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Federal Energy RD&D: Oil & Gas

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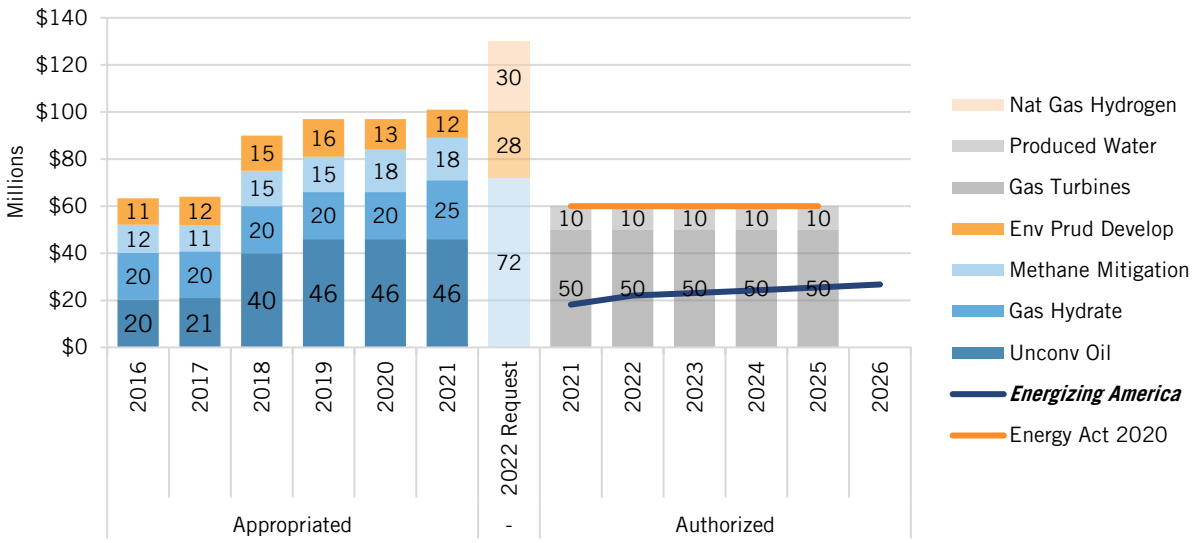
The Department of Energy's (DOE) oil and natural gas program supports research, development, and demonstration (RD&D) to ensure that domestic production, transmission, storage, and distribution of oil and natural gas remain safe, secure, and environmentally prudent. A key focus of this program has been to improve the safety and mitigate the environmental impacts of oil and natural-gas energy systems. The program has explored the connection between hydraulic fracturing and induced seismicity, while also seeking to reduce fugitive methane emissions. In addition, it has funded RD&D to reduce the amount of water used in oil and gas production, and to develop technologies to treat brackish water that is coproduced with oil and gas. The program also focuses on the development of new oil and gas resources, including methane hydrates and unconventional oil.[1]

Figure 1: The Energy Act of 2020 prioritizes gas turbines and produced water RD&D but does not provide new authorizations for existing oil and gas programs.[2]



What's at Stake

Domestic production from unconventional reservoirs has enabled the United States to become the world's largest producer of oil and gas over the last few years, keeping energy prices low, and decreasing reliance on imported crude oil. DOE's RD&D activities focus on improving the efficiency of natural gas infrastructures—including pipelines and storage facilities—to reduce fugitive methane emissions and better conserve domestic energy resources, as well as address high-priority challenges to the safe and prudent development of unconventional oil and gas resources. Methane, the main component of natural gas, is a powerful greenhouse gas that, on a pound-for-pound basis, is about 30 times more effective at trapping heat than carbon dioxide (CO_2), although its atmospheric residence time is much shorter.[3] Reducing methane emissions would have the dual effect of improving the environmental performance of natural gas systems and enhancing stewardship of domestic gas resources. Additional RD&D activities include

treating and managing produced water, characterizing and minimizing induced seismic risk, and reducing surface footprints on well-pad sites and surrounding areas.[4]

Other programs seek to expand access to domestic oil and gas resources. Current technology allows for recovery of only 7 to 10 percent of the oil found in such unconventional reservoirs, but RD&D on subsurface flow mechanics seeks to improve recoverability factors.

The gas hydrates program aims to characterize and evaluate domestic sources of methane hydrate deposits in Alaska and the Gulf of Mexico, which could lead to development of new sources of domestic natural gas.[5] However, the lifecycle impacts of potential methane hydrate resource development are highly uncertain. If methane hydrates were ever to be tapped as a new source of methane, a fugitive emission rate of as little as 3.2 percent across the entire production, transmission, distribution, and end-use chain would make the climate impacts of methane hydrate development worse than those of coal.[6]

The Energy Act of 2020 provides the first reauthorization of DOE's Fossil Energy programs in more than a decade. However, it does not provide new authorizations for DOE's existing oil and gas research programs. The bill establishes a new RD&D program to improve the efficiency of and reduce pollution from gas turbines used in power generation systems and aviation. The bill sets a goal of 67 percent efficiency for natural gas combined cycle power plants, and a 25 percent improvement in fuel efficiency for aviation gas turbines.[7] The bill also authorizes a new research and development (R&D) program to expand opportunities for the reprocessing of produced water at natural gas or oil development sites. (Research in produced water was formerly conducted in the Environmentally Prudent Development subprogram.)[8]

Figure 1 shows historical DOE investment in oil and gas by subprogram for FY 2016 through FY 2021, and the FY 2022 budget request. The orange line shows total authorized funding levels in the Energy Act of 2020 for FY 2021 through FY 2025, across the gas turbines and produced water programs. The blue line shows recommended RD&D funding levels from the *Energizing America* report, which encompasses recommendations for methane emissions quantification and mitigation but does not include recommended funding levels for the other oil and gas programs (see box 1).

Box 1: An Innovation Agenda for Methane Mitigation

The *Energizing America* report coauthored by the Information Technology and Information Foundation (ITIF) and Columbia University's Center on Global Energy Policy recommends continued investment in the development of methane leak detection and mitigation technologies and methods, consistent with the Fossil Energy R&D Act of 2019.[9]

Additionally, the National Academies of Sciences, Engineering, and Medicine (NASEM) found, "Repurposing existing fossil fuel infrastructure can reduce the overall costs of the transition while reducing the potential for stranded assets and workers." For example, upgrading or converting natural gas pipelines to carry hydrogen and natural-gas blends or 100 percent hydrogen could help retain the use of those pipelines in a low-carbon energy system, thereby avoiding the need for more costly and difficult-to-site new builds while also preventing stranded assets for pipeline owners and preserving jobs in natural gas transmission and distribution utilities. Using residual oil and gas basins for permanent underground storage of CO_2 could help oil companies transition into carbon management utilities.[10]

Oil & Gas RD&D Activities

RD&D in oil and natural gas is spread among four activities:[11]

- **Unconventional Fossil Energy from Petroleum R&D** supports the development of domestic production from unconventional reservoirs, which requires complicated engineering measures, such as hydraulic fracturing and directional drilling, to improve access and enable commercial production.
- **Methane Emissions Quantification and Mitigation** focuses on technologies that quantify and reduce methane leaks and vented emissions from natural gas systems. Methane is the second-largest driver of climate change (behind only CO_2), accounting for more than 10 percent of annual U.S. greenhouse gas emissions.[12] Oil and gas systems together account for the largest share of domestic methane emissions, with the lost methane is valued at an estimated $2 billion.[13] These R&D activities serve multiple purposes. They conserve domestic energy resources; reduce waste and inefficiencies in oil and gas systems, which keeps costs low for consumers; provide value to oil and gas producers by ensuring more gas makes its way to the consumer; and reduce the greenhouse gas emissions that cause climate change.
- **Environmentally Prudent Development** conducts research on induced seismicity and wellbore integrity, as well as into water quality, water availability, air quality, and environmental impacts of oil and gas resource development.
- **Gas Hydrates R&D** aims to advance technologies that will enable natural gas production from domestic and arctic offshore methane hydrate deposits. Gas hydrates are methane molecules trapped in ice that turn into natural gas and water when heated or depressurized.

OIL AND GAS

Key Elements of the FY 2022 Budget Proposal

The budget proposal seeks $130 million for oil and gas RD&D activities, a 26 percent boost from FY 2021 enacted levels. Some highlights include:

- **A 260 percent increase to the Methane Emissions Quantification and Mitigation subprograms**, including an $11.5 million increase for emissions quantification from natural gas infrastructure and a $40.5 million increase for emissions mitigation from midstream infrastructure.[14]
- **A 133 percent increase to the Environmentally Prudent Development subprogram,** which would support research on solutions to mitigate the environmental impacts of natural gas production.[15]
- **A new Natural Gas Hydrogen Research subprogram,** which will focus on hydrogen production, transportation, and storage R&D, funded at $30 million.[16]
- **No funding for Gas Hydrates research.**[17]
- **No funding for the Unconventional Fossil Energy Technologies from Petroleum R&D program.**[18]

Further Reading

- Varun Sivaram et al., *Energizing America: A Roadmap to Launch a National Energy Innovation Mission* (ITIF and Columbia University SIPA Center on Global Energy Policy, 2020), http://www2.itif.org/2020-energizing-america.pdf.
- National Academies of Sciences, Engineering, and Medicine (NASEM), *Accelerating Decarbonization of the U.S. Energy System* (National Academies Press, 2021), https://doi.org/10.17226/25932.

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ENDNOTES

1. DOE, "FY 2016 Congressional Budget Justification," Volume 3, 603–610 (DOE Chief Financial Officer, DOE/CF-0109, February 2015), https://www.energy.gov/sites/prod/files/2015/02/f19/FY2016BudgetVolume3_7.pdf; Proposed changes to DOE oil and gas programs in FY 2017 through FY 2020 budget cycles have been rejected by congressional appropriators, so an earlier description of the program is used here.
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7. Consolidated Appropriations Act, 2021. Division Z, Sec. 4005., https://rules.house.gov/sites/democrats.rules.house.gov/files/BILLS-116HR133SA-RCP-116-68.pdf.

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15. Ibid.

16. Ibid, 243.

17. Ibid.

18. Ibid, 244.