United States Government Accountability Office

Report to Congressional Committees

May 2024

DECARBONIZATION

Opportunities Exist to Improve the Department of Energy's Management of Risks to Carbon Capture Projects

GAO-24-106489

GAO Highlights

Highlights of GAO-24-106489, a report to congressional committees

May 2024

DECARBONIZATION

Opportunities Exist to Improve the Department of Energy's Management of Risks to Carbon Capture Projects

Why GAO Did This Study

In 2023, carbon dioxide (CO_2), the most abundant greenhouse gas, reached a record high concentration in the Earth's atmosphere, according to the National Oceanic and Atmospheric Administration. Scientific assessments have shown that reducing CO_2 emissions could help mitigate the negative effects of climate change. The federal government aims to achieve net-zero greenhouse gas emissions, including CO_2, by no later than 2050.

Carbon capture and direct air capture technologies have the potential to help the government meet the 2050 goal. The 2021 Infrastructure Investment and Jobs Act appropriated about $12 billion for DOE to administer new carbon capture and direct air capture projects.

Congress included a provision in the USE IT Act for GAO to review federally funded carbon capture and direct air capture projects. This report (1) describes the funds obligated by DOE to support these projects from fiscal years 2018 through 2023 and (2) examines DOE's project selection and management. GAO analyzed laws, regulations, and guidance; DOE funding data; and DOE documents for a sample of 40 projects. GAO selected projects to range in type, funding, and stage. GAO also interviewed DOE officials.

What GAO Recommends

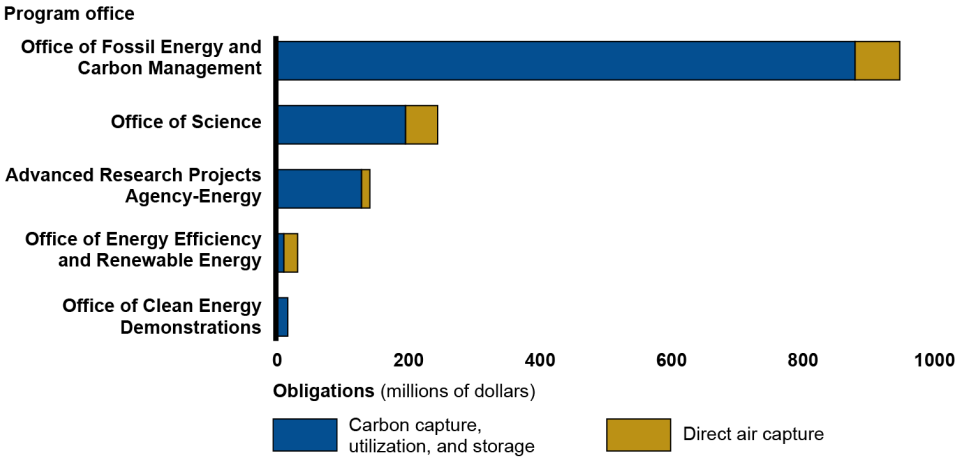
GAO is recommending that FECM (1) more clearly document project risk treatment strategies and (2) ensure that the office adheres to guidance for selecting projects that are deemed to be technically acceptable. DOE agreed with GAO's recommendations.

View GAO-24-106489. For more information, contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov.

What GAO Found

The Department of Energy (DOE) obligated almost $1.4 billion across 654 research and development projects to support carbon capture, utilization, and storage and direct air capture technologies from fiscal years 2018 through 2023. DOE's Office of Fossil Energy and Carbon Management (FECM) administered $950 million (69 percent) of funds and 410 projects (63 percent).

The Department of Energy's Obligations for Carbon Capture Projects by Office and Project Type from Fiscal Years 2018 through 2023



Source: GAO analysis of DOE data. | GAO-24-106489

Based on a review of DOE documentation for a nongeneralizable sample of 40 projects, GAO identified several practices, such as risk reviews, that DOE offices used to manage risks. However, FECM—responsible for the majority of projects, including 25 in GAO's sample of 40—engaged in practices as discussed below that could undermine the likelihood of project success:

Risk treatment. FECM did not clearly document risk treatment strategies for some projects—which can be important for project continuity given turnover in project managers. Additionally, FECM did not clearly document that project awardees reviewed project risks and treatment strategies for identified risks on a regular basis.

Project selection. DOE guidance states it should only select projects that are technically acceptable. However, GAO identified one case where FECM selected a $14.6 million project even though its technical score did not meet FECM's threshold. FECM was unable to provide documentation as to why this project was selected. This project, which is ongoing, has since experienced cost overruns and delays, resulting in an additional $5.1 million in FECM funding and an additional 18 months to complete.

It is unclear how widespread these practices are across all 410 FECM projects. However, by documenting risk treatment strategies and adhering to project selection guidance, FECM would provide greater assurances that selected projects are likely to succeed. This could also help reduce the risk to the over $12 billion appropriated for new carbon capture and direct air capture projects.

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Abbreviations

ARPA-E	Advanced Research Projects Agency-Energy
CCUS	Carbon capture, utilization, and storage
CO2	Carbon dioxide
DAC	Direct air capture
DOE	Department of Energy
EERE	Office of Energy Efficiency and Renewable Energy
FECM	Office of Fossil Energy and Carbon Management
OCED	Office of Clean Energy Demonstrations

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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May 16, 2024

Congressional Committees

In 2023, carbon dioxide (CO2), the most abundant greenhouse gas, reached a record high concentration in the Earth's atmosphere for the modern era, according to the National Oceanic and Atmospheric Administration. Key scientific assessments have shown that reducing CO2 emissions could help mitigate the negative effects of climate change. Each year, the federal government reports spending billions of dollars on efforts to help limit the magnitude of climate change, with many of these activities focusing on reducing emissions. Executive Order 14057: Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability, issued in 2021, aims to have the government lead by example to achieve net-zero emissions, including CO2, economy wide by no later than 2050.[1] Carbon capture, utilization, and storage (CCUS) and direct air capture (DAC) technologies have the potential to help the government meet the 2050 goal by separating and purifying CO2 from a source, which could be an industrial facility, or from the atmosphere, respectively.

The federal government has recently increased funding for CCUS and DAC, with funds largely going to the Department of Energy (DOE). The Infrastructure Investment and Jobs Act appropriated about $12 billion from fiscal years 2022 to 2026 for CCUS and DAC-related projects.[2] The CHIPS and Science Act of 2022 authorized an additional $1 billion from fiscal years 2023 to 2026.[3] The Inflation Reduction Act of 2022 also

[1]86 Fed. Reg. 70,935 (Dec. 13, 2021).

[2]Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, div. J. 135 Stat. 429, 1373-79 (2021).

[3]Research and Development, Competition, and Innovation Act, Pub. L. No. 117-167, § 10771(6)(C), 136 Stat. 1366, 1728 (2022). The act, in its entirety, is commonly referred to as the CHIPS and Science Act of 2022.

extended and expanded the federal 45Q tax credit for CO2 captured and stored.[4]

In 2021, we reported on significant risks to DOE's management of carbon capture and storage demonstration projects.[5] Specifically, we found that DOE increased risk by fully committing to projects at their initial selection and bypassing cost controls, resulting in the department spending $472 million on facilities that were never built. We recommended that DOE improve its project selection and negotiation processes and more consistently administer projects against established scopes, schedules, and budgets. DOE has taken preliminary actions to address these recommendations.

In light of past, ongoing, and potential future federal government investments in CCUS and DAC technologies, the USE IT Act includes a provision for GAO to report on all federal CCUS and DAC programs.[6] This report (1) describes the funds DOE obligated to support carbon capture, utilization, and storage projects and direct air capture projects from fiscal years 2018 through 2023; and (2) examines DOE's practices for selecting and managing projects.[7]

To address the first objective, we reviewed publicly available information on federal spending to identify which federal agencies obligated funds for CCUS and DAC projects during fiscal years 2018 through 2023.[8] We

[4]Pub. L. No. 117-169, § 13104, 136 Stat. 1818, 1924-29. The maximum value of the credit for carbon capture and storage was increased by 70 percent (relative to the maximum value under prior law), to $85 per metric ton for CO_2 that is geologically sequestered and to $60 per metric ton for CO_2 that is stored through enhanced oil recovery. The maximum value of the credit for DAC was increased by more than 250 percent, to $180 per metric ton of CO_2 for geologic sequestration and to $130 per metric ton for enhanced oil recovery. After calendar year 2026, the credit's values will be adjusted each year to rise with inflation.

[5]See GAO, *Carbon Capture and Storage: Actions Needed to Improve DOE Management of Demonstration Projects*, GAO-22-105111 (Washington, D.C.: Dec. 20, 2021).

[6]Consolidated Appropriations Act, 2021 Pub. L. No. 116-260, div. S, § 102, 134 Stat. 2243, 2247 (2020).

[7]An obligation is a definite commitment that creates a legal liability of the government for the payment of goods and services ordered or received, or a legal duty on the part of the United States that could mature into a legal liability by virtue of actions on the part of the other party beyond the control of the United States. Payment may be made immediately or in the future. GAO, *A Glossary of Terms Used in the Federal Budget Process*, GAO-05-734SP (Washington, D.C.: Sept. 1, 2005).

[8]Data are as of June 2023.

confirmed involvement with these agencies, which included DOE and the National Science Foundation. After a preliminary review of the data, we focused our review on DOE because it obligated the vast majority of funds for CCUS and DAC projects.[9] We then summarized award information by analyzing award data provided by DOE, including award obligations, years, and funding sources. We conducted a data reliability assessment for the award data collected by interviewing relevant agency officials and corroborating award data against available public information. We determined the data to be sufficiently reliable to describe the funds DOE obligated to support CCUS and DAC projects.

To address the second objective, we reviewed a nongeneralizable sample of 40 CCUS and DAC projects identified in our first objective.[10] We selected 40 projects awarded by the five DOE offices responsible for the greatest number of CCUS and DAC projects: 25 projects from the Office of Fossil Energy and Carbon Management (FECM), two projects from the Office of Science, two projects from the Advanced Research Projects Agency-Energy (ARPA-E), one project from the Office of Energy Efficiency and Renewable Energy (EERE), and 10 projects from the Office of Clean Energy Demonstrations (OCED). To get a range of projects, we selected 40 projects from those DOE offices based on project type (CCUS or DAC), amount and type of funding, and the stage of the project. Some of the 40 projects were in the selection and negotiation process, other projects were complete, and some were in between these states.

We reviewed documentation of the goals, outcomes, and expected and actual budgets and schedules of each selected project. This documentation included funding opportunity announcements, DOE project selection announcements, award amendments, risk assessments, and other decision documents. We analyzed these documents to identify project progress and the factors that contributed to their progress, which we discussed with DOE officials and project representatives.[11] We

[9]The National Science Foundation provided $8.4 million to support 21 carbon capture projects during this time. Of the 21 projects, 16 supported CCUS and five supported DAC and supported basic and applied research. We also identified additional agencies that supported various aspects of CCUS research during our initial review. Further reviews of these agencies determined that their research was not within the scope of this report. For example, NASA's CCUS projects were limited to crew and life support on spacecrafts.

[10]There was a total of 654 DOE projects identified in our first objective.

[11]The sample reviewed cannot be generalized to the projects we did not include in our review.

additionally reviewed relevant laws, regulations, DOE guidance, and federal internal control standards to assess the extent to which DOE followed these criteria when selecting and managing CCUS and DAC projects.[12] We interviewed DOE officials and project representatives to obtain their perspective on how DOE could improve the selection and management of future CCUS and DAC projects.

We conducted this performance audit from January 2023 to May 2024 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

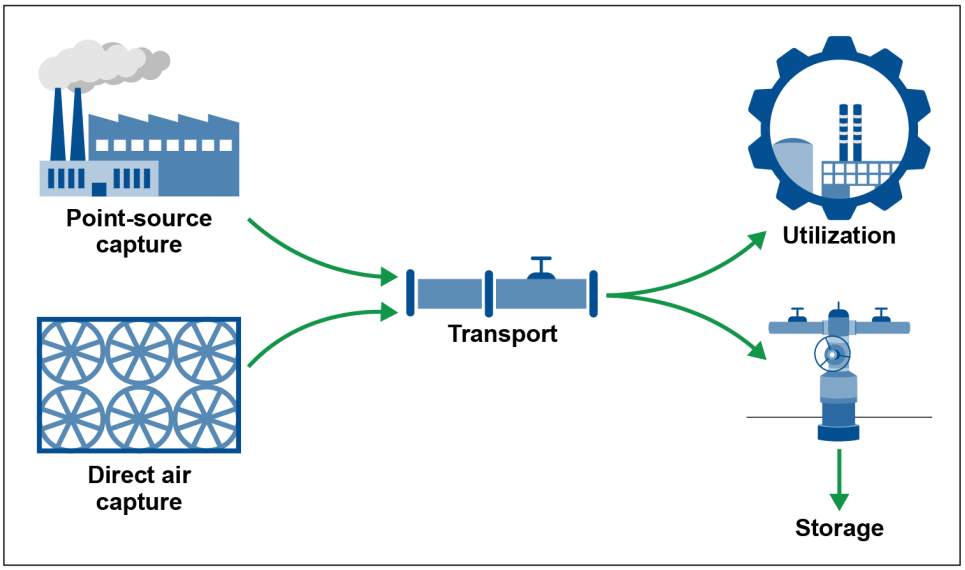
Background

Carbon Capture, Utilization, and Storage and Direct Air Capture Technologies

CCUS refers to a group of technologies for reducing CO2 emissions or removing CO2 from the atmosphere (see fig. 1). Carbon capture technology includes those that separate and purify CO2 from a source, which could be an industrial facility such as a power generation or manufacturing facility (point-source capture) or the atmosphere (DAC). Both point-source capture and DAC result in a concentrated stream of CO2 that can be compressed and transported—typically via pipeline—either for conversion into economically valuable products (utilization) or for storage in deep underground geologic formations.

[12]Department of Energy, *Guide to Financial Assistance: A Guide to the Award and Administration of Financial Assistance* (Washington, D.C.: Nov. 8, 2023); and *Merit Review Guide for Financial Assistance* (Washington, D.C.: Oct. 1, 2020). GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sept. 10, 2014).

Figure 1: Components of Carbon Capture, Utilization, and Storage and Direct Air Capture



Source: GAO (images). | GAO-24-106489

Technologies for transporting, storing, and directly using captured CO2 are mature. Companies are beginning to commercialize utilization technologies that convert captured CO2 into valuable products such as ethanol, sustainable aviation fuel, and mineral aggregates. However, many CO2-based products are not competitive with conventional products, may be excluded from the market by industry standards, and lack a standardized method for ensuring they effectively reduce CO2 emissions.[13]

While the U.S. has abundant potential geologic storage opportunities for CO2, the use of carbon capture and storage is still rare. According to the Congressional Budget Office, as of September 2023, only 15 facilities were capturing and transporting CO2 for permanent storage as part of an ongoing commercial operation.[14] Further, developing the necessary transportation and storage infrastructure presents a chicken-and-egg problem: CO2-emitting industries hesitate to deploy capture technologies if there is no infrastructure to transport and store the captured CO2, but

[13]GAO, *Decarbonization: Status, Challenges, and Policy Options for Carbon Capture, Utilization, and Storage*, GAO-22-105274 (Washington, D.C.: Sept. 29, 2022).

[14]Congressional Budget Office, *Carbon Capture and Storage in the United States* (Washington, D.C.: Dec. 13, 2023).

development of such infrastructure is risky if industry is not already capturing CO2. It can take years to plan, permit, and build infrastructure for capturing, transporting, and storing CO2.

DOE Support for Research and Development of CCUS and DAC Technologies

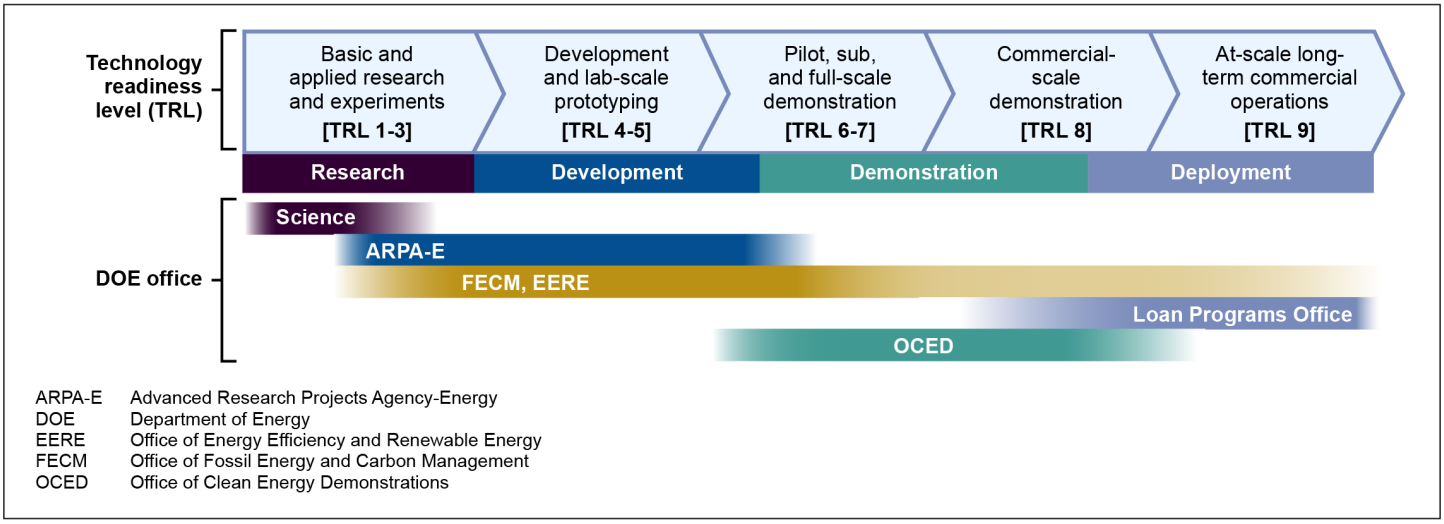
Multiple offices are responsible for carrying out DOE's carbon capture program. These offices support CCUS and DAC projects across different stages of maturity—referred to as technology-readiness levels (see fig. 2)—and encompass research, development, demonstrations, and deployments. These offices include

- **Office of Fossil Energy and Carbon Management (FECM).** FECM is responsible for the research and development of carbon capture, transport, storage, and conversion technologies, including high-priority areas such as point-source carbon capture and carbon dioxide removal, including DAC. FECM also oversees the infrastructure, operations, and research and development activities at the National Energy Technology Laboratory. The National Energy Technology Laboratory has dual roles: it serves as project manager for research and development projects that receive financial assistance, including carbon capture projects, and conducts applied research related to energy and environmental programs. FECM and the National Energy Technology Laboratory collaborate on selecting and administering DOE awards for carbon capture research and development projects.
- **Office of Science.** The Office of Science supports basic research in the physical sciences, including materials science and chemistry, with research aimed at improving materials and chemical processes for carbon capture.
- **Advanced Research Projects Agency—Energy (ARPA-E).** ARPA-E advances high-potential, high-impact energy technologies that are too early for private-sector investment. ARPA-E's FLExible Carbon Capture and Storage program aims to develop carbon capture and storage technologies that enable power generators to be responsive to grid conditions in a highly variable renewable energy environment.
- **Office of Energy Efficiency and Renewable Energy (EERE).** EERE's Renewable Carbon Resources subprogram supports strategies to better integrate DAC units with algae cultivation systems and to increase CO2 utilization efficiency within algal cultivation systems while optimizing CO2 utilization from air.
- **Office of Clean Energy Demonstrations (OCED).** OCED was established in November 2021 under the Infrastructure Investment and Jobs Act. Its goal is to deliver clean energy demonstration

projects at scale, including new programs to help accelerate the demonstration and deployment of carbon management technologies.

- **Loan Programs Office.** The Loan Programs Office is responsible for deployments. According to officials from the Loan Programs Office, they had not guaranteed any loans for carbon capture technology as of May 2023, and therefore we did not include the office in this review. However, they said that they will be offering access to capital for large-capacity CO2 transport projects under the carbon dioxide transportation infrastructure finance and innovation program in the future.[15] We have ongoing working evaluating the Loan Programs Office's application review process.

Figure 2: Roles of Department of Energy (DOE) Offices Across Technology Readiness Levels



Source: GAO summary of information from DOE. | GAO-24-106489

DOE generally uses competitive funding opportunity announcements for federal financial assistance—typically in the form of grants or cooperative agreements—to solicit applicants for carbon capture projects.[16] Applicants include entities such as universities, private companies, and national laboratories. Each year, DOE sets priorities for its CCUS and DAC research and development programs based, in part, on the amount of funding appropriated by Congress, as well as any direction that Congress may have specified for research and development of certain

[15]This program was established as part of the Infrastructure Investment and Jobs Act.

[16]The primary difference between a grant and cooperative agreement is that under a cooperative agreement, substantial involvement is anticipated between the DOE program office and the recipient during performance of the funded activity.

types of technology, and DOE's own research and development plans. Additionally, the Infrastructure Investment and Jobs Act of 2021 provided DOE with funding for several specific CCUS and DAC programs, including commercial large-scale carbon storage projects and regional DAC hubs. DOE's CCUS and DAC research and development projects typically require multiple years to complete.

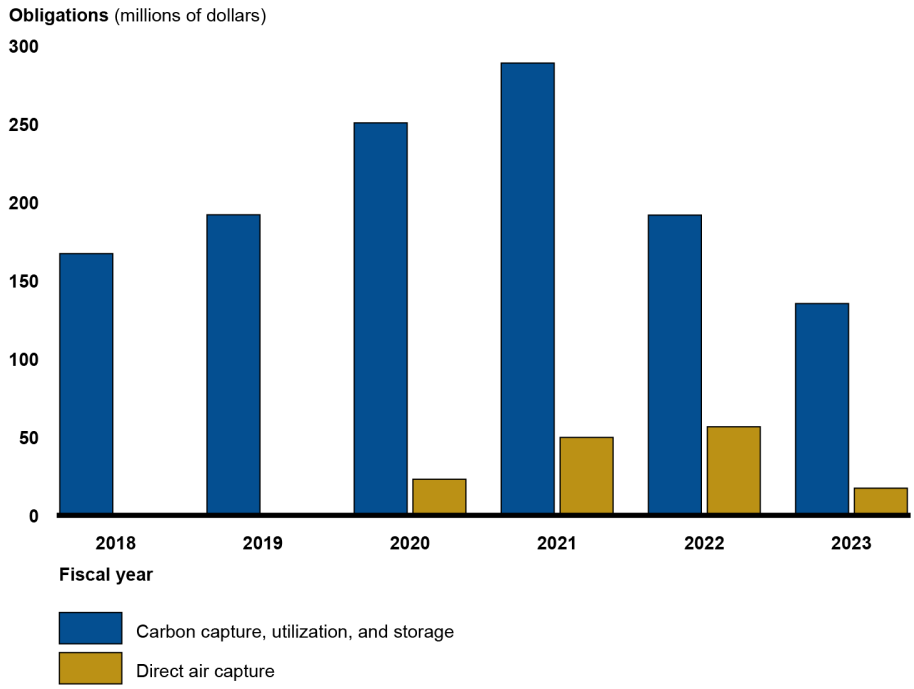
For those projects selected for funding, DOE and the awardee agree to technical progress milestones for each phase of the project to help ensure that projects accomplish a specific research and development objective or set of objectives. Phases generally include definition or preliminary design, design, construction, and operations. To manage risks inherent to these types of projects and to guide project management, DOE uses its Guide to Financial Assistance, which compiles DOE regulations for managing financial assistance awards with guidance for implementing those regulations.[17]

DOE Obligated Almost $1.4 Billion to Support Carbon Capture Projects from Fiscal Years 2018 through 2023

DOE supported 654 carbon capture projects with almost $1.4 billion in federal funds from fiscal years 2018 through 2023 (see fig. 3). Specifically, DOE obligated over $1.2 billion to support 545 CCUS projects and over $150 million toward 109 DAC projects through grants and cooperative agreements across five DOE program offices. These projects ranged from basic and applied research and development to small- and large-scale testing pilots, as well as a few early-stage demonstrations.

[17]DOE's financial assistance is generally governed by the regulatory requirements contained in 2 C.F.R. pt. 200, 2 C.F.R. pt. 910, and 10 C.F.R. pt. 600.

Figure 3: Department of Energy (DOE) Carbon Capture Project Obligations, Fiscal Years 2018–2023



Source: GAO analysis of DOE data. | GAO-24-106489

FECM obligated the significant majority of DOE's carbon capture funding. Specifically, FECM obligated almost $950 million, or 69 percent of DOE funding, to support 410 projects from fiscal years 2018 through 2023.[18]

- Of these 410 projects, 392 (about 96 percent) focused on technologies related to reducing emissions from coal and 18 (about 4 percent) from oil and gas. Project funding amounts ranged from $100,000 for research and development projects to $55.7 million for a large-scale CCUS pilot facility.
- Of the $950 million, FECM obligated almost $880 million (93 percent) to support 359 CCUS projects. Of these 359 projects, 107 focused on carbon storage, 101 focused on point-source carbon capture, and the rest focused on other areas.[19] On average, FECM obligated about $2.5 million per CCUS project. FECM also obligated about $68 million

[18]FECM employed cooperative agreements to award over 90 percent of the funds provided for CCUS and DAC projects.

[19]Such areas include carbon conversion, carbon utilization, and crosscutting research.

(7 percent) toward 51 DAC projects, averaging about $1.3 million per project.

Other DOE offices also obligated almost $432 million to support 244 carbon capture projects from fiscal years 2018 through 2023 (see fig. 4). For these projects,

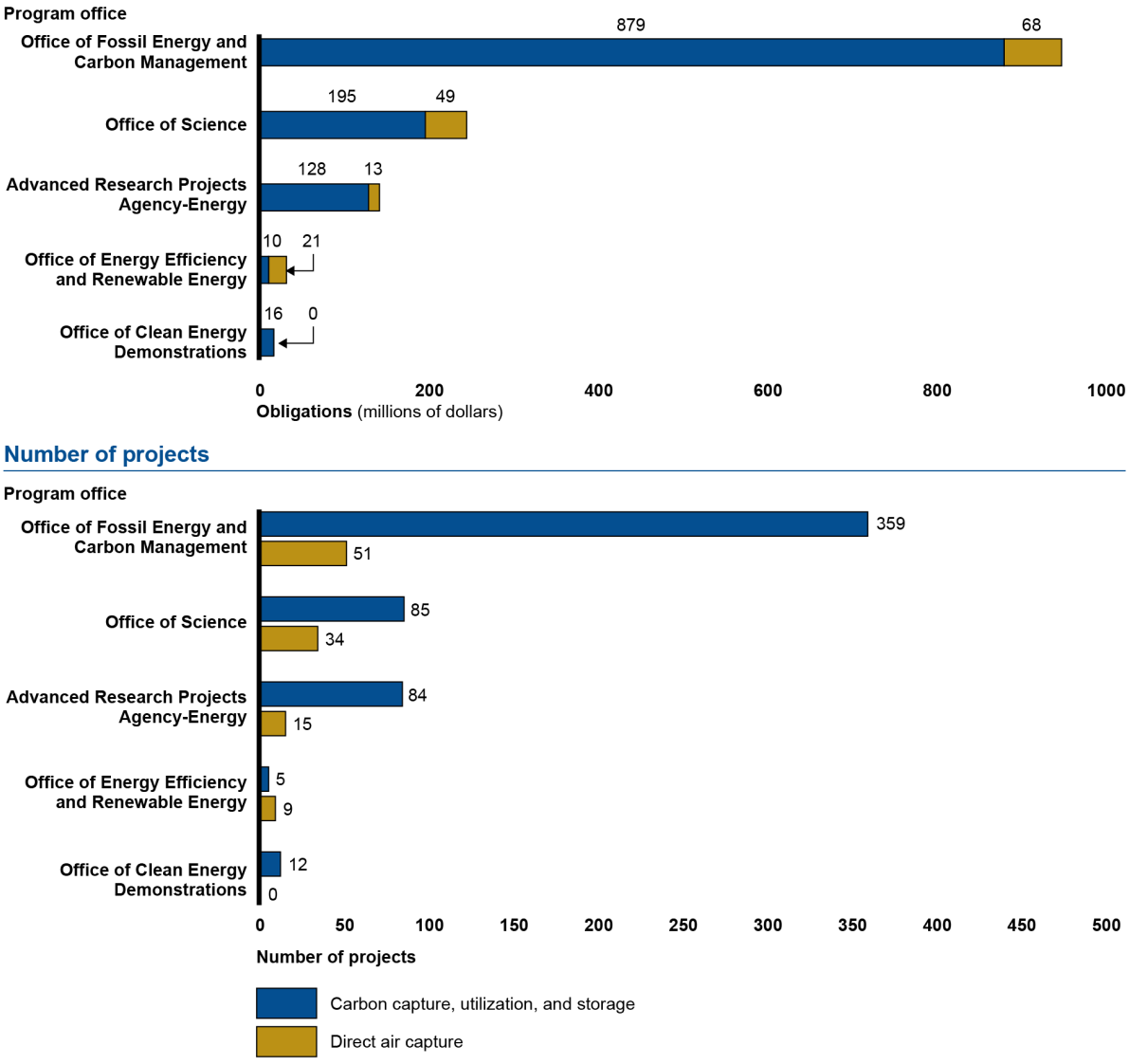
- Office of Science obligated over $244 million for 119 projects (project funding amounts ranged from $71,000 to $22 million);[20]
- ARPA-E obligated over $140 million for 99 projects (project funding amounts ranged from $93,000 to $3.7 million);[21]
- EERE obligated almost $31 million for 14 projects (project funding amounts ranged from $1 million to $4 million);
- OCED obligated over $16 million for 12 CCUS demonstrations (project funding amounts ranged from $4.7 million to $9.2 million).[22]

[20]Data exclude projects that began in fiscal year 2017 to which Office of Science had obligated funds in or after fiscal year 2018.

[21]This total excludes ARPA-E's funding provided toward direct ocean capture projects, which was about $5 million. Direct ocean capture is a method of capturing dispersed CO_2 from ocean water and other natural waters.

[22]This amount is based on obligation data as of January 2024.

Figure 4: Department of Energy (DOE) Obligations and Number of Projects for Carbon Capture Projects, by Office and Project Type, Fiscal Years 2018–2023



Source: GAO analysis of DOE data. | GAO-24-106489

DOE Offices Addressed Project Selection and Management Risks in Various Ways, but FECM Inconsistently Addressed Risks in Reviewed Carbon Capture Projects

DOE offices—including FECM, Office of Science, ARPA-E, EERE, and OCED—employed various processes to address risks associated with selecting and managing carbon capture projects, but FECM engaged in some practices that could expose taxpayer funds to the risk of funding unsuccessful projects and undermine the likelihood of project success. To manage risks, DOE offices employed risk reviews, multi-phase down selection processes, budget controls, and peer reviews. However, FECM did not consistently adhere to guidance regarding risk reduction in project selection and management.

DOE Offices Employed Varied Approaches to Address Risks in Reviewed Projects

Based on a review of DOE selection, award, and management documentation for a nongeneralizable sample of 40 projects, we found that DOE offices have taken several actions to manage risks associated with CCUS and DAC projects, such as risk reviews, multi-phase down-selection processes, budget controls, and peer reviews. While some actions, such as risk reviews, were used by all the DOE offices included in our review, not all actions were implemented by every office in our sample because offices have some discretion in how they manage risks.

Risk reviews. DOE offices conducted risk reviews for all projects in our sample to identify and analyze potential project risks, as required by regulation, to minimize the impacts of such risks and increase likelihood of project success.[23] For example, FECM conducted risk screenings for all projects to calculate the overall project risk potential. These risk screenings evaluate a project across several categories, including financially, technically, and management oversight. This screening determines the level to which the project is to be evaluated and monitored, with higher risk projects potentially requiring further screening and heightened levels of oversight. For example, according to documentation, FECM required one higher-risk project to regularly update its project management plan to identify, assess, monitor, and mitigate technical uncertainties as well as schedule, budgetary, and environmental risks associated with all aspects of the project.

[23]In addition, DOE's Research, Technology and Economic Security Vetting Center, established in March 2023, conducts or facilitates risk assessments of DOE awards that require due diligence prior to award selection, particularly in the areas of technology and economic security.

Down selections. DOE offices used a multi-phased down-selection process for 11 of the larger-scale projects in our sample to increase the likelihood that the projects selected would succeed.[24] While down-selects may not be appropriate for smaller-scale projects, under this process, DOE offices selected certain projects for initial funding, and then later selected a subset of those projects for full funding—an approach we had previously recommended—to reduce the risks of committing to fully funding a project upon initial selection.[25] In the sample reviewed, initial awards ranged from under $1 million to $8.8 million, and they increased in subsequent phases, totaling from about $9.7 million to $55.7 million by the final phase.

FECM officials we interviewed said that using a down-selection process is an effective means of reducing the risk of funding unsuccessful projects. Specifically, they said gaining additional information about a project allows them to make more informed decisions about which projects are best positioned to succeed. For example, in FECM, a project that had been highly rated in the first and second phases of a large pilot study was ultimately not selected to complete the final phase because the project experienced technical problems that did not support project construction readiness. Because FECM had not obligated funding for the entire project, the office was able to select a different project for the construction phase that it believed was more likely to succeed. By not fully committing to a project upon initial selection, FECM increased the likelihood that the projects ultimately selected for construction would succeed.

FECM officials told us they are in the process of creating guidance that will define when it is appropriate to use the down-select process. In general, FECM officials plan to use down-selects for projects that are higher-risk or for higher dollar amounts. These officials specified that down-selects may not be necessary for smaller projects levels with lower funding levels because those projects typically have shorter timelines and more discrete program objectives.

Budget controls. DOE implemented budget controls for all relevant projects in our sample to decrease the risk that DOE would continue to

[24]DOE offices included FECM, Office of Science, and OCED. According to ARPA-E and EERE documentation, they also employ down-selects for projects.

[25]See GAO-22-105111.

award funding to unsuccessful projects.[26] Under DOE's *Guide to Financial Assistance*, awardees must submit an application to continue a project at the end of each budget period. These continuation applications contain progress reports, requests for revisions to the project schedule, and adjustments to the budget for the coming budget period. If DOE concurs with the continuation application, the project is formally extended to the next budget period, and the awardee has official authorization to spend funds, subject to congressional appropriations. If DOE does not concur with the application, it works with the awardee to come to agreement on acceptable targets and next steps for the project, according to DOE officials. DOE officials also told us if they are unable to come to agreement, the project ends and DOE begins the closeout process. Our review sample did not include any projects discontinued as the result of DOE nonconcurrence with a continuation application.

Peer reviews. DOE offices, including the Office of Science and FECM, used external independent reviews to help manage risk by addressing organizational biases for seven projects in our sample.[27] According to DOE officials, program offices can be overly optimistic in their assessment of projects, including potential cost and schedule risks, because program offices both manage and provide oversight to awards and want them to succeed. External independent reviews help bring to light actions that can potentially limit the likelihood of success and can help balance this optimism.

The Office of Science's Energy Frontier Research Centers included an external peer review for both projects in our sample when they were approximately halfway to completion, according to documentation we reviewed.[28] Funding for the final years of these projects is likely contingent upon satisfactory completion of an extensive mid-term progress review, including external peer reviews. The National Energy Technology Lab also conducts peer reviews of FECM's research programs, although these are not required for all projects. Additionally,

[26]Some projects in our review were still in the first budget period, and therefore had not yet submitted any continuation applications. Other projects consisted of only one budget period.

[27]According to DOE's project management order, an external independent review is a project review performed by personnel from DOE and augmented by individuals outside DOE at critical decision points of a project.

[28]Energy Frontier Research Centers are a basic research program funded by the Office of Basic Energy Sciences within the Office of Science. The centers employ multidisciplinary approaches to advance energy research.

while not in our reviewed sample, EERE and ARPA-E use external independent reviews. According to EERE guidance, peer reviews occur for projects that account for about 80 to 90 percent of the funding (based upon dollar value), and 100 percent of key projects, which include projects of high relevance, among other things.[29] According to an ARPA-E official, ARPA-E has used peer reviews in limited circumstances.

FECM Inconsistently Adhered to Guidance Regarding Risk Reduction in Project Management and Selection

FECM, which is responsible for the significant majority of carbon capture funding and projects under review, engaged in practices that could expose taxpayer funds to the risk of funding unsuccessful projects and undermine the likelihood of project success. Specifically, FECM did not adhere to guidance designed to reduce risk, and, as a result, the office did not always clearly document risk treatment strategies and selected a project that was not deemed technically acceptable.

Unclear risk treatments. It is not clear that FECM comprehensively addressed risks identified by risk screenings and merit reviews because risk treatments, which include both preventative and mitigative actions, were not always clearly documented in the sample of projects we reviewed. According to DOE's *Guide to Financial Assistance*, FECM should maintain the official financial assistance files; ensure that they contain all pertinent materials, records, and documentation; and identify and mitigate technical and financial risks in implementation strategies. However, FECM did not always clearly document such risk treatment strategies in the sample of projects we reviewed. For example, one project's risk screening stated that more internal scrutiny may be required to prevent duplication of efforts. According to FECM officials, the project manager was familiar with the awardee's other projects and determined there was no duplication of efforts per further review, but they were unable to provide documentation to support this determination. In another case, merit review selection documentation noted that the project management plans did not adequately address risks associated with COVID-19's impact on the project schedules in 2021. The project management plans that were later updated in 2022 did not address COVID-19 risks. According to FECM officials, the risks of COVID-19 were addressed in other ways, such as amendments to the initial funding agreement; however, this is not clearly documented.

[29]Department of Energy, *Peer Review Guidance*, DOE EERE G 413.001 (Washington, D.C.: December 2020).

Additionally, FECM directs project awardees to identify potential project risks and provide treatment and response strategies for identified risks, but the office does not require awardees to document reviews of these risk assessments on a regular basis. According to best practices found in DOE's Risk Management Guide, risk assessments, along with risk treatment strategies, should be updated on a quarterly basis because it is not possible to identify all risks at the onset of a project.[30] FECM officials told us that project risk assessments are formally updated on an as-needed basis when there are material changes, or between project phases. According to officials, instead of updating the risk assessment, if new risks arose throughout the course of the project, the awardee would communicate these risks with the project manager, who may then direct the awardee to update the risk assessment. However, without documenting that identified potential risks and treatment strategies were reviewed on a regular basis, it is not clear that the awardee or FECM addressed such risks.

DOE guidance states that FECM should ensure that project record files contain all relevant documentation. Documentation is particularly important for project continuity because while a project manager may understand the details of a project, turnover in project managers does occur. Of the FECM projects we reviewed, more than half experienced at least one project manager change throughout the course of a project, with some projects experiencing two or three changes. Further, *Standards for Internal Control in the Federal Government* states that agency management should identify, analyze, and respond to risks related to achieving the agency's defined objectives.[31] Without clear documentation, we were unable to verify that DOE administration of carbon capture projects is consistent with this principle, specifically in its analyses and responses to identified risks. By more clearly documenting risk treatment strategies, FECM would provide greater assurances that taxpayer dollars are going towards selected projects that are more likely to succeed. This is particularly important given the approximately $12 billion appropriated

[30]DOE's Risk Management Guide provides non-mandatory risk management approaches to implementing DOE's Program and Project Management for the Acquisition for Capital Assets. According to DOE's Guide to Financial Assistance, program officials can apply the basic principles from DOE's Program and Project Management for the Acquisition for Capital Assets regarding project management to financial assistance awards. Such principles include the identification and treatment of project performance risks (technical, financial, and otherwise).

[31]GAO-14-704G.

for new CCUS and DAC projects in the Infrastructure Investment and Jobs Act, with initial projects already underway.

High-risk project selection. FECM did not adhere to DOE guidance for project selection criteria in one of the 25 FECM projects in our sample. DOE's *Merit Review Guide for Financial Assistance* states that programs should only select projects that are deemed technically acceptable to reduce the risk that DOE awards unsuccessful projects. However, FECM selected and awarded funds to a project in our review sample that did not meet DOE criteria. Specifically, in 2020, FECM selected and awarded a $14.6 million carbon storage project even though the project's technical score[32] was below the acceptable threshold.[33] The funding opportunity announcement stated that for a project to qualify, the preliminary evaluation of the storage test site should already be completed. However, according to merit review documentation, this project had not conducted any evaluations of the storage site, making it difficult to determine if the proposed site was amenable for carbon storage.

Subsequent to FECM's selection of this project, it experienced cost overruns and delays, resulting in FECM approving an additional $5.1 million and an additional 18 months to complete the project. According to documentation, the estimated project completion date is now March 2025, although it may be further delayed.[34] FECM was unable to provide documentation regarding the rationale for selecting a technically unacceptable project. Based on our nongeneralizable sample of projects reviewed, it is unclear how widespread this practice is. However, by adhering to project selection guidance to select technically acceptable projects, FECM would provide greater assurances that taxpayer dollars going towards selected projects are more likely to succeed. This is particularly important given the approximately $12 billion appropriated for

[32]For this funding opportunity announcement, it was determined all applications that scored 700 points or higher were technically acceptable. FECM selected the five highest-ranking projects, which included four technically acceptable projects and a project that scored below the threshold with 540 points.

[33]An additional $2.5 million in non-FECM federal funds was also provided to this project. These funds were provided by a federally funded research and development center, which is a public-private partnership that conducts research and development for the U.S. government and is sponsored by various federal agencies.

[34]The final milestone of this project is to obtain a Class VI well permit, which is used to inject CO_2 into deep rock formations for sequestration. According to the Environmental Protection Agency's Class VI Permit Tracker, this project is not expected to receive a permit decision until July 2025.

new CCUS and DAC projects in the Infrastructure Investment and Jobs Act, with initial projects already underway.

Conclusions

CCUS and DAC technologies have the potential to support the federal government's goal of net-zero CO2 emissions by 2050, but implementing these technologies has been a challenge. To address this challenge, from fiscal years 2018 through 2023, DOE awarded hundreds of carbon capture projects, providing almost $1.4 billion in funding, to further accelerate the maturity of CCUS and DAC. DOE is planning to award many more projects in the coming years, with the Infrastructure Investment and Jobs Act providing approximately $12 billion for CCUS and DAC projects. It is crucial that DOE—and especially FECM—manages the risks associated with these projects, and it has employed some processes to do so. However, based on the sample of projects we reviewed, FECM—which administered the majority of carbon capture funding to date—also engaged in some practices that could undermine the likelihood of selected project success. First, it is not clear that FECM comprehensively addressed risks identified throughout the course of a project because treatments are not always clearly documented in the projects we reviewed. By more clearly documenting risk treatment strategies, which can be important for project continuity given common turnover in project managers, FECM would provide greater assurances that taxpayer dollars are going towards selected projects that are more likely to succeed.

Second, FECM's decision to award funds to a project that was not deemed technically acceptable by merit reviewers increased the risk of funding a project that was less likely to succeed. By adhering to merit review guidance that it select only technically acceptable projects, FECM could better ensure that future carbon capture projects it selects are more likely to succeed.

Recommendations for Executive Action

We are making the following two recommendations to DOE:

The Principal Deputy Assistant Secretary for the Office of Fossil Energy and Carbon Management should take actions to more clearly document project risk treatment strategies consistent with the project management principles identified in its Guide to Financial Assistance. (Recommendation 1)

The Principal Deputy Assistant Secretary for the Office of Fossil Energy and Carbon Management should take steps to ensure that the office adheres to guidance and only selects projects that are deemed to be

technically acceptable, as required by its Merit Review Guide for Financial Assistance. (Recommendation 2)

Agency Comments

We provided a draft of this report to DOE for review and comment. In its comments, reproduced in appendix I, DOE concurred with both recommendations and indicated that it plans to implement them. DOE also provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Energy, and other interested parties. In addition, the report is available at no charge on the GAO website at https://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or ruscof@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix II.

Frank Rusco
Director, Natural Resources and Environment

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Appendix I: Comments from the Department of Energy

Department of Energy
Washington, DC 20585

May 2, 2024

Mr. Frank Rusco
Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street NW
Washington, DC 20548

Dear Mr. Rusco,

The Department of Energy (DOE or Department) appreciates the opportunity to comment on the Government Accountability Office's (GAO) draft report titled, "*Decarbonization: Opportunities Exist to Improve the Department of Energy's Management of Risks to Carbon Capture Projects" GAO-24-106489.* DOE provides the following comments below.

The draft report contained a total of two recommendations, of which GAO directed two recommendations to DOE. DOE concurred with GAO's draft recommendations and provided technical and general comments to improve the report. The Department plans to implement the recommendations as articulated by GAO in the draft report.

If you have further questions, please contact Ms. Priyanka Hooghan, Chief of Staff, Office of Fossil Energy and Carbon Management, at (240) 449-5143.

Sincerely,

Brad Crabtree
Assistant Secretary
Office of Fossil Energy and Carbon Management

Enclosure

Enclosure

Management Response
GAO Draft Report: "*Decarbonization: Opportunities Exist to Improve the Department of Energy's Management of Risks to Carbon Capture Projects*" GAO-24-106489

Recommendation #1: The Principal Deputy Assistant Secretary for the Office of Fossil Energy and Carbon Management should take actions to clarify document project risk mitigation strategies consistent with the project management principles identified in its *Guide to Financial Assistance*.

DOE Response: Concur

The Office of Fossil Energy and Carbon Management (FECM) is in the process of updating relevant guidance on risk management for project management staff. FECM will reiterate, as aligned with current processes, the need to document the risk mitigation strategies as they occur. FECM's guidance will complement Department-wide guidance contained in the Department of Energy (DOE) *Guide to Financial Assistance*.

Estimated Completion Date: Action on this recommendation has been initiated and the updated guidance is expected to be available by the end of fiscal year 2024.

Recommendation #2: The Principal Deputy Assistant Secretary for the Office of Fossil Energy and Carbon Management should take steps to ensure that the office adheres to guidance and only selects projects that are deemed to be technically acceptable, as required by its *Merit Review Guide for Financial Assistance*.

DOE Response: Concur

The Principal Deputy Assistant Secretary will direct staff to follow the DOE *Merit Review Guide for Financial Assistance*, including guidance for reviewing the technical feasibility of projects. This direction will be reinforced by the Head of Contracting Activity for FECM. The Selection Officials will be responsible for adherence to the guidance.

Estimated Completion Date: The message from the Principal Deputy Assistant Secretary will be sent no later than May 30, 2024.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Frank Rusco, at 202-512-3841 or ruscof@gao.gov

Staff Acknowledgments

In addition to the contact name above, Matthew Tabbert (Assistant Director), Colson Campbell Ricciardi (Analyst-In-Charge), Macie Benincasa, Quindi Franco, Cindy Gilbert, Patrick Harner, Latoya Hogg, Gwen Kirby, Victor Ponds, Dan Royer, Robert Sanchez, Caitlin Scoville, and Elise Vaughan Winfrey made key contributions to this report.

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