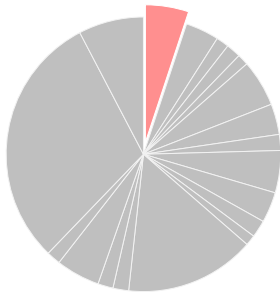




Federal Energy R&D: ARPA-E

BY COLIN CUNLIFF AND BATT ODGEREL | MARCH 2020

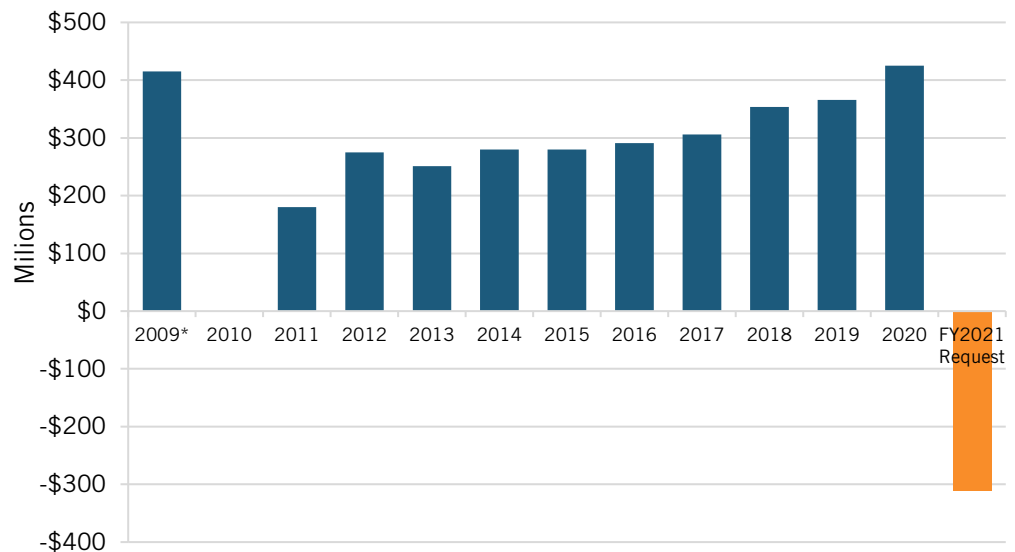
This briefing is part of a series on the U.S. energy budget. See: itif.org/energy-budget.



ARPA-E (pink)
Energy R&D (light grey)

Modeled after the highly successful Defense Advanced Research Projects Agency (DARPA), the Advanced Research Projects Agency-Energy (ARPA-E) advances high-potential, high-impact energy technologies that could radically improve U.S. economic prosperity, national security, and environmental well-being, but are too early for private-sector investment. Its grants help fund energy innovators that are developing technologies to solve critical cross-cutting, real-world problems in transportation, electricity, building, and other sectors.

Figure 1: The FY 2021 budget request would eliminate funding for ARPA-E¹



What's at Risk

Created by Congress in 2007, and funded for the first time in 2009, ARPA-E is an important new institution that has proven to be a valuable and versatile catalyst of energy innovation.² Compared with traditional research and development (R&D) programs, ARPA-E was designed to focus more on the potential impact of the research that it funds. To qualify for ARPA-E funding, each program must explain how its success will change the global energy landscape, identify the key barriers to making such a change, and lay out a set of milestones and metrics for assessing progress.

ARPA-E's high-risk/high-reward ventures are already yielding big returns. As of March 2020, ARPA-E had provided \$2.3 billion in R&D funding to over 850 projects; 161 ARPA-E projects had attracted more than \$3.2 billion in private-sector follow-on funding;

82 ARPA-E project teams had formed new companies to advance their technologies; and 219 ARPA-E projects had partnered with other government agencies for further development. Moreover, ARPA-E projects have generated 3,658 peer-reviewed journal articles, along with 385 new patents.³ According to a 2017 ITIF analysis, on average, firms funded by ARPA-E raise more private capital than other clean-energy start-up firms.⁴ The Bipartisan Policy Center noted that ARPA-E funded projects that would not have otherwise received funding and that other Department of Energy (DOE) offices have started to adopt ARPA-E's best practices.⁵ Congress has continuously shown bipartisan support for the agency.

The American Energy Innovation Act of 2020, introduced with broad bipartisan support, would increase the agency's budget to \$750 million by FY 2024.⁶ The FY 2021 budget's proposed elimination of ARPA-E would significantly undermine federal efforts to tackle urgent problems of energy supply, management, and use—and eliminate an important source of institutional innovation within DOE.

ARPA-E R&D Programs and Projects

ARPA-E funds are not bound by the technology-specific silos of DOE's applied-energy offices. Rather, ARPA-E's programs are developed by technical experts drawn from industry and academia who, during their three- or four-year terms as program managers, engage intensively with communities of researchers and innovators to create targeted, time-limited programs that seek to fill the "white space" of underexplored but potentially great ideas. In addition, ARPA-E holds open competitions every three years to bring to light promising ideas that might otherwise slip through the cracks between energy R&D programs.

ARPA-E currently funds 283 projects across 48 active programs, which are broadly organized into four areas: electricity generation; efficiency and emissions; transportation and storage; and grid and grid storage.⁷ These projects provide a sense of ARPA-E's accomplishments:

- **Primus Power**, which sells zinc-bromide flow batteries, was named one of the prestigious 2019 Global Cleantech 100 companies, and had raised almost \$100 million in equity investment as of late 2018. In June 2019, the California Energy Commission awarded Primus a \$4 million grant to increase the company's manufacturing capacity of EnergyPod 2, a long-duration, low-cost zinc bromide flow battery.⁸
- **Rebellion Photonics**, based in Houston, produced monitoring imagers that detect methane leaks in real time to reduce environmental effects from the gas supply chain. The company continued to make progress in its intelligent monitoring platform, the only of a kind that "visually identifies and quantifies gas releases," and demonstrated rapid growths in revenue before it was acquired by Honeywell in December 2019.⁹

- An ARPA-E-funded research team lead by Clemson University in South Carolina is developing resilient sorghum varieties that will be optimized for energy biomass production in the Southeast on land not suitable for food production.¹⁰

Key Elements of the FY 2021 Budget Proposal

ARPA-E would be completely eliminated. Additionally, the budget would rescind \$332 million of previously appropriated funding, taking advantage of the fact that ARPA-E has been slow to spend funds appropriated by Congress for FY 2018 and FY 2019. The Government Accountability Office found that the Trump administration had deliberately and unlawfully withheld ARPA-E from spending its FY 2017 appropriation—and this pattern may have been repeated in the last three years.¹¹ The Natural Resources Defense Council (NRDC) found that, as of December 10, 2018—more than two months after the end of fiscal year 2018—ARPA-E had been unable to spend some \$280 million (79 percent) of its \$353 million FY 2018 research budget, and had not even begun to spend its FY 2019 research, development, and demonstration budget.¹² More recently, NRDC estimated that, as of February 2020, ARPA-E had only allocated 32–52 percent of its FY 2019 funds.¹³

ENDNOTES

1. In 2009, ARPA-E received \$15 million in regular appropriations and \$400 million in one-time funding pursuant to the American Recovery and Reinvestment Act. The FY 2021 budget proposes eliminating ARPA-E and cancelling \$332 million in previously appropriated funding. Department of Energy, “FY 2021 Congressional Budget Request: Budget in Brief” (DOE CFO, February 2020), p 75, https://www.energy.gov/sites/prod/files/2020/02/f71/doe-fy2021-budget-in-brief_1.pdf.
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3. ARPA-E, “ARPA-E Impact,” accessed March 16, 2020, <https://arpa-e.energy.gov/?q=site-page/arpa-e-impact>; see also National Academies of Science, Engineering and Medicine (NASEM), Committee on Evaluation of the Advanced Research Projects Agency-Energy (ARPA-E), Board on Science, Technology, and Economic Policy, “An Assessment of ARPA-E” (Washington, D.C.: National Academies Press, 2017).
4. Hart and Kearney, “ARPA-E: Versatile Catalyst for U.S. Energy Innovation.”
5. Erin Smith and Addison Stark, “ARPA-E at 10.” (Bipartisan Policy Center, April 2019), <https://bipartisanpolicy.org/blog/arpa-e-at-10/>
6. See American Energy Innovation Act of 2020, S. 2657, 116th Cong. (2020) , accessed March 10, 2020, https://www.energy.senate.gov/public/index.cfm?a=files.serve&File_id=09AF16B7-1920-4C22-96E2-26039A24B55D; American Institute of Physics, “ARPA-E Reauthorization Act - H.R.4091 / S.2714,” accessed February 18, 2020, <https://www.aip.org/fyi/federal-science-bill-tracker/116th/arpa-e-reauthorization-act>; House Science Committee, “Chairwoman Johnson Introduces ARPA-E Reauthorization” (Washington, D.C., July 2019), <https://science.house.gov/news/press-releases/chairwoman-johnson-introduces-arpa-e-reauthorization>.
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8. California Energy Commission, “Minutes of June 12, 2019, Energy Commission Business Meeting” (California, June 2019), https://www.energy.ca.gov/sites/default/files/2019-07/2019-06-12_Minutes.pdf.
9. Honeywell, “Honeywell Acquires Rebellion Photonics, a Leader in Intelligent, Automated, Visual Gas Monitoring Solutions” (Charlotte, NC, December 2019), <https://www.honeywell.com/en-us/newsroom/pressreleases/2019/12/honeywell-acquires-rebellion-photonics-a-leader-in-intelligent-automated-visual-gas-monitoring-solutions>; ARPA-E, “Rebellion Photonics (MONITOR)” (DOE, May 2018), <https://arpa-e.energy.gov/?q=impact-sheet/rebellion-photonics-monitor>; Olivia Pulsinelli, “Honeywell Acquires Fast-Growing Houston-Based Energy Tech Co.” (*Houston Business Journal*, December 2019), <https://www.bizjournals.com/houston/news/2019/12/18/honeywell-acquires-fast-growing-houston-based.html>.
10. “ARPA-E Impacts: A Sampling of Project Outcomes, Volume III,” edited by Dr. Yanzhi Ann Xu (ARPA-E, 2018), p 41, <https://arpa-e.energy.gov/sites/default/files/documents/files/ARPA-E-Impact-Book-Volume-3-Final-May10.pdf>.
11. U.S. Government Accountability Office (GAO), “Impoundment of the Advanced Research Projects Agency-Energy Appropriation Resulting from Legislative Proposals in the President’s Budget Request for Fiscal Year 2018” (GAO, December 12, 2017), <https://www.gao.gov/products/B-329092>.
12. Jackie Wong and Madhur Bloor, “DOE Stalls Clean Energy R&D: Risking Jobs & Competitiveness” (Natural Resources Defense Council, December 10, 2018), <https://www.nrdc.org/experts/jackie-wong/doe-stalls-clean-energy-rd-risking-jobs-competitiveness>.
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