

Energy Storage RD&D in the Fiscal Year 2020 Budget Proposal

DAVID M. HART | MARCH 2019

Federal funding for energy storage RD&D is more vital than ever. The administration's budget proposal for fiscal year 2020 includes a new advanced energy storage initiative with laudable goals, but insufficient funding and inadequate reach across federal agencies.

KEY TAKEAWAYS

- The Trump administration's fiscal year 2020 budget proposal would devote \$158 million to establish an advanced energy storage initiative within the Department of Energy (DOE).
- This initiative is a welcome, but inadequate response to the urgent need to expand and better coordinate federal investment in energy storage research, development, and demonstration (RD&D).
- The initiative's proposed budget would likely represent a cut from current levels, while limiting the effort to DOE would miss an opportunity to strengthen synergies across agencies, particularly between DOE and the Department of Defense.
- ITIF calls on Congress to expand the federal energy storage RD&D budget and to press the administration to develop a whole-of-government strategy and build international cooperation in this important field.

THE ENERGY STORAGE IMPERATIVE

Electrification is a 21st century energy mega-trend. Established energy end uses like transportation and heating must shift from fossil-fuel dependence to carbon-free electricity to protect civilization from the worst consequences of climate change. Most new energy end uses, especially those enabled by the continuing global revolution in information and communications technology—from robots to drones to the Internet of Things—require a reliable supply of affordable, clean electricity.

One of the biggest technological challenges presented by electrification is energy storage. Electricity systems at any scale must always balance supply and demand. Imbalances can cause problems. For example, a home powered only by a windmill would lose its air conditioning on a hot, calm day, just when the demand is highest. The same home may have to discard power when it is most easily supplied, such as on a windy night when demand is low because the lights are out and appliances are off. A home battery would solve such problems, but in the past it has been too costly to afford.

The same logic applies at a grander scale. The high cost of batteries and other energy storage technologies has stymied widespread adoption of electric vehicles (EVs) and could slow the growth of renewables in the future. While rapid decreases in the cost of lithium-ion (Li-ion) batteries (made possible in part by decades of public research funding) have made home batteries, EVs, and short-duration grid-scale storage systems more affordable and practical, these products are not yet fully cost-competitive in many circumstances and suffer from significant drawbacks in safety and durability, as any cellphone user can attest. In addition, Li-ion batteries will not work for large-scale, long-duration energy storage, which is becoming increasingly valuable as renewables reach higher penetration levels. Moreover, the proliferation of grid-connected batteries and other storage devices will create new challenges for grid operations that require careful analysis and planning to solve. It is not too much of a stretch to say that our economic and environmental future depend on solving these diverse and complex energy storage challenges. Ambitious, well-focused federal investment in energy storage research, development, and demonstration (RD&D) is more vital than ever.

FEDERAL ENERGY STORAGE RD&D PROGRAMS

Energy storage spans diverse technologies and applications, so federal RD&D relevant to it is dispersed across the government. An August 2012 report from the Government Accountability Office identified 39 energy storage initiatives in six agencies.¹ Within the Department of Energy (DOE), which carries out the bulk of this work, several major units are involved, which is also case in the Department of Defense (DOD).²

Within DOE³.

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- The Office of Energy Efficiency and Renewable Energy's (EERE's) Hydrogen and Fuel Cell Technologies Office provides R&D funding for methods to use hydrogen as a storage medium that can be efficiently produced by and converted back into electricity.
- EERE's Solar Energy Technologies Office supports R&D on thermal-energy storage and its integration into concentrating solar power systems.
- EERE's Vehicles Technologies Office explores new battery chemistry and cell technologies to reduce the cost of electric vehicle batteries.
- EERE's Water Power Technologies Office invests in closed-loop pumped-hydro storage designs.
- The Office of Science's (SC's) Basic Energy Sciences program funds fundamental science underlying storage technologies, including the Joint Center for Energy Storage Research (JCESR) headquartered at Argonne National Laboratory.
- The Advanced Research Projects Agency–Energy (ARPA-E) has put about 10-15 percent of its budget into energy storage over the course of the past decade, including the DAYS program, initiated in 2018 to support R&D on a diverse portfolio of long-duration storage technologies.

Beyond DOE⁴.

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- DOD's Base Power warfighter opportunity area works with commercial suppliers to demonstrate longer-duration, lower-cost microgrid and storage technologies.
- DOD's Autonomous System Power warfighter opportunity area is pursuing batteries with improved energy and power density as well as the ability to recharge quickly and over long distances.
- Basic research in material science, chemistry, and other disciplines that may contribute to improved energy storage technology is supported by the National Science Foundation and National Aeronautics and Space Administration as well as DOD and DOE.

THE FEDERAL ENERGY STORAGE RD&D BUDGET

Energy storage spans diverse technologies and applications, so federal RD&D relevant to it is dispersed across the government. An August 2012 report from the Government Accountability Office identified 39 energy storage initiatives in six agencies.¹ Within the Department of Energy (DOE), which carries out the bulk of this work, several major units are involved, which is also case in the Department of Defense (DOD).²

While it is possible to identify which agencies and programs support energy storage RD&D, total federal spending in this field cannot be estimated precisely. Investments in fundamental research are intrinsically difficult to categorize, since a single scientific breakthrough may impact multiple technologies, including energy storage technologies. Adding to the difficulty, storage RD&D is sometimes a component of a larger system development effort, such as in concentrating solar power RD&D, or a set of projects within a broader program, such as pumped-hydro storage within water power RD&D, neither of which is reported independently for budget purposes.

In 2015, the Office of Management and Budget conducted a formal interagency “crosscut” and estimated that approximately \$300 million was spent on energy storage RD&D in that year.⁵ The 2015 crosscut remains the most comprehensive accounting of this federal investment. In his oral testimony before the Senate Committee on Energy and Natural Resources in November 2018, Undersecretary of Energy Mark Menezes endorsed the \$300 million figure as consistent with the Trump administration’s energy storage RD&D strategy.⁶

The administration’s budget proposal for fiscal year 2020 features a \$158 million Advanced Energy Storage Initiative (AESI) within DOE, including \$5 million for a grid-scale battery testing center and \$15 million for experimental microgrid testing. “Building on current applied energy program activities,” the proposal states, “this initiative would develop a coordinated strategy for aligning DOE R&D and establish aggressive, yet achievable goals for cost competitive energy storage services.”⁷ AESI will be jointly led by OE and EERE. The proposal’s emphasis on cost-competitiveness is laudable, since electricity provision is largely a commodity business in which the lowest cost provider has a great advantage in the market.

The AESI encompasses the Fossil and Nuclear Energy Offices as well as OE and EERE, although the information available to date provides few details about their participation.⁸ Offices with preexisting energy storage RD&D programs within EERE, including Solar, Vehicle, and Water Technologies, will participate in the initiative, as well as others with less well-established interests in the field, like Buildings, Geothermal, and Wind Technologies.⁹ Surprisingly, considering that 2018 DOE Research and Innovation Act requires DOE to establish an Electricity Storage Research Initiative spanning EERE and SC, the AESI does not extend to SC’s fundamental research program.¹⁰

The relatively broad scope and focused goals of the AESI are offset by its meager budget. The 5 percent increase proposed for the OE Energy Storage Program, which would take its budget to

\$48.5 million in 2020, is not representative of all programs involved in the initiative. Indeed, the research budget of this program would actually be cut by \$2.5 million even as the program receives \$5 million to construct the AESI's battery testing center.¹¹ Even the addition of energy storage research supported by SC, including \$24 million for JCESR along with a variety of other projects, to the initiative's \$158 million budget would not likely bring the department-wide total to the \$300 million level endorsed by Undersecretary Menezes. It is worth recalling that even that level would show zero nominal growth since 2015, losing real purchasing power to inflation over the past five years.

If DOE were merely phasing out RD&D for mature technologies that benefit from thriving private investment, such as some forms of mass-produced Li-ion battery cells, such a cut might be defensible. However, the proposal appears to go far beyond a healthy pruning of DOE's program. For instance, the administration proposes to eliminate ARPA-E altogether, even though its programs last for only three or four years and are regularly refocused on key emerging needs and opportunities. ARPA-E's most recent energy storage R&D program addressed the vital problem of long-duration grid storage, which had not been getting adequate attention from other DOE programs.¹² An evaluation of ARPA-E by the National Academies of Sciences, Engineering, and Medicine concluded that its prior funding of energy storage R&D had been "highly productive with respect to accelerating commercialization" and led to the formation of at least six new companies in the field.¹³

Although the elimination of ARPA-E is the most egregious example, the proposal also calls for major cuts in almost every office other than OE that would participate in the AESI, including:

- 86 percent for EERE as a whole
- 63 percent for Hydrogen and Fuel Cell Technologies
- 73 percent for Solar Energy
- 78 percent for Vehicle Technologies
- 57 percent for Water Power

Even SC, which is favored by the administration's focus on early stage research, faces a 16 percent cut, including 14 percent for Basic Energy Sciences, which administers most fundamental research projects related to energy storage.¹⁴

In addition to expanding the budget for the DOE offices participating in the AESI, the initiative might be extended to a broader group of players. Within DOE, the Advanced Manufacturing Office could be added to support RD&D that would raise the odds that production of new energy storage systems would be located in the United States. Investing now in manufacturing processes and technologies could avert the migration of production abroad in the future, which has largely been the fate of Li-ion batteries, most of which are made in Asia, even though much foundational work on that technology was done by U.S. researchers.

While DOD pursues energy storage RD&D to support its national security mission, civilian applications would benefit from tighter linkages between DOD and other agencies, which the AESI could foster. A recent report for ITIF by former DOD senior officials Dorothy Robyn and Jeffrey Marqusee noted particular opportunities for interagency partnerships to demonstrate innovative stationary energy storage systems as well as to collaborate on fundamental R&D.¹⁵ The White House's National Science and Technology Council should convene a working group that includes NSF, NASA, and other agencies along with DOD and DOE to strengthen horizontal linkages for information exchange and coordination.

Finally, the administration's initiative should explicitly incorporate international cooperation. The United States does not have a monopoly on energy storage technologies—far from it. The first liquid-air storage facility opened in 2018 in the United Kingdom, while China is constructing the world's largest flow battery. Although countries and companies may compete to control energy storage technologies as they reach the market, deepening the global pool of fundamental knowledge relevant to this challenge would benefit everyone. The United States should propose and take leadership of a new challenge on long-duration grid storage within the international Mission Innovation framework.¹⁶

CONCLUSION

Energy storage spans diverse technologies and applications, so federal RD&D relevant to it is dispersed across the government. An August 2012 report from the Government Accountability Office identified 39 energy storage initiatives in six agencies.¹ Within the Department of Energy (DOE), which carries out the bulk of this work, several major units are involved, which is also case in the Department of Defense (DOD).²

The administration's proposal for an advanced energy storage initiative within DOE is a welcome but inadequate response to the urgent need to expand and better coordinate federal investment in energy storage RD&D. The initiative's \$158 million budget would likely represent a cut from current levels, while limiting the effort to DOE would miss an opportunity to strengthen synergies across agencies, particularly between DOE and DOD. ITIF calls on Congress to expand the federal energy storage RD&D budget and to press the administration to develop a whole-of-government strategy and build international cooperation in this important field.

ENDNOTES

1. Government Accountability Office, “Batteries and Energy Storage: Federal Initiatives Supported Similar Technologies and Goals but Had Key Differences,” August 2012, <http://www.gao.gov/products/GAO-12-842>. This report identified a single storage RD&D program at both NIST and EPA, and these agencies are not covered further in this report.
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4. Dorothy Robyn and Jeffrey Marqusee, “The Clean Energy Dividend: Military Investment in Energy Technology and What It Means for Civilian Energy Innovation,” Information Technology and Innovation Foundation, March 5, 2019, <https://itif.org/events/2019/03/05/taking-fight-energy-innovation-what-military-investment-energy-innovation>
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8. DOE's Congressional budget justification for Fossil Energy for fiscal year 2020 designates \$4.5 million for “Crosscutting research and analysis...on thermal, mechanical, and/or chemical storage that can be feasibly and economically integrated with existing and future fossil energy power systems.” *DOE FY2020 Congressional Budget Request*, vol. 3, part 1, p. 442, https://www.energy.gov/sites/prod/files/2019/03/f61/doe-fy2020-budget-volume-3-part-1_2.pdf
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10. PL 115-246, Section 303, <https://www.congress.gov/bill/115th-congress/house-bill/589>
11. DOE, “Department of Energy FY 2020 Summary Control Table by Organization,” <https://www.energy.gov/sites/prod/files/2019/03/f61/doe-fy2020-control-table-by-organization.pdf>, 4.
12. ARPA-E, “DAYS” – Project Descriptions, September 2018, https://arpa-e.energy.gov/sites/default/files/documents/files/DAYS_Project_Descriptions_FINAL.pdf
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14. DOE, *Budget in Brief*, 14, 48. The proposed budget cuts to EERE's component offices are actually more severe than these figures suggest, because the administration counts on carrying forward funds that were unspent in fiscal 2019.
15. Robyn and Marqusee, "Clean Energy Dividend."
16. David M. Hart and Spencer Nelson, "Long-Duration Energy Storage R&D: An Opportunity for American Climate Leadership," *Utility Dive*, December 14, 2018, <https://www.utilitydive.com/news/long-duration-energy-storage-rd-an-opportunity-for-american-climate-leade/544333/>

ACKNOWLEDGMENTS

The author thanks Rob Atkinson, Randolph Court, Colin Cunliff, Arjun Krishnaswami, and Faith Smith for helpful comments.

ABOUT THE AUTHOR

David M. Hart is a senior fellow at ITIF and director of the Center for Science, Technology, and Innovation Policy at George Mason University's Schar School of Policy and Government, where he is professor of public policy. Hart is the author of numerous ITIF reports, academic journal articles, and books, including *Unlocking Energy Innovation* (MIT Press, coauthored with Richard K. Lester).

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