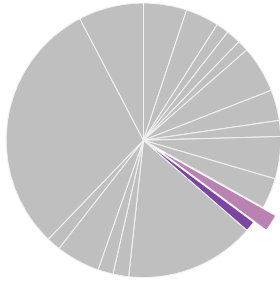




# Federal Energy R&D: Grid Modernization

BY COLIN CUNLIFF | APRIL 2019

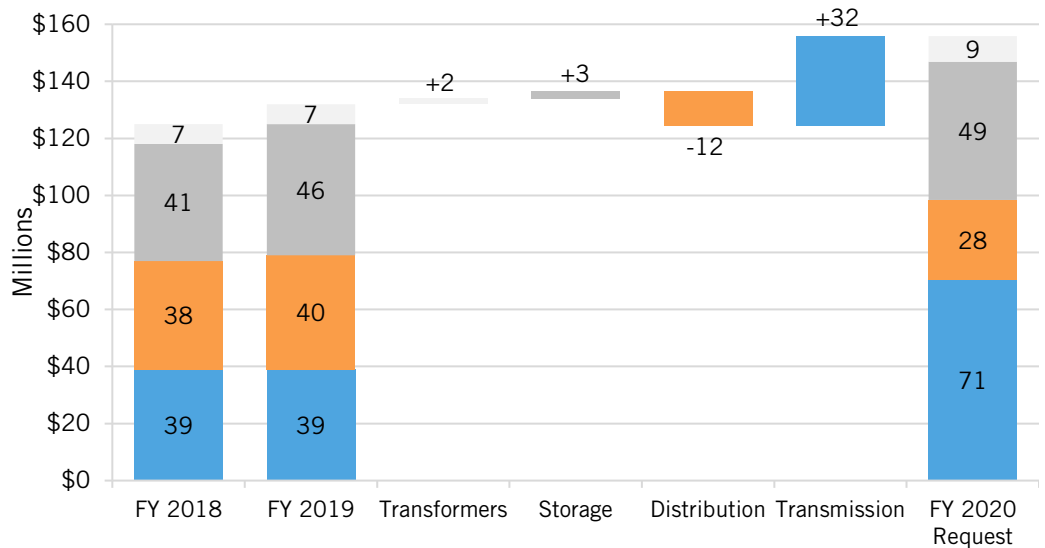
*This briefing is part of a series on the U.S. energy budget. See: [itif.org/energy-budget](http://itif.org/energy-budget).*



Grid Mod (lavender)  
Energy TS&D  
Energy R&D (light gray)

The grid modernization R&D programs in the Office of Electricity (OE) accelerate discovery and innovation in electric transmission and distribution technologies to incorporate greater levels of distributed and variable energy resources, provide enhanced connectivity between systems and devices, and improve reliability and resilience. OE seeks to provide solutions to market, institutional, and operational failures that go beyond any one utility’s ability to solve.<sup>1</sup> The program’s work on resilience, threat assessment, risk management, and grid hardening is motivated by natural disasters, such as hurricanes Harvey and Maria and Superstorm Sandy, as well as the 2013–2015 drought and accompanying wildfires in the western United States. The OE-funded R&D into energy-storage technologies aims to enable greater stability, resiliency, and reliability in the electric grid, while also supporting increasing levels of variable renewable energy sources such as wind and solar.<sup>2</sup>

**Figure 1: The FY 2020 Budget Request Would Increase Grid Modernization R&D by 18 Percent.<sup>3</sup>**



## What’s At Stake

Grid modernization is critical to ensuring reliable and affordable energy delivery, sustaining economic growth, and mitigating risks to the security of the grid and other vital sectors that depend on the grid’s services. In collaboration with the utility industry, DOE established the Grid Modernization Initiative to coordinate R&D activities. Through the

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initiative, a multiyear R&D roadmap outlining six technical areas (devices and integrated systems testing; sensing and measurements; system operations, power flow, and control; design and planning tools; security and resilience; and institutional support) that industry and government should jointly pursue to establish a resilient, secure, sustainable, and reliable grid was created.<sup>4</sup> For its part, DOE has set aggressive targets and performance measures in reliability and resilience, as well as cost and performance targets for new grid-storage technologies.<sup>5</sup>

### Grid Modernization R&D Subprograms

Grid modernization R&D is made up of four main subprograms:<sup>6</sup>

- **Transmission Reliability and Resilience (TRR)** focuses on ensuring the reliability and resilience of the U.S. electric grid through R&D on measurement and control of the electrical system, and risk assessments to address challenges across integrated energy systems.
- **Resilient Distribution Systems (RDS)** pursues strategic R&D to improve reliability, resiliency, outage recovery, and operational efficiency of the distribution portion of the electricity-delivery system, with a focus on improved resilience against extreme weather and other natural and man-made hazards.
- **Energy Storage** focuses on the development of new materials and device technologies that both improve the cost and performance of utility-scale energy-storage systems and better integrate storage into the grid infrastructure.
- **Transformer Resilience and Advanced Components (TRAC)** supports modernization, hardening, and resilience of grid components, including transformers, power lines, and substation equipment.

### Key Elements of the FY 2020 Budget Proposal<sup>7</sup>

- **An 81-percent increase in Transmission Reliability and Resilience**, including the development of an integrated North American Energy Resiliency Model (NAERM) to improve planning and contingency analyses that address energy system vulnerabilities; new R&D efforts on transmission sensors and data analytics; and reduced activities in synchrophasor tools.
- **A 30-percent reduction in Resilient Distribution Systems**, with ongoing support for the development of GridAPPS-D, an open-source advanced distribution management system that can manage greater levels of distributed energy resources (DERs), and a discontinuation of R&D activities in advanced low-cost distribution sensors, and university-based R&D of sensing, intelligent machines in the Internet of Things.
- **A 5-percent increase in Energy Storage**, including \$5 million for design and construction planning of a new Grid Storage Launchpad to accelerate materials

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development, testing, and evaluation of battery materials and systems; and a \$2.5 million decrease in research in next-generation flywheels, storage valuation models, and the development of “second use” grid applications for batteries from retired electric vehicles.<sup>8</sup>

- **A 29-percent increase in Transformer Resilience and Advanced Components**, which currently conducts research on grid-component vulnerabilities to geomagnetic disturbances (GMD) and electromagnetic pulses (EMP), as well as R&D on improving the resilience of large power transformers—which are one of the most vulnerable components of the grid and would pose a significant risk to the nation in the event of multiple failures.<sup>9</sup>

## ENDNOTES

1. For example, individual utilities and grid operators lack the wide-area visibility that could have minimized the 2003 Northeast blackout, or the modeling and analytical tools identified as necessary for containing the 2011 Southwest blackout.
2. DOE, “FY 2020 Congressional Budget Request,” Volume 3 Part 1, DOE/CF-0152 (Washington, D.C.: DOE Chief Financial Officer, March 2019), 9-43, [https://www.energy.gov/sites/prod/files/2019/03/f61/doe-fy2020-budget-volume-3-part-1\\_2.pdf](https://www.energy.gov/sites/prod/files/2019/03/f61/doe-fy2020-budget-volume-3-part-1_2.pdf).
3. DOE, FY 2020 Congressional Budget Request Volume 3 Part 1, 13.
4. DOE, “Grid Modernization Multi-Year Program Plan” (Washington, D.C.: November 2015), <https://www.energy.gov/sites/prod/files/2016/01/f28/Grid%20Modernization%20Multi-Year%20Program%20Plan.pdf>.
5. DOE, “Fiscal Year 2017 Annual Performance Report / Fiscal Year 2019 Annual Performance Plan,” 92-97, (DOE Chief Financial Officer DOE/CF-0147) <https://www.energy.gov/sites/prod/files/2018/11/f57/fy-2017-doe-annual-performance-report-fy-2019-annual-performance-plan.pdf>.
6. DOE, FY 2020 Congressional Budget Request Volume 3 Part 1, 9-43.
7. DOE, FY 2020 Congressional Budget Request Volume 3 Part 1, 9-43.
8. David M. Hart, “Energy Storage RD&D in the Fiscal Year 2020 Budget Proposal,” (Information Technology and Innovation Foundation, March 2019), <https://itif.org/publications/2019/03/27/energy-storage-rdd-fiscal-year-2020-budget-proposal>.
9. DOE, “Strategic Transformer Reserve Report to Congress” (Washington, D.C.: March 2017), <https://www.energy.gov/oe/downloads/strategic-transformer-reserve-report-congress-march-2017>.

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## **ABOUT THE AUTHOR**

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