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Funding for Carbon Capture and Carbon Removal at DOE

Federally funded research and development (R&D) on carbon capture and carbon removal is supported primarily by the U.S. Department of Energy (DOE). In the Energy Act of 2020 (Division Z of P.L. 116-260), Congress authorized an expanded scope for DOE carbon capture and carbon removal research programs. The President's budget request for fiscal year 2022 (FY2022) likewise proposed expanding DOE's activities in these areas compared to previous years. This analysis summarizes these proposed changes and provides information on FY2021 and FY2022 appropriations.

Background

Carbon capture and storage (CCS, sometimes called carbon capture and sequestration) is a process that is envisioned to capture man-made carbon dioxide (CO_2) at its source and store it underground to prevent its release to the atmosphere. Captured carbon also can be used in products, as opposed to being stored underground, in a process called carbon capture, utilization, and storage (CCUS). Carbon dioxide removal (CDR, sometimes called carbon removal or negative emissions technologies) is a suite of technologies and practices that aim to remove CO_2 from the atmosphere and store it underground or in living organisms. CDR often involves natural CO_2 sinks like forests and croplands, but also can involve technologies like direct air capture (DAC). Further discussion of some of these technologies and historical appropriations for related DOE R&D activities is provided in CRS Report R44902, *Carbon Capture and Sequestration (CCS) in the United States*.

CCS (with or without utilization) and CDR both are viewed as potential options to address climate change, though they address different aspects of the issue. CCS equipment can reduce CO_2 emissions from point sources that use fossil fuels (e.g., power plants or other industrial facilities), potentially resulting in carbon neutral facilities if 100% of the emissions are captured. DAC facilities can be located anywhere and can be potentially carbon negative if the DAC process uses non-emitting energy sources. CDR involving living organisms (e.g., based on agricultural soils or forestry practices) is often site-constrained by habitat and related factors.

FY2021 Appropriations

Among other provisions, the Energy and Water Development and Related Agencies Appropriations Act, 2021 (Division D of P.L. 116-260) provided regular appropriations for FY2021 for ongoing R&D activities within DOE. Most of DOE's CCUS research is funded through its Fossil Energy program. According to tables in the explanatory statement for the appropriations act, Congress provided $228.3 million to CCUS line items for FY2021. (See **Table 1**.) These appropriations are lower than the FY2021 authorized amounts in other divisions of the law (as discussed in the "Energy Act of 2020 Authorizations" section below.)

The explanatory statement provides at least $72.5 million of DOE's appropriated funds for R&D on CDR (which it referred to as negative emissions technologies) in three DOE programs:

- within Fossil Energy, not less than $40.0 million, including not less than $15.0 million for DAC;
- within Energy Efficiency and Renewable Energy, not less than $10.0 million for DAC; and
- within Science, not less than $22.5 million, including not less than $7.5 million for DAC.

Energy Act of 2020 Authorizations

DOE's carbon capture R&D activities date back to at least 1997 and historically centered on two aspects: carbon capture technology for coal-fired power plants and underground geologic storage reservoirs. In recent appropriations reports, Congress recommended that DOE expand its focus to include carbon capture for other sources and some types of CDR.

Congress codified these and other objectives for DOE's carbon capture and carbon removal R&D in P.L. 116-260, the first major amendments to DOE's statutory R&D program objectives since 2007. Most authorizations are provided by the Energy Act of 2020. The USE IT Act (enacted as part of Division S of P.L. 116-260) provided additional guidance for DOE carbon utilization R&D.

The Energy Act of 2020 provides policy direction for DOE's CCUS R&D activities in Title IV—Carbon Management. Sections 4002, 4003, and 4004 address carbon capture, carbon storage, and carbon utilization, respectively. In part, the law directs DOE to fund carbon capture demonstration projects at varying stages of technology maturity, and to continue funding carbon storage projects. Funded carbon capture projects must apply to different types of facilities, such as natural gas-fired power plants and facilities outside the power sector. The law also directs DOE to fund research to identify novel uses of carbon and CO_2.

DOE's CCUS R&D activities pursuant to Title IV—Carbon Management are authorized at $1,284.0 million in FY2021; $1,285.3 million in FY2022; $1,131.6 million in FY2023; $1,132.9 million in FY2024; and $1,084.4 million in FY2025 (all values rounded to the nearest tenth).

The Energy Act of 2020 provides policy direction for DOE's CDR R&D activities in Title V—Carbon Removal. Section 5001 establishes a new DOE research program on CDR, to be coordinated with the U.S. Department of Agriculture and other relevant federal agencies. Section 5001 identifies six CDR options DOE should support: DAC, bioenergy with CCS, enhanced geological weathering, agricultural practices, forest management and afforestation, and planned or managed carbon sinks. Section 5001 also establishes Air Capture Prize Competitions for two classes of DAC. The larger competition, for more mature technologies, is authorized at $100 million (available until expended) and may award eligible facilities up to $180 per ton of CO_2 captured and stored. The awards are to be smaller if the captured CO_2 is utilized, including for enhanced oil recovery.

DOE's CDR R&D activities pursuant to Title V—Carbon Removal are authorized at $175.0 million in FY2021 (of which $115.0 million is for DAC prize competitions, to remain available until expended); $63.5 million in FY2022; $66.2 million in FY2023; $69.5 million in FY2024; and $72.9 million in FY2025 (all values rounded to the nearest tenth). The FY2021 appropriations reports did not address any DAC prize competition.

FY2022 Appropriations

On May 28, 2021, the Biden Administration released its FY2022 budget request. DOE's *Budget in Brief* describes changes the Administration proposes for carbon capture and carbon removal research at DOE. To a certain extent, these proposed changes align with the policy objectives provided by the Energy Act of 2020. Some key proposed changes are summarized below.

The Administration proposes to rename DOE's Fossil Energy Research and Development appropriations account to the Fossil Energy and Carbon Management (FECM) Research, Development, Demonstration and Deployment account. Similarly, Biden Administration materials, such as press releases, refer to the Office of Fossil Energy and Carbon Management instead of the Office of Fossil Energy.

The Administration proposes to expand carbon capture research beyond application to coal-fired power plants. According to its *Budget in Brief* (p. 52), DOE's justification for the change is "Carbon Capture activity has completed its efforts in first-generation technology through successful demonstration projects. FY2022 activities represent a focus on new capture technologies in addition to the demonstration of more proven capture approaches."

The Administration also proposes a new DOE budget line item for CDR within FECM's account. As described by DOE's *Budget in Brief* (p. 53), "FECM has focused on the chemical and mineral-based CDR approaches, which was previously funded under the Carbon Capture Program. It builds upon past CCUS efforts which have been funded through FECM's CCUS programs, such as past work on DAC mineralization, co-firing of biomass, and capture technology development."

As shown in **Table 1**, DOE's FY2022 request is for increased CCUS and CDR funding relative to FY2021 enacted appropriations. However, the requested increase is less than the levels authorized by the Energy Act of 2020, especially for carbon capture.

Table 1. Funding for Carbon Capture and Carbon Removal R&D Activities at DOE

Budget Authority in millions of dollars

Program Area	FY2021 Enacted	FY2022 Requested	FY2022 Authorized
Carbon Capture	126.3	150.0	1,030.0
Carbon Utilization	23.0	38.0	55.3
Carbon Storage	79.0	117.0	200.0
Subtotal	*228.3*	*305.0*	*1,285.3*
Carbon Dioxide Removal	n/a	63.0	63.5
Total	228.3	368.0	1,348.8

Sources: FY2021 enacted from explanatory statement for P.L. 116-260, Division D. FY2022 requested from DOE FY2022 *Budget in Brief*. FY2022 authorized from P.L. 116-260, Division Z.

Notes: Carbon utilization authorized values rounded. FY2021 appropriations documents have no line item for carbon dioxide removal. The USE IT Act authorizes $50 million for carbon utilization research to be available until expended (P.L. 116-260, Division S, §102(c)), not included in this table.

Apart from requested changes to carbon capture and carbon removal R&D, two other proposed changes to DOE's programs could potentially affect those activities should Congress adopt them.

The budget request proposes a new Office of Clean Energy Demonstrations. According to the *Budget in Brief* (p. 90), this new office would "accelerat[e] the maturation of near- and mid-term clean energy technologies and systems with the goal of quicker commercial adoption and increased availability." The request states this new office, should it be funded, would focus on energy storage in its first year. Later years could potentially focus on carbon capture or carbon removal.

The request also proposes a new Advanced Research Projects Agency–Climate (ARPA-C) within DOE, modeled on the existing Advanced Research Projects Agency–Energy (ARPA-E), to "develop technologies to address climate adaptation, resilience and non-energy emissions mitigation" (p. 2). Should the new program be funded, it could potentially support some carbon removal activities as part of a non-energy emissions mitigation portfolio.

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