 2015. WETO is the second of three technology offices that did not obligate awards every year, with no R&D awards (as defined in this report) obligated in 2016. Average annual obligations by WETO equaled $9 million before 2009, $151 million from 2009 to 2011, $39 million from 2012 to 2017, and $29 million from 2018 to 2021.

In the 2002 DOE budget request hearing, South Dakota Senator Tim Johnson stated: "Wind power funding is due to be cut by 50% in the DOE budget. My state is fourth in the nation in wind power capacity. Harnessing and utilizing wind power has proven to be effective in my part of the nation. Cutting funding for wind power sends the wrong message at a time when we should be diversifying our resources" (U.S. Senate, 2002, p. 5).

Secretary Spencer clarified: "In the area of wind energy we have seen significant cost reduction in terms of the kinds of unit that could be installed, but we have impediments on the regulatory side, and siting and so on, to put them into place, and I want to evaluate that before we continue down the course, because I think relative to the contributions these three areas are making, the technology maturation has been pretty much completed in some areas" (U.S. Senate, 2002, p. 28).

Given this context, it was not until EPAct and then the 2006 Advanced Energy Initiative that sizeable funding was allocated for wind energy research (Energy Policy Act Of 2005, 2005; Office of the Press Secretary, 2006). By 2009, WETO'S budget began to increase as federal spending was increasing to stabilize the economy from the 2008 recession (Office of Energy Efficiency and Renewable Energy, 2009). At a time when the U.S. was leading in wind energy production, the 2010 surge in WETO funding, driven by ARRA, was characterized as a strategic investment to overcome the key hurdles around wind turbine performance, reliability, and transmission & systems integration (Office of Energy Efficiency and Renewable Energy, 2009). With the 2011 release of the National Offshore Wind Strategy, EERE outlined its goals and strategy for investment in offshore wind technologies over the following decade, which also informed funding decisions made by both WETO and WPTO going forward (Office of Energy Efficiency & Renewable Energy, 2011b).

Figure 13. WETO R&D Obligations, FY 2002–2021



Note: WETO yearly obligations are calculated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

By 2012, the U.S. installed capacity from wind energy could power 15 million homes and then 28 million homes by 2019 (Wind Energy Technologies Office, 2024). After the end of the expansionary fiscal period in response to the Great Recession, the Obama administration maintained its support for wind energy at consistently lower levels. In fact, after winning his second term, a monthly business magazine focused on this sector called President Obama, "the country's most wind-friendly president ever" (Windpower Monthly, 2012, para. 1).

During the first Trump administration, which expressed opposition toward wind energy, obligations through WETO decreased (Geiling, 2017). However, the Energy Act of 2020 included funding for wind energy R&D (Energy Act of 2020, 2020). Currently, wind energy as a share of total renewable energy consumption is 18% compared to 13% in 2011 (U.S. Energy Information Administration, 2024; U.S. Energy Information Administration, 2012). Wind energy was a minor share of renewable energy consumption in 2002 (U.S. Energy Information Administration, 2003).

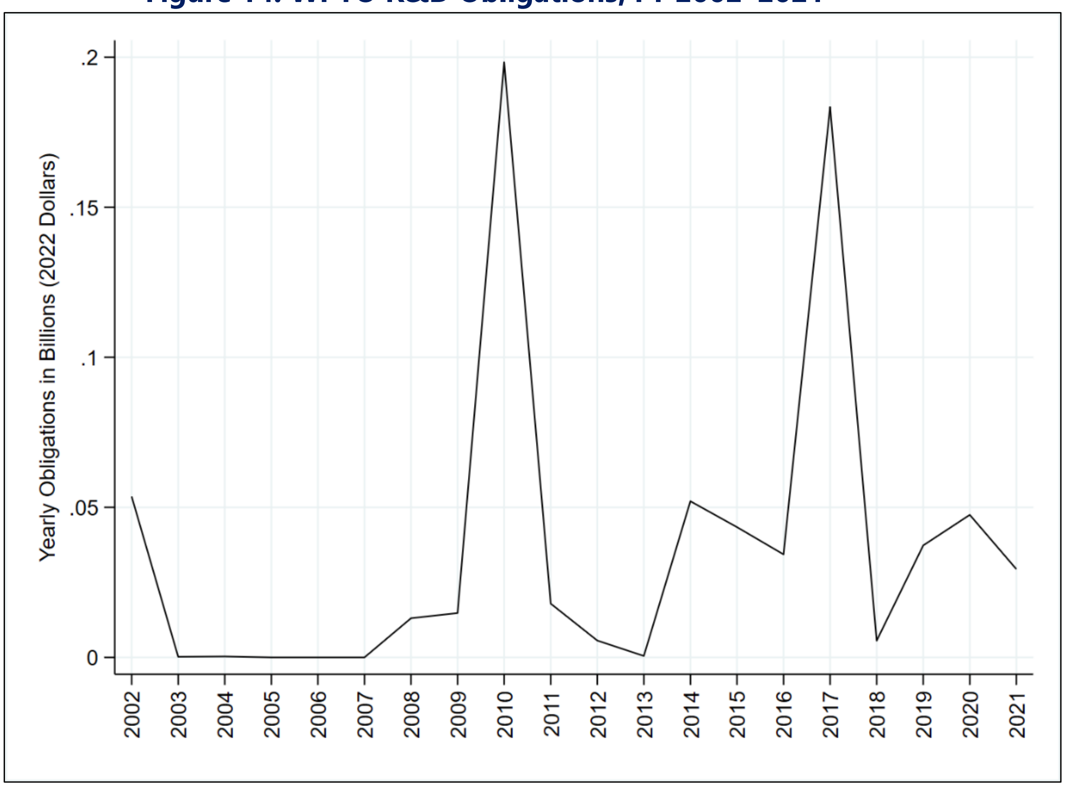
4.2.4. Water Power

Figure 14 depicts water power research funding from FY 2002 to 2021. Note that a technology office solely focused on water power was not established until 2016 (Water Power Technologies Office, 2019). Prior to this point, water power research was funded through the same office as wind energy, which we explain in Section 2.2.4. For the purpose of examining research funding trends for this technology, we illustrate water power awards obligated under an earlier version of WETO as a precursor to ones later awarded under WPTO.

As seen in Figure 14, obligations started at approximately $54 million in 2002. Funding then decreased substantially to $200-300 thousand in 2003 and 2004. In addition to geothermal and wind energy, hydropower is the third technology office that does not seem to obligate R&D awards (as defined in this report) every year, with no awards obligated in 2005, 2006, and 2007. Starting in 2008, WPTO obligations began to increase, and similar to other technology offices, exhibited a peak in 2010 with $198 million obligated. A second spike was observed in 2017 at $183 million. Average annual obligations by WPTO equaled $10 million before 2009, $77 million from 2009 to 2011, $53 million from 2012 to 2017, and $30 million from 2018 to 2021.

In 2002, the Bush administration allocated a small portion of the requested DOE budget for hydropower R&D activities "to support the development of a new generation of more environmentally-friendly hydropower turbines" (U.S. Senate, 2002, p. 11). Although EPAct allocated funds to renewable energy, including hydropower, by FY 2006, EERE had substantially decreased funding for the hydropower program, citing the inability to "find a partner willing to cost share the full-scale testing of a new, innovative turbine, indicating a lack of interest and/or need by the industry" (Office of Energy Efficiency & Renewable Energy, 2005, p.45).

Figure 14. WPTO R&D Obligations, FY 2002–2021



Note: WPTO yearly obligations are calculated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

With the Obama administration, which shifted federal priorities and adopted a strategy that aimed to diversify the U.S. energy portfolio, WPTO received and obligated substantial funding (Office of Energy Efficiency and Renewable Energy, 2009). Following the release of the hydropower vision report in 2016, another large wave of funding was obligated through WTPO in FY 2017 (Office of Energy Efficiency and Renewable Energy, 2016c; U.S. Department of Energy, 2018b).

The first Trump administration was supportive of hydropower, although at lower levels than the Obama administration. It launched the Water Innovation for a Resilient Electricity System (HydroWIRES) initiative, which was less focused on decreasing costs and instead aimed to increase integration by understanding the needs of the grid, aligning hydropower's ability with these needs, and funding innovation that can facilitate the process (U.S. Department of Energy, 2022b). In addition, the Energy Act of 2020 included funding for marine energy and hydropower R&D (Energy Act of 2020, 2020).

Currently, hydroelectric power as a share of total renewable energy consumption is 10% compared to 35% in 2011 (U.S. Energy Information Administration, 2024; U.S. Energy Information Administration, 2012). Hydroelectric power accounted for nearly 3% of renewable energy consumption in 2002 and steadily grew throughout the subsequent decade; however, by 2014, it was overtaken by nonhydro renewables (U.S. Energy Information Administration, 2003; U.S. Energy Information Administration, 2014).

4.3. Buildings & Industry

4.3.1. Advanced Materials & Manufacturing

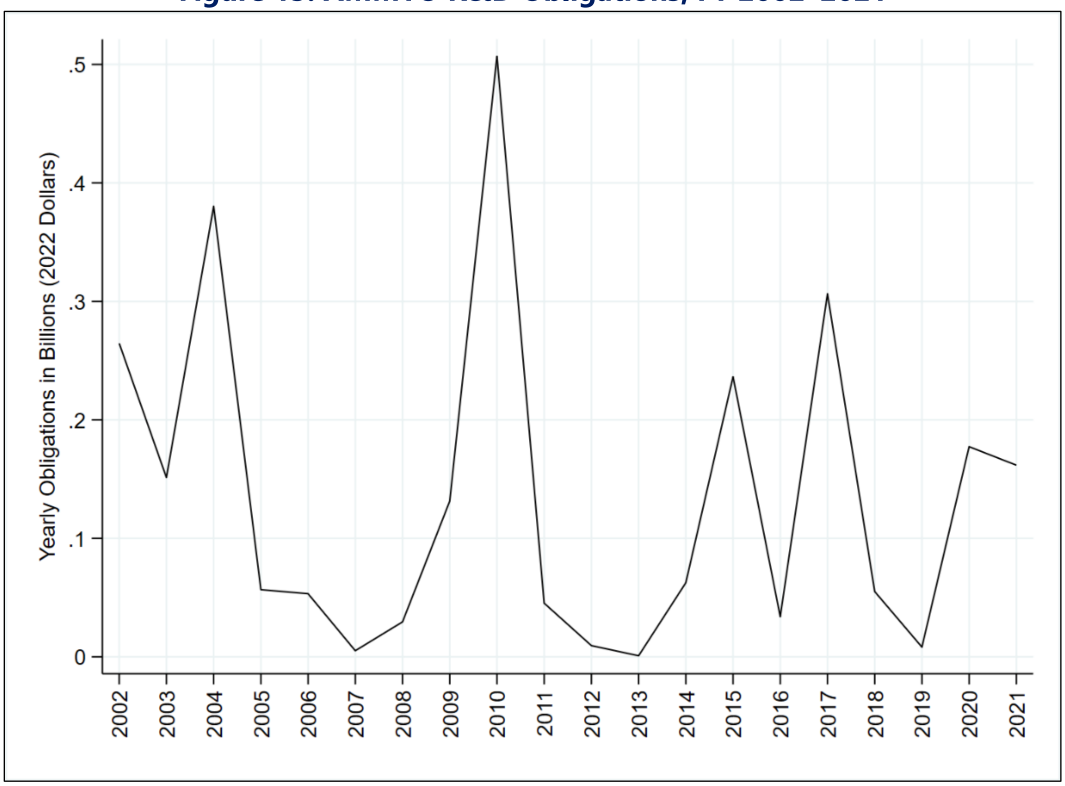
Figure 15 depicts R&D funding focused on advanced materials and manufacturing from FY 2002 to 2021, starting at $265 million in 2002. Funding from this technology office exhibits cyclicality at regular intervals, with the highest peak observed in 2010 at $507 million. Average annual obligations by AMMTO equaled $134 million before 2009, $228 million from 2009 to 2011, $108 million from 2012 to 2017, and $101 million from 2018 to 2021.

In 2002, under the Bush administration, AMMTO was focused on advancing technologies and practices that reduce energy consumption, specifically within the nine highest energy-using industries: agriculture, aluminum, chemicals, forest products, glass, metal casting, mining, and steel (U.S. Senate, 2002). Over the next two years, obligations were relatively consistent. By 2005, several efforts within this technology area, including the Industries of the Future subprogram, were reduced or closed out for either being "complete, unable to provide high levels of public benefit, or have reached a point where federal funding is no longer appropriate" (U.S. Department of Energy, 2004, p. 37). In 2008, obligations began to increase and then eventually peaked in 2010 due to appropriations from EPAct, America COMPETES Act of 2007, Energy Storage Competitiveness Act of 2007, and ARRA (Energy Policy Act Of 2005, 2005; United States Energy Storage Competitiveness Act of 2007, 2007; America COMPETES Act, 2007; American

Recovery and Reinvestment Act of 2009, 2009). By 2012, the bulk of appropriations had been allocated, leading to a sharp decrease in obligations.

Starting in FY 2013, AMMTO's funding increased to support the Obama administration's Innovative Manufacturing Initiative, which received over 1,400 letters of interest, requesting over $4.3 billion in R&D funding (Environmental and Energy Study Institute, 2012; Kelly, 2012). In addition, FY 2014 funding helped set the stage for an expansion of the Clean Energy Manufacturing Initiative, which aimed to increase American competitiveness in clean energy production and improve manufacturing output (Office of Energy Efficiency & Renewable Energy, 2014b). Congress also provided additional support for advanced manufacturing R&D with the passage of the Revitalize American Manufacturing and Innovation Act of 2014 (Revitalize American Manufacturing and Innovation Act of 2014, 2014). Advanced manufacturing R&D was well funded throughout the Obama administration, receiving an additional boost through an expansion of the Manufacturing USA network in 2016 (The White House, 2016b).

Figure 15. AMMTO R&D Obligations, FY 2002–2021



AMMTO yearly obligations are calculated by the authors using information from USAspending (2025), *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

Throughout the first Trump administration, EERE focused on U.S. manufacturing competitiveness (U.S. Department of Energy, 2020b). Similar to VTO and SETO, funding levels remained similar to those in the second term of the Obama administration. Notably, during this time, the technology office was mostly focused on quantum networking, computing, and materials (U.S.

Department of Energy, 2020c). At the time, the Energy Act of 2020 included funding for energy-efficient technologies for industry R&D (Energy Act of 2020, 2020).

During the period of analysis, energy intensity decreased by about 53% from 9,200 BTUs per real dollar of GDP in 2002 to 4,340 BTUs per real dollar of GDP in 2022 (Federal Reserve Bank of Chicago, 2006; U.S. Energy Information Administration, 2022). However, this decrease not only reflects improvements in energy efficiency and the adoption of cleaner technologies; it also reflects the shifting structure of the industrial sector.

4.3.2. Building

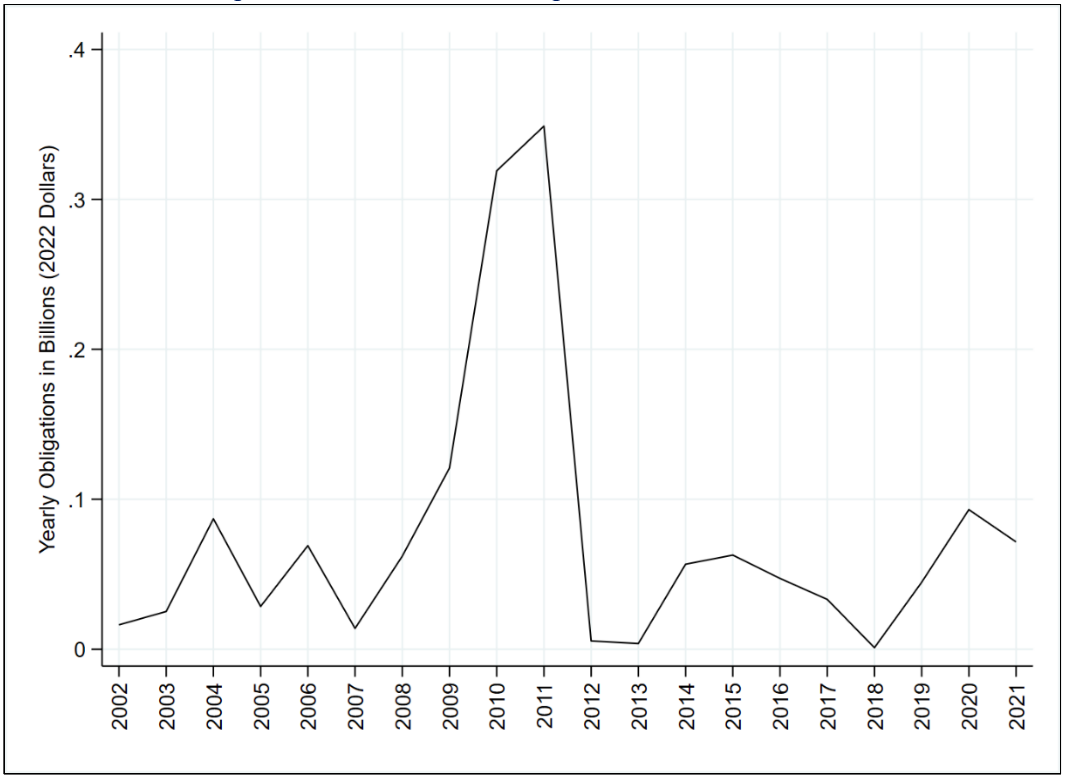
Figure 16 depicts research funding focused on energy-efficient building technologies from FY 2002 to 2021, starting at approximately $16 million in 2002. Funding peaked in 2010 at $319 million. Prior to 2009, the average level of obligations was $43 million. Average annual obligations by BTO equaled $263 million from 2009 to 2011, $35 million from 2012 to 2017, and $53 million from 2018 to 2021.

Energy efficiency for buildings was not central to the Bush administration's energy policy. However, EPact did provide support for BTO's zero-energy homes program and energy-efficient appliances (Office of the Press Secretary, 2005). In 2008, obligations began to increase and then eventually peaked in 2010 due to appropriations from EPAct and the America COMPETES Act of 2007 (Energy Policy Act Of 2005, 2005; America COMPETES Act, 2007).

This reflected the Obama administration's emphasis on energy efficiency as a cornerstone of its energy policy, although mostly through assistance programs, which are excluded from this analysis. In terms of R&D, the Obama administration prioritized programs such as Building America, which focused on reducing total energy use in a new home by 60–70% and the Emerging Technologies subprogram seeking to develop cost-effective technologies (e.g., lighting, windows, and space heating and cooling) for residential and commercial buildings (Office of Energy Efficiency & Renewable Energy, 2008). The second Obama term saw a decrease in BTO obligations.

With the shift to the first Trump administration, and although it requested decreased funding for BTO, Congress maintained federal investment in energy-efficient building technologies at relatively constant levels (Hart & Cunliff, 2018). During this time, the Energy Act of 2020 included funding for building-to-grid integration R&D (Energy Act of 2020, 2020). Throughout the period of analysis, per-household energy consumption fell by approximately 16% from 2001 to 2022 (American Council for an Energy-Efficient Economy, 2022).

Figure 16. BTO R&D Obligations, FY 2002–2021



BTO yearly obligations are calculated by the authors using information from USAspending (2025*), Award Data Archive*.
https://www.usaspending.gov/download_center/award_data_archive

5. Contextualization Through Interviews

Having established that the main drivers behind funding priority shifts within EERE are policy responses to crises and administration changes reflecting varying priorities often shaped by market dynamics and advocacy efforts, we supplement the analysis of trends from secondary data with primary data collected from interviews with former EERE staff. Deputy Assistant Secretaries, our preferred choice for interviewees, manage multiple technology areas and thus have the required level of overarching knowledge to provide the type of information we are seeking.

In settings where little or no consolidated information is available in the public domain, it is common for researchers to rely on interviews to fill knowledge gaps. To illustrate, when the DOE's Office of Energy Policy and Systems Analysis wanted to learn more about how the different state regulatory entities across the U.S. made economic decisions pertaining to reliability/resiliency, they tasked Lawrence Berkeley National Laboratory with conducting an initial set of interviews with public utility/service commission staff (LaCommare et al., 2016). Similarly, our own research team recently completed a study that synthesized findings from interviews with state budget directors and staff to learn more about the challenges that states face as they produce their long-term expenditure forecasts (Carroll, Khalaf, & Pham, 2024).

In identifying potential respondents to interview, we collected information from EERE organization charts, which required an extensive search online because they were not linked to a parent page or presented in a centralized format. Throughout the period of analysis, the EERE website has been reenvisioned various times. The resulting lack of a well-organized and centralized repository of historical and archived EERE information highlights the need for efforts to preserve such information at regular intervals. Ultimately, we identified 11 Deputy Assistant Secretaries over the three groups of technology areas that served either as appointees or in an acting capacity from 2002 to 2024. As a reminder, prior to 2002, EERE duties were initially divided among four Deputy Assistant Secretaries. In 2002, all duties were consolidated under one Deputy Assistant Secretary. This was reversed in 2007 when duties were divided among two Deputy Assistant Secretaries, and eventually, EERE reverted to three Deputy Assistant Secretary positions in 2014.

We took an iterative approach to contacting these potential interviewees. To clarify, we wanted to interview at least one individual for each technology area as well as one individual that overlapped the period where all EERE duties were consolidated under a single Deputy Assistant Secretary. So, for example, once we interviewed a participant focused on transportation, we no longer contacted other Deputy Assistant Secretaries in this group and shifted focus to recruiting participants focused on the other technology areas. In total, we interviewed four Deputy Assistant Secretaries.

To elicit information from interviewees, we produced a semi-structured interview protocol (see the appendix) to collect information on the decision-making process within EERE, political pressures, priority setting, as well as other themes that emerged when we examined the data. Interview questions, consent forms, and recruitment materials were reviewed by the University of Illinois Chicago's Institutional Review Board prior to engaging in interviews. The interviews were conducted and recorded on Zoom, then transcribed and coded to identify the following key themes.

5.1. Priority Setting Process

One interviewee perfectly captured the fluctuations seen in the research obligations data visualized in Sections 3 and 4 by describing EERE funding as:

> *a series of cycles spurred or catalyzed by crises and then followed by periods of calm where there is slow, steady research funding only then to be interrupted by a new crisis that is followed by a bow wave of funding*.

During the period of calm, the process is described as:

> *The executive political cadre tries to set the agenda, but they are always working with an R&D budget that is going to be 80–95% the same year to year. So, the civil servants have a very strong role to play because they interpret the current budget.*

Further, at any given point in time, EERE is working with three budgets, as explained here:

> *The current one, the one that's being debated in Congress…and the one [being written] for OMB [to be debated]…next year...*

A respondent further clarified this challenge:

> *The way the budget cycles work in the Federal Government, you are always planning those efforts a couple years out. So, you have to write your budget in a way that allows things to change over time…you cannot be so specific that you [risk]…the world shifting a lot before you can…get the dollars through the annual appropriation cycle.*

Another participant explained the process as:

> *a very complex orchestration…a negotiation that starts with…[the] total dollars that the President would like to request and then how those dollars get allocated [is] negotiated from the Undersecretary to the Assistant Secretary to the Deputy Assistant Secretaries down to the [technology] offices…the technology managers and the program managers have a multi-year plan that they tend to work towards. That is their roadmap. They negotiate [based on that roadmap]…with the directors of the offices, who then [go back up the hierarchy] and negotiate [with] the Deputy Assistant Secretaries [etc.].*

Another respondent added:

> *Many of the EERE [program] offices on routine basis, do what are long term multi-year planning documents so that you can get out and engage with stakeholders quite extensively as to where researchers, industry, and others see the big opportunities as well for driving innovation.*

This explanation is in line with a U.S. Government Accountability Office report where EERE officials answered structured questions and stated that each EERE office "develops a plan that articulates how its overarching goals, priority program thrusts, roadmaps, and prioritization methodologies align with overall EERE strategic priorities, and ultimately, with broader DOE and administration priorities" (U.S. Government Accountability Office, 2022, p. 33). In addition, "each EERE office and subprogram develops technical roadmaps in consultation with industry, university, national laboratory, and other stakeholders and experts. These roadmaps help guide R&D investments, moving offices towards their program plan goals and building towards EERE and DOE strategic goals" (U.S. Government Accountability Office, 2022, p. 33).

For some of the relatively newer technologies, e.g., solar energy, one of the interviewee reflected on the initial absence of stakeholder engagement and the role of national laboratories, saying:

> *There were no large companies the way there are today. So, a lot of your research input came from the national labs…[and] very small startups that were*

just trying to find…niche markets…So, it was difficult to get industry input because there was no industry…money [was sent] to the labs [and they figured out how to use it]…past 2008, there was a transition…all that decision making was going to be pulled into headquarters, though the labs were obviously still a large part of that conversation.

5.2. EERE Restructuring

Throughout the history of EERE, there have been phases of comprehensive change. One of the most impactful ones, during our period of analysis, is the restructuring conducted during the first Bush administration, described by one interviewee as:

> *all about control, control of the decision makers, control of who within the civil servants would be there to implement the political priorities...[and to] create a new cadre of program managers that were much more receptive.*

In terms of reverting from a centralized leadership chain to one that allows for multiple Deputy Assistant Secretaries, with each focused on a portfolio of related technologies, one interviewee clarified that this structure is:

> *aligned with the mentality of corporate players.*

Reflecting on de-emphasizing or sunsetting programs, one participant explained that the decision depends on the questions:

> *At what level is [a technology office priority] mature enough for industry to [take over*]?...*If you cut the cost of certain components in half, how much does that really impact the [product], and is the industry ready to take over some of this?...So, if you are successful, who is asking for it?*

The participant added:

> *We have diminished funding in one area…because the impact that it would have if successful was smaller than the impact that [solving a problem in a different priority area] would have…the pendulum sometimes swings back, what you de-emphasize one year, 5 years later you might find new industry challenges [that you] have to come back and solve.*

Ultimately, the participant noted:

> *Choices have to be made…there is not enough money to do all the things we want, what gets [more or less funding], what gets de-emphasized, what gets retired…we got to end projects when they are either not delivering value or they achieve the market outcome that they need to.*

As it pertains to relocating programs from EERE to become their own independent office under DOE, an interviewee explained:

When you have too much money [under] one assistant secretary['s purview], it becomes very difficult for senior leadership to manage. So, there is a desire to chop off pieces…so that the Secretary and the Deputy Secretary and the White House can have a little more influence.

Another respondent explained:

It was also understood that you did not need to realign [offices] in the department just for the purpose of realignment. Those are very large undertakings in a federal agency. So,…you want to…[tackle this] when there is truly an imperative to do it, and an expectation of improved efficiency.

The respondent further clarified that two factors drive the repositioning of offices: 1) the size of awarded funding, and 2) mission alignment. A large budget for a program requires considerable staffing levels, which creates a need for a separate office. In addition, EERE's focus is primarily R&D, so when a program is focused on deployment, there is motivation for relocation.

The respondent added:

Once you have gone through a few realignments you actually come to the conclusion that there are no perfect [structures]…[It is more productive to] figure out what the issues are, across which you need to coordinate, and set up the appropriate coordination infrastructures as opposed to constantly taking a few people over here and putting them over...What's productive is getting the right people in the room and mapping out the right forward looking strategies, so that you know how to prioritize your funding.

5.3. Administration Changes

In the absence of crises, change in administration is the main driver of funding priority shifts. One interviewee noted that one of the key differences between administrations is:

Are they more committed to R&D or are they more committed to deployment, commercialization, and scaling?

A participant confirmed:

Republicans, typically believe very early-stage R&D is the role of the Federal government, and that as you move closer to commercialization of technologies, that the private sector should be taking that on much more actively itself. Then, when you switch over to Democratic administrations, you see a view that well, maybe the private sector should, but the private sector does not. So, there is an extensive gap and then, if we are going to rapidly make the progress we would like to make to achieve national or global objectives, you really need to fill that demonstration, deployment, and commercialization gap.

In addition, an interviewee added:

> *The executive branch often sees their first two years as their opportunity to put their stamp on the entire Federal government, including EERE.*

Stakeholders' interests are intertwined with administration changes, as noted by an interviewee:

> *During the nineties, the most important stakeholders, in the Clinton administration, were the auto companies and ethanol producers. When the Bush administration came in in 2001, the most important stakeholders changed*.

In discussing the role of stakeholders, another participant echoed this statement, stating:

> *That's assumed to happen through the political process in terms of [the political] agenda, what they[, the administration,] were voted into office to do. So, public opinion comes in through that mechanism.*

Notable, priority shifts can occur within an administration, as described here:

> *There was a huge change in the priorities from the first Bush administration. The second Bush administration…was no longer a retrenchment [compared to the Clinton administration that promoted energy efficiency and renewables. Instead, it adopted] a business centered approach to priority setting.*

The interviewee added that this shift in priorities was accompanied by a transfer of influence from the auto companies that were driving the hydrogen fuel cells agenda of the first term to Silicon Valley and the clean tech movement, as well as other auto companies more aligned with the priorities of the second term. Another participant further explained that priority shifts from one administration's term to the next can also impact the risk level taken by program offices when funding projects.

Appointed staff changes within EERE, which sometimes occurred during an administration's tenure, also affect the targets set by the program and models used to validate these. As one participant explained:

> *When you are a program manager, even when you are a director, it is very hard to look at your own programs and then say, we need to do more of this and less of this, because less of this is somebody's program*. *One of the things that people have a hard time with is knowing when they are not shooting at the right target or maybe they are setting targets because they can achieve them. But those targets don't necessarily equal outcomes in the real world. So, this is where [new appointees can] change the innovation profile.*

5.4. The Role of Congress

The interviewees did emphasize that for all administrations, the states and key congressional members contribute to setting administration priorities. One respondent clarified:

You have a lot of work [that EERE] does to tell Congress where it thinks the added progress can be made within its mission space, and then you have a lot of opportunity for Congress to give you feedback as to whether they agree with that…If you look at the budget documents that DOE advances to Congress, you'll see they are very extensive documents with the programs really working hard to articulate where they see the opportunity space to drive innovation around objectives.

In fact, congressional appropriations effectively determine funding levels. To illustrate, one interviewee shared:

When the first Bush administration tried to really elevate hydrogen, it took multiple years for them to really get Congress to go along and squeeze the other renewable energy programs lower while they pushed hydrogen higher.

In an example of what motivates congressional members to advocate for specific funding, one of the respondents explained:

You had champions for that on the hill because that technology played particularly well in [a group of] states…[some technologies are] geographically dependent…not all technologies perform equally well across climate zones or geographic zones.

The method used by congressional members to assert influence changes over time. The interviewee, reflecting on the earlier period examined, noted:

When earmarks went away in the congressional appropriation process that changed the balancing of power…so it became harder to do horse trading deals [i.e. increase funding for a technology area that impacts one geography in return for increased funding in a different budget component].

Another participant described the post-earmark era as:

There used to be, "earmarks" that weren't earmarks, but the language was written in such a way that you had to fund one or two organizations. There was nobody else that fit the definition, and everybody knew that.

In 2021, the Federal government returned to using earmarks after a decade-long moratorium (Cassella, Fagan, & Theriault, 2023).

5.5. Market Dynamics

Industry trends and the global competitive environment are incorporated into administration priorities. One interviewee explained:

The Energy Policy Act of 2005…a huge seismic shift in republican leadership embracing commercialization, scaling, and deployment…[was motivated by *how] Germany and China were really beating us to the punch with deployment and market penetration of renewable and energy efficiency technologies.*

Here again, the role of stakeholders is evident, as described by the same interviewee:

> *Folks from Texas, even folks from California, folks from New York, they wanted the Federal Government in this space, helping promote market adoption and scaling…[which] catalyzed in 2005.*

Although the delay in adopting such policies, eroded the country's competitiveness, as one of the respondents explained:

> *[EERE] had the SunShot program to bring down [the cost of solar energy production] to a dollar a Watt by 2020, and that was judged as a great success, though by probably any rational objective analysis, it was not because of the DOE program. It was because of the Chinese ramping up manufacturing and just driving cost of Silicon PV….PV did come down the cost curve, but all the manufacturing had left the US…10 years, 15 years later, we are in the process of trying to see how we reshore that manufacturing capability.*

Another participant weighed in on the role of stakeholders:

> *Advocacy…is useful…It [allowed me] to listen to a broad set of ideas and then go back to my team and say how come we don't have something like this, and they would have a reason...there is a zero-sum game in funding at the program level. There is a fear that every new idea just displaces an old idea.*

The participant added:

> *You always want to stay abreast of the large companies and what they are doing as well as the small companies…there needs to be a strong partnership between industry and the Federal government as well as the national labs, because otherwise it is research for research's sake.*

However, one of the respondents suggested:

> *We do not know if this will ever turn into something but if the government, does not do it, nobody else is ever going to do it. That is what you want government research to do[, to undertake] the low probability event…It would be too easy to say, well, nobody in industry is doing that. Why are you doing that? Because the point of government research is to a certain degree plug a hole.*

Oil markets and EERE funding have also been historically intertwined, with one interviewee noting:

> *Due to the Iraq War, they[, the Bush administration,] suddenly found we are in a very insecure world related to oil [which led to increased funding for EERE].*

In addition, an interviewee noted the role of climate change, explaining:

> *EERE funding was seen as a vital contributor to climate change mitigation, not just energy, dating back to the 1990 UNFCCC. The politics of climate change add to the cyclical forces putting pressure on EERE alternatively to expand or contract. This directly affected the Energy Policy Act of 2005... Note also the tremendous efforts during the Obama terms to emphasize the Paris agreement of UNFCCC and the associated need to expand "green and clean" energy investment.*

Extreme market disruptions, such as the 2008 recession, substantially impact EERE funding. These are the periods when the office receives massive levels of appropriations. However, this creates challenges, with one interviewee explaining:

> *You now get 10 years of funding all in one go…How are we possibly going to spend this much money in an appropriate, rational way in a short period of time, while following the rules.*

EERE staff and the national laboratories play a crucial role here, as explained by one interviewee:

> *The scientists, the engineers at the national labs, and within the Department of Energy…study [industry] trends…they have written the roadmap...So, when these events happen, the scientists and the engineers are the ones that we go to [and] say, well, give me a plan. What do I do? Where do I invest?...and congressional folks do the same thing. The congressional staff do not just…write stuff on their own. They call up the national lab, or they call up the Secretary of Energy…these ideas percolate, and they come up together [with initiatives] in response to the crises.*

Similarly, the Bipartisan Infrastructure Law and the Inflation Reduction Act (IRA) were described as:

> *giant waves of funding.*

Although, one of the respondents differentiated the two periods, saying:

> *[The Recovery Act] was a huge amount of money, and we never thought we would see that much money again, and then IRA came…[The Recovery Act] was different from the IRA [which is] about deployment…In 2008–2009, [funding went to] a lab, university, or small company saying I have got this [project], It is ready to go, [but] I need funding for it.*

However, the respondent noted one exception, which was that VTO funding:

> *was one of the exceptions that really was around deployment and commercialization.*

Another respondent echoed the thoughts on how the two massive rounds of funding were distributed differently and acknowledged that EERE is taking a more purposeful approach this time around:

> *The Recovery Act was an interesting program at that time, where the number one objective was job stimulus…and so [EERE staff] moved a fairly significant amount of money quite quickly…[EERE staff] learned a lot from that work that is been rolled into the current round of substantial funding. And of course, today's priorities are quite different with the big infrastructure funding creating a glide path to the future. So, people are being very thoughtful about the pace of the money, so that you are making very sound investments that will stand the test of time and hopefully be well positioned to catalyze even greater investment by the private sector.*

5.6. Collaboration

In terms of collaboration across EERE technology offices, as well as across DOE offices, there seems to be a shift that occurs where the practice was not common initially, with one interviewee from the earlier period of analysis explaining:

> *For my entire career at the Department of Energy, our challenge was…working in silos.*

The interviewee also noted:

> *With the Bush administration restructuring, it really became a competition between hydrogen and everybody else.*

Another participant described the competition between technology offices by stating:

> *There was always a little bit of a tug of war [in terms of] who is responsible for manufacturing…because manufacturing is in everything.*

Here, again, the national laboratories play a crucial role, with an interviewee clarifying that in earlier years:

> *The national labs became the de facto collaboration conduit, because you would have one grant going to NREL to work on HVAC systems, and then you have another grant from the Solar Office or the Wind Office [also] going to NREL, and [the scientists there] they talk [which leads to collaboration].*

In later years, one interviewee described the process of bringing program offices together by stating:

> *What I think is a natural cross functional collaboration often had to be forced to happen…the Assistant Secretary [would] drive some of these crosscuts and then each program is required to pony up some dollars from their budget.*

The participant further explained that offices were not enthusiastic about participating in these collaborations as they were perceived as budget cuts forcing program offices to fund less of the research that was aligned with their roadmaps. For background, DOE established six R&D Crosscut Teams in early 2014 to address high priority research areas through formalized coordination between the science and energy program offices and the National Laboratories (U.S. Department of Energy, 2017).

In more recent years, a culture shift appeared, with one respondent explaining the current collaboration process:

> *You start with sharing what your program plans, and then you figure out [how] to co-fund things because of the different equities and interests…you can get further by working together. The department is a very collaborative space...some of it starts organically, and then the way that the department is set up is, there is a number of opportunities to have these crosscutting conversations. There is a whole part of the DOE budget that is called crosscuts, which include the ones that the Department has identified, and then sometimes cross-cut topics come back from Congress.*

The respondent noted that some of the energy earth shots have been a product of these crosscut collaborations. Specifically, the Hydrogen Shot™, Long Duration Storage Shot™, Carbon Negative Shot™, Enhanced Geothermal Shot™, Floating Offshore Wind Shot™ and Industrial Heat Shot™ were all guided by DOE crosscut teams (U.S. Department of Energy, 2023d).

5.7. Refining the Process

When asked what improvements would be useful for EERE's priority setting process, one interviewee offered:

> *For years and years, we thought a very positive reform would be to have biannual budgets instead of annual budgets for the R&D development program. Specifically, it is so much easier to manage if you only have to go back to Congress every two years instead of every one year.*

For the purpose of providing guidance for future programs, one respondent suggested:

> *more retrospective analysis on is this money being well spent…It is not easy working in that middle technology readiness levels range because [there is tension]…being industry led versus being more high risk…but it does still seem like there should be some level of study to do that.*

To facilitate critical evaluation of projects and programs by career civil servants, another participant suggested that EERE:

> *Cross train people [so they do not] feel like their entire careers [are tied] to one project, move them into other new areas [of research].*

The participant added:

> *It is a success if you can show that you have driven something to completion. and then say, now we want the next challenge.*

One respondent offered that institutionalizing coordination is really important and noted:

> *[With coordination, there] is always a question of whose job is it to pull it all together…and really drive forward an integrated strategy…it was individuals who are trying to coordinate their job [and] also be the ringleader. So, it is like having two day jobs, and then that is just hard. So, providing the experts that want to come to the table with the extra resources to be able to facilitate that integrated coordination can be very helpful.*

The respondent added that Congress has recently provided funding to support coordination. To illustrate, funding was requested for interagency coordination in support of R&D in the budget proposal for FY 2025 (Congressional Research Service, 2024b)

The respondent also emphasized the importance of EERE adopting holistic approaches to innovation:

> *[It is not enough that] you know how to reduce [a technology's] risk, to reduce its cost. You need to be able to manufacture it in a high quality and low-cost way as well, particularly if we want to achieve the objectives of manufacturing quickly in this country…Are there other risks, whether it is in the capability of your workforce or other market aspects where we need to expand our thinking about the things to address, so that you can have quick adoption, and…market liftoff of all these innovative technologies.*

6. Conclusion

In this report, we defined EERE R&D funding as financial assistance awards that include grants and cooperative agreements but exclude contracts. Specifically, awards focused on (1) increasing America's use of fuels, chemicals, materials, and power made from domestic biomass on a sustainable basis, (2) research effort in buildings technologies, vehicle technologies, solid state lighting technologies, advanced materials and manufacturing technologies, and industrial efficiency and decarbonization, (3) efforts in the following energy technologies: solar, biomass, hydrogen and fuel cells, wind, hydropower, and geothermal, and (4) technology deployment, demonstration, and commercialization of energy efficiency and renewable energy technologies. Since funding from EERE to national laboratories is allocated through contracts, the funding for R&D through this channel is not captured in this analysis. However, we note that two-thirds of federal R&D obligations are estimated to be received by organizations outside the federal government (U.S. Government Accountability Office, 2022).

From 2002 to 2021, only 35% of financial assistance awards by EERE were focused on R&D, while the rest were mostly transfers to governmental entities. Aggregate R&D funding by EERE can be divided into three distinct periods. Prior to ARRA, the first period (2002–2008) mostly consists of decreases in year-over-year obligations with only two years exhibiting an increase. The first spike in 2004 reflects Bush administration priorities focused on increased investments in hydrogen. The second increase occurring in 2008 reflects the beginning of an expansionary fiscal period that is initially driven by EPAct, and EISA. The second period (2009–2011), overlapping ARRA-driven R&D obligations, averages $3.8 billion compared to $734 million in the prior period. The last period (2012–2021) averages $611 million and exhibits relatively regular funding cyclicality.

Examining EERE R&D obligations by technology areas demonstrates that funding trends vary significantly across topics. Each technology area has its own pattern reflecting the complex interplay of priorities across a range of stakeholders. For the most part, EERE funding for R&D is primarily influenced by administration priorities. Here, key examples include the level of support provided for hydrogen by the Bush administration or wind energy by the Obama administration. Markedly, EERE R&D funding is bolstered through legislative actions in response to crises. While these periods include increasing funding for all technologies, ultimately, the administration retains the ability to prioritize one area over the rest. To illustrate, following the Great Recession and the subsequent ARRA legislation, all technology offices, except hydrogen, obligated a substantially higher amount than usual, with funding for vehicle technologies, surpassing all other areas, in line with the Obama administration's priorities.

In general, the sharpest spikes in EERE R&D observed over time were driven by legislation with the smaller, relatively regular increases reflecting administration priorities through yearly appropriations. Hydrogen is the only exception with the peak in R&D obligations motivated by Bush administration priorities. Throughout the period of analysis, R&D funding for vehicle technologies was a bipartisan priority. Similarly, solar energy and manufacturing energy efficiency were consistently funded, in the post-ARRA period. Notably, ARRA provided transformational funding for vehicle, bioenergy, buildings energy efficiency, and solar energy technologies. Geothermal, wind energy, and water power R&D has historically been funded at lower levels compared to other technologies, on average, with the highest levels achieved under the Obama administration.

Having established that the main drivers behind funding priority shifts within EERE are policy responses to crises and administration changes reflecting varying priorities, interviews with former EERE staff provided further contextualization. These interview findings confirmed that EERE R&D funding is cyclical with spikes catalyzed by crises and periods of calm shaped by administration and congressional priorities. These are largely influenced by industry perspectives, advocacy efforts, market dynamics, and global standing. Notably, collaboration within EERE, and DOE more broadly, has changed during the period of analysis, from practically absent to following formalized practices culminating in energy earth shots.

The cyclical funding illustrated in this report and the hesitancy noted around risk taking is aligned with findings in the literature, where economic and political pressures driving inconsistent funding and ephemeral priorities, as well as valuing incumbent technologies and fuels over innovation, create hurdles for federal energy R&D (Abdulla et al., 2017). In recent years, advocacy efforts aimed to increase funding for R&D through EERE in an effort to match the scale of the climate crisis (Shah & Krishnaswami, 2019). This motivated landmark legislation by the Biden administration, specifically the Inflation Reduction Act (Inflation Reduction Act of 2022, 2022). However, as with all administration changes, the shift to the second Trump administration significantly shifted federal priorities and created uncertainty for the energy R&D landscape.

This retrospective analysis underscores the significant influence administrations wield in shaping priorities for federally funded energy R&D, while also highlighting the tempering role of Congress, which represents the interests of a wider range of stakeholders. Restructuring offices, an activity that administrations often undertake, to preserve the ability to influence R&D funding decisions, are disruptive and do not always represent a pareto improvement. Instead, increased efforts for institutionalized collaboration can be more productive. Further, adopting a holistic approach to R&D funding, one that accounts for manufacturing capacity, infrastructure, workforce skills, regulatory landscape, market demand, and other factors, would better guarantee success.

Finally, EERE and DOE repeatedly undergo restructuring of their respective websites and sometimes even domain changes. This is particularly challenging for researchers as these sites serve as a repository for most of the contextual information around energy R&D funding priority shifts. Thus, regular archiving of this information can add to government transparency efforts by preserving documents from pivotal periods of transition in American energy history.

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APPENDIX

Table A. 1. Projects Grants & Collaborative Agreements by DOE Program Offices in FY 2023

Program Office	Number of Awards	Awards (in $)
Office of Science	4,976	$19,517,125,939
Office of Energy Efficiency & Renewable Energy	2,297	$5,865,411,723
Office of Clean Energy Demonstrations	17	$5,630,712,312
Office of Fossil Energy & Carbon Management	963	$4,178,878,093
Office of Nuclear Energy	427	$4,052,120,349
Office Of Manufacturing & Energy Supply Chains	62	$1,726,628,270
Advanced Research Projects Agency–Energy	635	$1,556,396,107
Office of Environmental Management	202	$1,178,054,798
Office of Cybersecurity, Energy Security, & Emergency Response	51	$149,640,352
Grid Deployment Office	18	$104,750,615
Office of Electricity	57	$103,018,136
Office of Legacy Management	58	$79,548,986
Office of Indian Energy Policy & Programs	71	$78,658,497
Office of State and Community Energy Programs	31	$50,489,029
Artificial Intelligence and Technology Office	5	$8,384,441
Federal Energy Management Program	3	$2,388,000
Office of Critical and Emerging Technology [Established in 2023]	--	--
Loan Programs Office	N/A	N/A

Note: Federal spending data from FY 2023 include information on contracts, defined as agreements between the federal government and a prime recipient to provide goods and services for a fee. It also includes information on financial assistance, defined as a federal program, service, or activity that directly aids organizations, individuals, or state/local/tribal governments. Financial assistance is distributed in many forms, including grants, loans, direct payments, or insurance. Given our interest in funding research activities, we restrict our examination to financial assistance data, specifically project grants and cooperative agreements. The table lists the total number and amount of awards in the form of project grants and collaborative agreements by DOE program offices. The *Office of Critical and Emerging Technology* has recently been established and does not yet appear in spending data. The *Loan Programs Office* does not fund project grants and collaborative agreements. These results are calculated by the authors using USAspending (2025*)*, *Award Data Archive*. https://www.usaspending.gov/download_center/award_data_archive

Table A. 2. Assistance Listing Numbers Associated with EERE

Assistance Listing Number	Title	Objective	Notes
81.036	Inventions and Innovations	To encourage the **development** and commercialization of energy-saving inventions by providing financial and technical assistance to projects that have a potential for significant energy savings and future commercialization markets through a competitive solicitation process. For more: https://comptroller.alabama.gov/wp-content/uploads/2019/09/2018-Catalog-of-Federal-Domestic-Assistance.pdf.	• Archived in 2022 • Not included in analysis since all awards were collaborations with other offices
81.041	State Energy Program	The purpose of this program is to increase market transformation of energy efficiency and renewable energy technologies through policies, strategies, and public-private partnerships that facilitate their adoption and implementation. For more: https://sam.gov/fal/f9007b6ec8d84b06a59191841e155463/view.	• Not included in analysis
81.042	Weatherization Assistance for Low-Income Persons	To improve home energy efficiency for low-income families through the most cost-effective measures possible. For more: https://sam.gov/fal/4d666690f48f4a66bfa5fadab42fb7a0/view.	• Not included in analysis
81.079	Regional Biomass Energy Programs	This program is designed to help meet the goal of significantly increasing America's use of fuels, chemicals, materials, and power made from domestic biomass on a sustainable basis… Assistance may be used to **develop** and transfer any of several biomass energy technologies to the scientific and industrial communities. For more: https://comptroller.alabama.gov/wp-content/uploads/2019/09/2018-Catalog-of-Federal-Domestic-Assistance.pdf.	• Archived in 2021 • Included in analysis
81.086	Conservation Research and Development	The goal of this program is to conduct a balanced, long-term **research** effort in Buildings Technologies, Vehicle Technologies, Solid State Lighting Technologies, Advanced Materials and Manufacturing Technologies, and Industrial Efficiency and Decarbonization. For more: https://sam.gov/fal/74aac66b04264785aa91f5e6cfc1feae/view.	• Included in analysis
81.087	Renewable Energy Research and Development	To conduct balanced **research** and **development** efforts in the following energy technologies: solar, biomass, hydrogen and fuel cells, wind, hydropower, and geothermal. For more: https://sam.gov/fal/336782e8ea514a4d8a4350d97b7535aa/view.	• Included in analysis
81.105	National Industrial Competitiveness through Energy, Environment, and Economics	To improve industrial energy efficiency, reduce industry's costs, and promote clean production. For more: https://www.aceee.org/files/proceedings/1995/data/papers/SS95_Panel2_Paper59.pdf.	• Archived in 2022 • Not included in analysis since all awards were collaborations with other offices

Assistance Listing Number	Title	Objective	Notes
81.117	Energy Efficiency and Renewable Energy Information Dissemination, Outreach, Training and Technical Analysis/Assistance	The Department of Energy (DOE) seeks to provide financial assistance for information dissemination, outreach, training and related technical analysis/assistance. For more: https://sam.gov/fal/db575fb36ba64ce090406f2db74fc633/view.	• Not included in analysis
81.119	State Energy Program Special Projects	To allow States to submit proposals to implement specific Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy deployment activities and initiatives as Special Projects under the State Energy Program. For more: https://sam.gov/fal/2382538128cc49069334c78b17370de9/view	• Not included in analysis
81.127	Energy Efficient Appliance Rebate Program	The program provides financial and technical assistance to States to establish residential energy star rated appliance rebate programs. For more: https://comptroller.alabama.gov/wp-content/uploads/2019/09/2018-Catalog-of-Federal-Domestic-Assistance.pdf.	• Archived in 2021 • Not included in analysis
81.128	Energy Efficiency and Conservation Block Grant Program (EECBG)	The program provides financial and technical assistance to assist State and local governments create and implement a variety of energy efficiency and conservation projects. For more: https://sam.gov/fal/832e743b4eec44a5ae811e4bd4943531/view.	• Not included in analysis
81.129	Energy Efficiency and Renewable Energy Technology Deployment, Demonstration and Commercialization	This program provides financial assistance for the technology deployment, demonstration, and commercialization of Energy Efficiency and Renewable Energy technologies For more: https://comptroller.alabama.gov/wp-content/uploads/2019/09/2018-Catalog-of-Federal-Domestic-Assistance.pdf.	• Archived in 2021 • Included in analysis

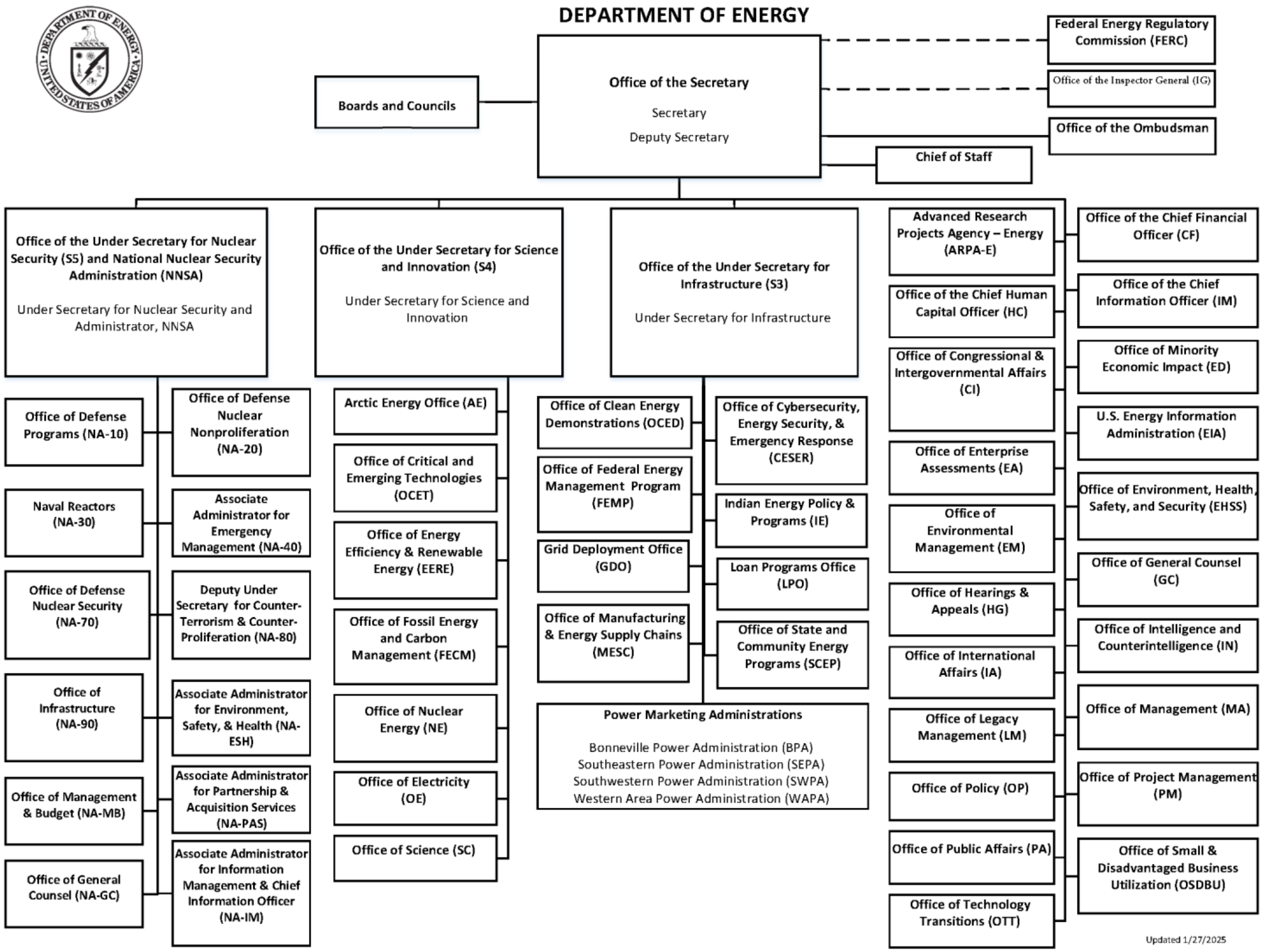
Table A. 3. Dataset Construction

Steps	Number of Observations	Notes
Download USAspending data from 2002 to 2021 where awarding agency name or funding agency name is *Department of Energy*	183,747 observations	USAspending data includes a unique identifier per award and lists each award modification as an observation.
Remove duplicate awards	48,249 observations	In this step, we keep observations with the most recent modification thus each observation represents a unique award.
Remove de-obligations	43,507 observations	Here, we remove awards with a null or negative *total obligated amount*. These are de-obligations that occur when agencies decrease previous obligations to correct errors or to reflect new information (USAspending, 2024).
Keep EERE awards	12,444 observations	Here, we keep observations with assistance listing number that corresponds to EERE (see Table A.2).
Keep EERE awards focused on research	6,377 observations	In this step, we remove observations with assistance listing number that corresponds to EERE awards not focused on research or development and ones that were collaborations with offices outside of EERE (see Table A.2).

Table A. 4. Tier 3 Categorization of R&D Awards by Technology Offices within EERE

Conditions	Vehicle	Bioenergy	Hydrogen & Fuel Cell	Solar Energy	Wind Energy	Water Power	Geothermal	Advanced Materials & Manufacturing	Building
Transaction Description mentions:	Alternative Fuels, Batteries, Bus, Cars, Clean Cities, Duty, HEV, Lithium, PEV, Truck, Vehicle	Algae, Bioenergy, Biofuel, Biomass, Biorefinery, Lignocellulosic, Yeast	Hydrogen, Fuel Cell, Integrated Regional Technical Exchange Centers	CPV, Heliostat, Photovoltaic, PV, Solar, Sun (including, Sunshot)	Turbine, Wind	Dam, Hydroelectric, Hydrokinetic, Hydropower, Tidal, Wave	Geothermal	Advanced Manufacturing, Alloys, CHP, Clean Energy Application, Assessment Center	Buildings, Energy Efficiency, Home, LED, LEDS, Lighting

Figure A. 1. Current DOE Structure



Source: U.S. Department of Energy (2025), *Organizational Chart*. https://www.energy.gov/sites/default/files/2025-01/DOE_Org_Chart_energy_20250127.pdf

Semi-Structured Interview Questions

1. Can you please tell us about your background and specifically your experience with the office of energy efficiency and renewable energy?

Decision-Making Process

2. Our research is focused on understanding the drivers of research funding priorities within EERE. So, we are hoping to learn from you, during your time at EERE, who were the primary stakeholders involved in setting funding decision priorities, and how were their roles defined?
   Prompt if needed: During the appropriation process, EERE leadership, and more broadly DOE, the administration, the Office of Management and Budget, and Congress all play different roles that lead to the adopted budget. Can you share with us how EERE leadership set the office's priorities? Did they fully adopt the administration's priorities? Or did they advocate for specific outcomes? If EERE had a set of priorities that differed from the administration's, how did the office navigate the negotiation process?
3. What role, if any, did public opinion or advocacy play in shaping funding decisions/priorities?
4. Did geographic representation matter for funding decisions?
   Prompt if needed: Do congress members advocate for specific projects or technology areas relevant to their regions in venues other than congressional hearings and letters of support for specific projects? And if so how does EERE navigate this or incorporate this feedback?
5. Are business/industry interests considered?

Adjusting to External Factors/Restructuring

6. Can you describe the shifts in funding priorities that you have experienced and what prompted these changes?
   Prompt if needed: How does EERE adapt its funding priorities in times of administration changes? How does EERE adapt its funding strategies in response to changes in market dynamics or technological advances?
7. How does EERE decide when to sunset funding for specific types of research or technology areas? *Example if needed: regional biomass energy programs.*
8. What is the turning point from funding under EERE to moving a program to other offices within DOE? *Example if needed: Weatherization Assistance Program, State Energy Program, and Energy Efficiency Conservation Block Grant were transferred to the new Office of State and Community Energy Programs while the Tribal Energy Program was transferred to the newly created Office of Indian Energy.*

Context for Data Analysis

9. Some research awards are funded collaboratively across EERE programs. How are decisions made in terms of when to collaborate, on what, and how to split the cost among programs?
10. Is the process similar when collaborating with other DOE offices or other federal agencies?

11. We have noticed that projects funded by EERE classified as research sometimes focus on other activities, e.g., training or technical assistance. Can you provide context for why some projects are classified as research although other Assistance Listing Numbers (ALN), formerly known as Catalog of Federal Domestic Assistance (CFDA), classifications might fit better? *Example if needed: Tribal weatherization projects not assigned weatherization cfda, rather mostly classified as renewable energy research and development*.

Wrapping up

12. Are there any factors or drivers that play a role in EERE funding priorities that we have not mentioned that we should be aware of?
13. Are there any areas where you'd like to see changes or improvements in how research funding priorities are set within EERE?