Federal Energy R&D: Carbon Storage and Utilization

BY COLIN CUNLIFF | APRIL 2019

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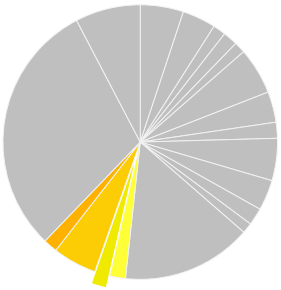
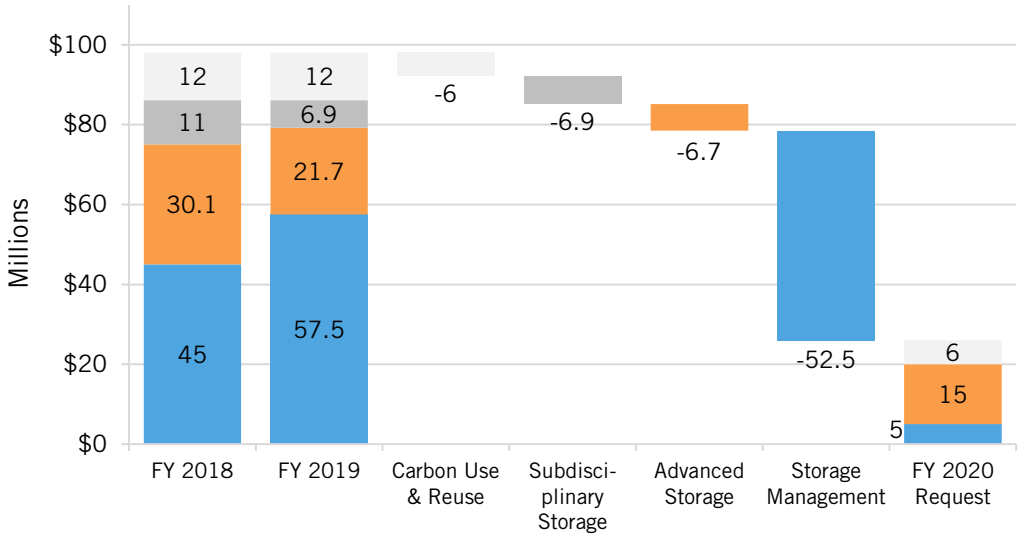


Carbon Storage (yellow)
Other Fossil (yellow)
Energy R&D (light gray)

The Carbon Storage and Utilization subprogram is focused on development of technologies for the safe and permanent utilization and storage of captured carbon dioxide (CO_2). It conducts research and development on 5 primary geologic storage media—saline formations, oil and natural gas reservoirs, unmineable coal seams, basalts, and organic shales—and in reservoirs across 11 geologic depositional classes.[1]

Figure 1: The FY 2020 Budget Request Would Cut Carbon Storage and Utilization R&D by 73 Percent.[2]



What's At Risk

Preliminary research suggests the United States has enough subsurface capacity to permanently sequester 1.71 trillion metric tons of CO_2, which is the equivalent of 950 years of carbon emissions from power plants at 2016 levels.[3] However, additional cost reductions, validation, safety testing, and mitigation research are necessary to realize this capacity. While the size of many subsurface storage reservoirs has been initially characterized, detailed site-specific work is required to confirm their potential. R&D is also needed to develop tools to map and simulate below-ground fractures and faults with a high degree of resolution and fidelity, devise wellbore materials that can better resist corrosion by CO_2-saturated brine, and improve the ability to monitor and mitigate the risk of induced seismicity from the injection of CO_2 underground. And large-scale, long-

term demonstration projects are necessary to ensure captured carbon dioxide is safely and permanently stored.

In April 2017, the Illinois Industrial Carbon Capture and Storage project—funded jointly by DOE and private investors—began capturing CO_2 from an ethanol-production facility and storing it underground in a saline reservoir at a rate of one million metric tons of CO_2 per year. This large, first-of-a-kind demonstration project is testing and validating technologies, while concurrently endeavoring to reduce future costs.[4] In 2018, DOE selected three additional cost-shared R&D projects to identify sites that can store more than 50 million metric tons of CO_2.[5] The proposed budget would cut funding substantially for this promising effort.

Carbon Storage and Utilization R&D Activities

Funding for carbon storage and utilization R&D is spread across four activities:

- **Storage Infrastructure R&D** focuses on geologic resource characterization and small- and large-scale field projects to demonstrate permanent geologic storage; validation of injection, simulation/risk assessment, and monitoring strategies; and assessment of the probability, and subsequent mitigation, of potential seismic events. Program activities include the Carbon Storage Assurance Facility Enterprise (CarbonSAFE) initiative, which funds industry cost-shared R&D projects to characterize and develop commercial-scale (50+ million metric of CO_2) storage complexes by 2025; the Brine Extraction Storage Test (BEST), which advances strategies for managing subsurface pressure and fluid flow; and the seven Regional Carbon Sequestration Partnerships (RCSPs), which are currently testing large-scale CO_2 injection and storage technologies.[6]

- **Advanced Storage R&D** is focused on developing and validating storage monitoring, simulation, risk-assessment, and advanced wellbore technologies to detect and mitigate wellbore issues. R&D activities include developing CO_2-resistant construction materials and well-integrity technologies, plus technologies to detect and mitigate potential CO_2 leakage pathways.

- **Carbon Use & Reuse R&D** explores the beneficial reuse of CO_2, including conversion into higher-value products such as chemicals, plastics, and building materials, and accelerated curing for cement. The primary objective is to lower the near-term cost of CCUS through the creation of value-added products via the conversion of CO_2.

- **Sub-Disciplinary Storage R&D** focuses on assessment and validation of subsurface models; support for the National Risk Assessment Partnership (NRAP), with a focus on storage risk tools; and development of the Energy Data Exchange (EDX) system which supports data management and technology transfer.[7]

Key Elements of the FY 2020 Budget Proposal

- **A 91-percent reduction in Storage Infrastructure R&D,** and no funding for activities outside of "infrastructure network studies and analyses." It is unclear whether CarbonSAFE, BEST, or the RCSPs would continue to be supported. Long-term, ongoing evaluation and monitoring of storage test sites is necessary to provide confidence that captured carbon dioxide is safely and permanently stored.

- **A 48-percent reduction in Advanced Storage R&D** (which would be merged with Sub-Disciplinary Storage R&D). Current activities in this area focus on development of monitoring, verification, accounting, and assessment (MVAA) tools for CO_2 storage; simulation and risk-assessment technologies; and advanced wellbore technologies to detect and mitigate wellbore issues from both short- and long-term exposure to CO_2. It is unclear which activities would be scaled down or discontinued under the proposed budget.

- **A 50-percent reduction in Carbon Use & Reuse R&D,** with remaining funding focused laboratory- and bench-scale activities to convert CO_2 into chemicals, fuels, and building products.

ENDNOTES

1. DOE, "FY 2020 Congressional Budget Justification," Volume 3 Part 1, 447-448, (DOE Chief Financial Officer, DOE/CF-0152, March 2019), https://www.energy.gov/sites/prod/files/2019/03/f61/doe-fy2020-budget-volume-3-part-1_0.pdf.
2. DOE, "FY 2020 Congressional Budget Justification," Volume 3 Part 1, 425-426.
3. DOE, "Siting and Regulating Carbon Capture, Utilization, and Storage Infrastructure" (Washington, D.C.: DOE Office of Energy Policy and Systems Analysis and Office of Fossil Energy, January 2017) 14, https://www.energy.gov/sites/prod/files/2017/01/f34/Workshop%20Report--Siting%20and%20Regulating%20Carbon%20Capture%2C%20Utilization%20and%20Storage%20Infrastructure.pdf; EPA Draft, "Inventory of U.S. Greenhouse Gas Emissions and Sinks," Table ES-2, (Washington, D.C.: Environmental Protection Agency, February 2018), https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.
4. DOE, "DOE Announces Major Milestone Reached for Illinois Industrial CCS Project," https://www.energy.gov/fe/articles/doe-announces-major-milestone-reached-illinois-industrial-ccs-project, accessed March 29, 2019;
5. DOE, "Energy Department Selects Additional Carbon Storage Feasibility Projects to Receive Nearly $30M in Federal Funding," https://www.energy.gov/fe/articles/energy-department-selects-additional-carbon-storage-feasibility-projects-receive-nearly, accessed March 29, 2019.
6. DOE, "Storage Infrastructure," https://www.energy.gov/fe/storage-infrastructure, accessed March 29, 2019.
7. DOE, "FY 2018 Congressional Budget Justification," Volume 3, 369-372, (DOE/CF-0130, May 2017). The FY 2020 budget request proposes restructuring the carbon storage projects, so definitions from an energy fiscal year are used here.

ACKNOWLEDGMENTS

The author wishes to thank the David M. Hart for providing input to this report. Any errors or omissions are the author's alone.

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