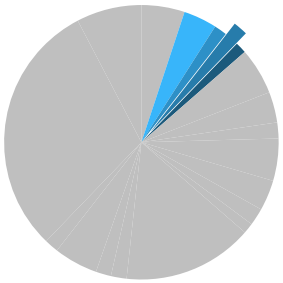
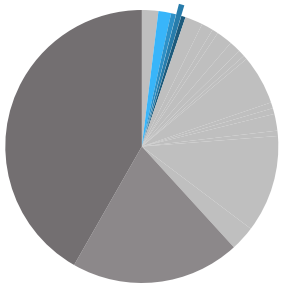
Federal Energy R&D: Water Power

BY DAVID M. HART AND COLIN CUNLIFF | APRIL 2018

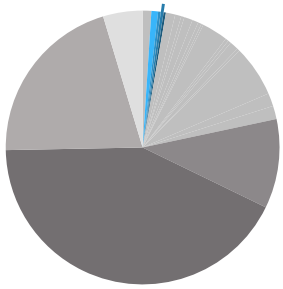
This briefing is part of a series on the U.S. energy budget. See: itif.org/energy-budget.



Water (blue)
Other Renewables (blue)
Energy R&D (light gray)



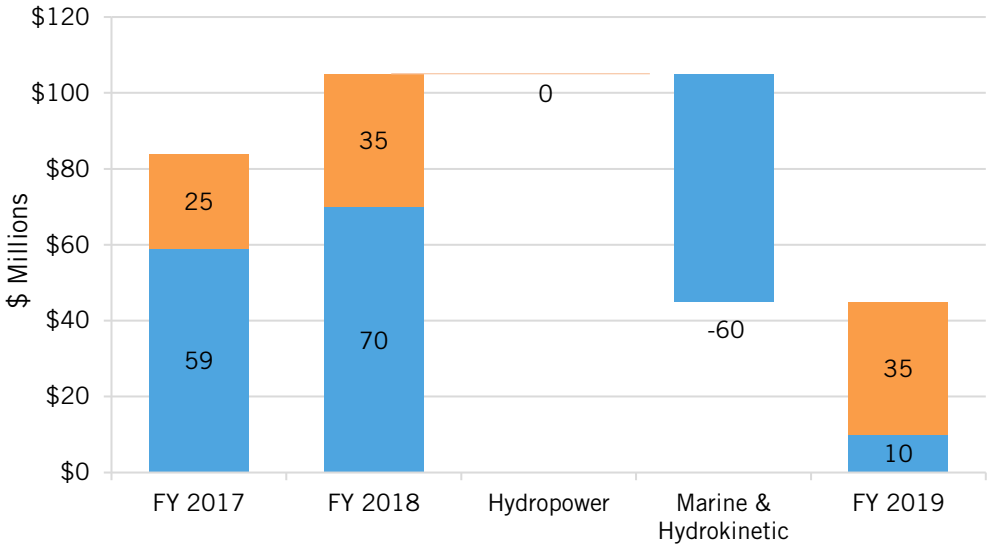
Water & Energy R&D
Basic Science R&D
Defense R&D



Water & Energy
Basic Science
Defense
Environ Mngmt
Other DOE

The Department of Energy's (DOE) Water Power program supports research and development (R&D) of two types of technologies: conventional hydropower (including pumped storage), and marine and hydrokinetic (MHK) energy. Conventional hydropower uses a dam or other structure to convert the kinetic energy of flowing water into electricity, while MHK technologies convert the energy of waves, tides, and currents into electricity.

Figure 1: The FY 2019 Budget Request Would Cut Water Power R&D by 57 Percent



What's At Risk

DOE's 2016 "Hydropower Vision" report identified up to 50 GW of new hydropower capacity that could be gained from upgrading and modernizing the existing fleet, installing generation on non-powered dams, and developing new, small hydropower and pumped-storage technologies.[1] Near-term growth of hydropower generation through 2030 is estimated at 9.4 GW, while approximately 16.2 GW in new pumped-storage hydropower could also become available. However, new technologies and system-design concepts are needed to reduce costs and improve efficiency in order to realize this potential.

National resource assessments have found 1.25–1.85 terawatt-hours per year (TWh/yr) of untapped, technically extractable MHK potential, or the equivalent of 30 percent of the total electricity generated in the United States.[2] MHK technologies are at an early stage of development due to the fundamental scientific and engineering challenges of generating

power from complex low-velocity/high-density dynamics in a corrosive ocean environment. Although they could potentially provide a low-carbon energy alternative for the 28 coastal and Great Lake states, additional cost reductions are needed to make MHK cost competitive with other sources of electricity. The proposed budget cuts threaten to stall the progress currently being made to extract significant energy value from this rich national resource.

Water Power R&D Subprograms

R&D in the Water Energy program is spread across two subprograms:

- **Hydropower R&D** seeks to reduce the site-specific costs of construction, powerhouse design/installation, and environmental mitigation of new hydropower at non-powered dams; develop turbine designs that generate more power at given water flows or increase operational ranges with reduced impacts for existing hydropower facilities; optimize modes of operation for grid stabilization; and develop novel closed-loop pumped-storage designs that can be deployed at a wider range of sites.

- **Marine and Hydrokinetic (MHK) Technologies** focuses on researching controls to maximize power production over a range of ocean conditions; improving and validating modeling tools and methodologies to optimize device and array performance and reliability across operational and extreme conditions; and investigating new approaches to safe and cost-efficient installation, grid integration, operations, maintenance, and decommissioning of MHK projects. MHK is currently developing an open-water wave-energy test facility—to be completed in 2021—that will allow testing and validation of industry-developed MHK energy-conversion components and systems.

Key Elements of the FY 2019 Budget Proposal

- **An 86-percent reduction in the MHK Technologies subprogram**, including a discontinuation of competitive industry-led RD&D of ocean, river, and tidal-energy-conversion components and systems. This subprogram also houses RD&D in advanced materials and structural-health monitoring; a joint DOE/Navy project targeting advanced controls for wave-energy-conversion technologies; and development of wave-classification metrics and site-specific wave-energy characterization.

- **Flat spending on Hydropower RD&D**, including increased funding for pumped-storage hydropower R&D, and R&D into modular hydropower technologies. The proposal would discontinue funding for techno-economic analysis of the value of pumped-storage hydropower coupled to areas with high levels of variable and renewable electricity generation.

ENDNOTES

1. DOE, "Hydropower Vision: A New Chapter for America's 1st Renewable Electricity Source" (Washington, D.C.: DOE, July 2016). https://www.energy.gov/sites/prod/files/2018/02/f49/Hydropower-Vision-021518.pdf.
2. DOE, "Quadrennial Technology Review" (Washington, D.C.: DOE, September 2015), https://www.energy.gov/sites/prod/files/2017/03/f34/quadrennial-technology-review-2015_1.pdf.

ABOUT THE AUTHORS

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