INFORMATION TECHNOLOGY & INNOVATION FOUNDATION

Federal Energy R&D: Water Power

BY COLIN CUNLIFF | APRIL 2019

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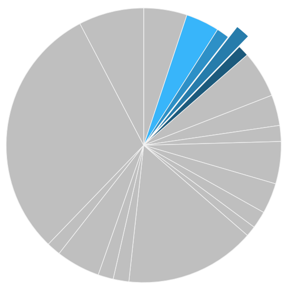
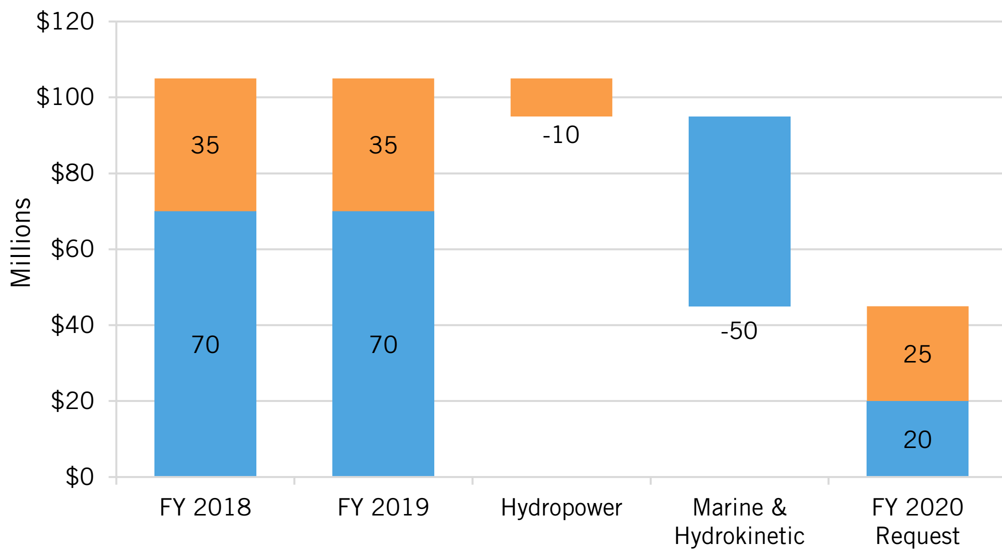


Water (blue)
Other Renewables (blue)
Energy R&D (light grey)

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.[1]

Figure 1: The FY 2020 Budget Request Would Cut Water Power R&D by 57 Percent.[2]



What's At Risk

Hydropower is the largest source of renewable energy, providing 7 percent of the nation's electricity (and 19 percent of its carbon-free electricity) in 2018.[3] However, installed capacity of conventional hydropower and pumped storage hydropower has stalled at about 100 gigawatts (GW), and innovation is needed to jumpstart growth in hydropower. 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. 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. New technologies and system-design concepts are needed to reduce costs and improve efficiency in order to realize this potential.[4]

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.[5] 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 MHK technologies could potentially provide a low-carbon energy alternative for the 28 coastal and Great Lake states, additional cost reductions are needed to make them cost competitive with other sources of electricity.

Additionally, marine energy can provide new capabilities, such as onboard energy generation and remote recharging, in areas far from land-based power grids. In April 2019, DOE released a new report "Powering the Blue Economy" that identifies non-grid applications and opportunities for marine renewable energy to tap into new markets and provide new energy services.[6] However, 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:[7]

- **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.[8] MHK is also exploring the ability of marine energy to provide non-grid energy services in areas where access to an electric grid is limited.[9]

Key Elements of the FY 2020 Budget Proposal[10]

- **A 72-percent reduction in the MHK Technologies subprogram**, including reduced funding to test and validate performance of wave devices at the PacWave test facility, as well as elimination of funding for advanced materials, MHK device components, system design and validation, and infrastructure upgrades at the National Marine Renewable Energy Centers.

- **A 29-percent reduction in the Hydropower Technologies subprogram**, including reduced R&D funding for advanced manufacturing techniques for modular hydropower and elimination of incentives for deployment of hydropower at existing non-powered dams would be eliminated. Increased funding for pumped-storage hydropower R&D in support of the Advanced Energy Storage Initiative would offset these cuts.

ENDNOTES

1. DOE, "About the Water Power Program," https://www.energy.gov/eere/water/about-water-power-program, accessed April 3, 2019.
2. The FY2020 budget for EERE would use $353 million in prior year (FY 2018 and FY 2019) balances to fund FY2020 programs. Thus the numbers shown in the figure underestimate the magnitude of cuts included in the proposed budget. Department of Energy, "FY 2020 Congressional Budget Request: Budget in Brief," (DOE CFO, March 2019), p 3, https://www.energy.gov/sites/prod/files/2019/03/f60/doe-fy2020-budget-in-brief.pdf; DOE, "FY 2020 Congressional Budget Justification" Volume 3 Part 2, 136 (DOE Chief Financial Officer DOE/CF-0153, April 2019), https://www.energy.gov/sites/prod/files/2019/04/f61/doe-fy2020-budget-volume-3-part-2_0.pdf.
3. Energy Information Administration, Monthly Energy Review Table7.2a, https://www.eia.gov/totalenergy/data/monthly/, accessed April 3, 2019.
4. 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.
5. 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.
6. DOE, "Powering the Blue Economy: Exploring Opportunities for Marine Renewable Energy in Maritime Markets," (DOE EERE, April 2019), https://www.energy.gov/sites/prod/files/2019/03/f61/73355.pdf.
7. DOE, "FY 2019 Congressional Budget Justification" Volume 3 Part 2, 147-159, (DOE/CF-0141, March 2018) https://www.energy.gov/sites/prod/files/2018/03/f49/FY-2019-Volume-3-Part-2.pdf.
8. DOE, "PacWave," https://www.energy.gov/eere/water/pacwave, accessed April 3, 2019.
9. DOE, "Powering the Blue Economy."
10. DOE, "FY 2020 Congressional Budget Justification," Volume 3 Part 2, 133-148.

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