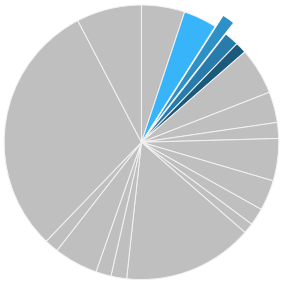
Federal Energy R&D: Wind Energy

BY COLIN CUNLIFF AND BATT ODGEREL | MARCH 2020

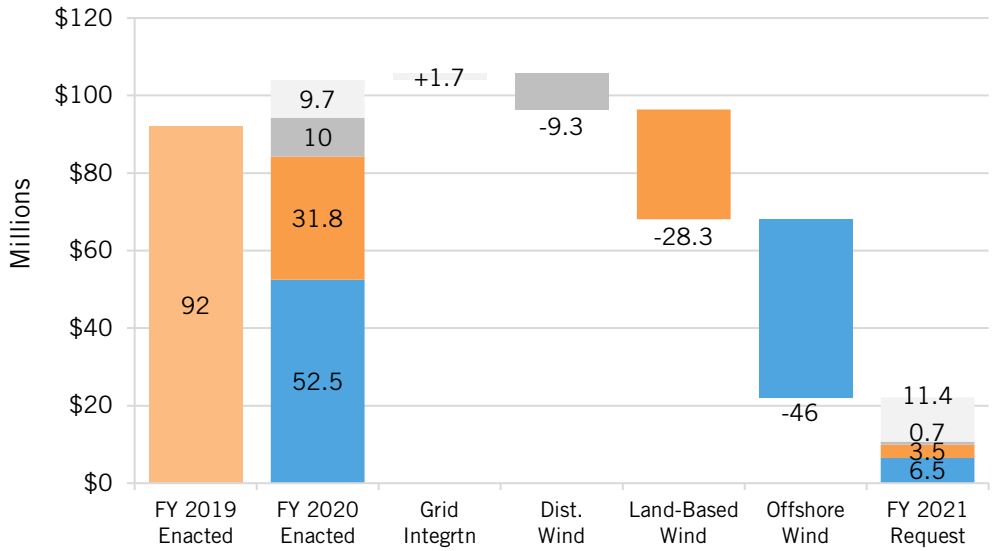
This briefing is part of a series on the U.S. energy budget. See: itif.org/energy-budget.



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

The Department of Energy's (DOE) Wind Energy program targets innovations in onshore, offshore, and distributed wind power to capture the kinetic energy in wind and turn it into electricity via spinning generators. The program also works to integrate wind generation more effectively into the bulk power system to enable wind farms to provide more reliable power output and essential reliability services to the grid.[1]

Figure 1: The FY 2021 budget request would cut wind energy R&D by 74 Percent.[2]



What's at Risk

DOE's Wind Energy program has already achieved substantial cost reductions and technology improvements that have enabled the rapid expansion of land-based wind power. The cost of energy from land-based wind power has decreased from more than 55 cents per kilowatt-hour ($0.55/kWh) in 1980 to a national average for new wind projects built in 2018 of $0.036/kWh, thus enabling the expansion of wind power to more than 40 states.[3] DOE should build on this success to improve performance and reduce costs much further until unsubsidized wind power becomes competitive across more parts of the country. DOE's "Wind Vision" report provides a path to reducing the cost of energy from unsubsidized land-based wind to $0.023/kWh and achieving a 50 percent reduction from the 2017 level in the cost of energy from offshore and distributed wind by 2030. Achieving these goals could enable up to 200 gigawatts (GW) of total wind capacity by 2030, thereby contributing to energy affordability and security while also reducing carbon emissions.[4]

The nascent offshore wind industry is also beginning to take off, with 25,824 megawatts (MW) of new offshore wind capacity in the development and operational pipeline as of 2018, of which 2,043 MW have begun permitting processes for construction.[5] In 2019, DOE, along with the New York State Energy R&D Authority (NYSERDA), committed $20.5 million to form a National Offshore Wind R&D Consortium. NYSERDA agreed to match the DOE commitment and has released the solicitation for an award.[6] Offshore wind could present a low-carbon energy alternative for the 28 coastal and Great Lake states, although additional cost reductions will be needed to make it cost competitive with other sources of electricity—as it already is in parts of Europe. Validation and demonstration of new offshore wind technologies will also provide investors with greater confidence in the growing array of energy projects in U.S. waters.[7]

Wind Energy R&D Subprograms

R&D in the Wind Energy program is divided into four subprograms:[8]

- **Offshore Wind** focuses on reducing offshore wind technology costs and risks, and improving wind-plant performance, operation, and maintenance given the unique offshore environment in the United States. The subprogram implements the Atmosphere to Electrons initiative, aimed at improving predictions of wind/wave resources in offshore wind development areas; and will continue the existing Wind-Plant Integrated System Design & Engineering Model (WISDEM™) to support offshore wind turbine and plant optimization.

- **Land-Based Wind** R&D focuses on tall wind turbine technology innovations—including those that enable higher hub heights, larger rotors, light-weight components, and improved energy capture—that have the potential to reduce the cost of utility-scale land-based wind, and also seeks technical solutions to environmental and siting challenges to land-based wind energy. The subprogram also supports Sandia's Scaled Wind Farm Technology (SWiFT) which uses multiple wind turbines to measure turbine performance in a wind farm environment. [9]

- **Distributed Wind** focuses on the integration of distributed wind energy with other distributed energy resources in hybrid plants and microgrids. To that end, the subprogram supports research in a range of areas, including balance of system cost reduction and atmospheric physics for site assessment.

- **Systems Integration,** which would include the former Grid Integration & Analysis program, promotes R&D in ensuring a cost-effective, reliable, and resilient power system with growing levels of supply from land-based, offshore, and distributed wind energy resources.

Prior to FY 2020, DOE structured its Wind Energy subprograms differently, so FY 2019 subprograms (light orange in figure 1) are not directly comparable. DOE made the change to the current structure to better comply with congressional direction.

Key Elements of the FY 2021 Budget Proposal[10]

- **An 88 percent reduction in Offshore Wind,** including no funding for competitively awarded projects to improve offshore wind resource characterization and forecasting; no funding for offshore development and demonstration projects; reduced funding for National Laboratory-led turbine and foundation projects; no funding for research to evaluate the environmental performance of offshore wind plants. The offshore wind industry is already taking off in Europe, leaving the United States at risk of falling behind without further investment.

- **An 89 percent reduction in Land-Based Wind,** with reduced funding for the research test facilities at National Renewable Energy Laboratory's (NREL)'s Flatirons Campus and Sandia's SWiFT facility, which would be kept in standby mode; reduced funding for adaptive load control technologies within the Big Adaptive Rotor initiative; no funding for competitive award for Tall Tower Demonstration, a program designed to address constraints to tall wind turbine towers; and continued support for the American Wake Experiment (AWAKEN), a planned international wake observation and validation campaign for wind-farm modeling.

- **A 93 percent reduction in Distributed Wind,** with reduced funding for testing and reliability; and reduced funding for wind technologies associated with military design requirements. Existing efforts regarding integration of distributed wind with storage and other distributed energy resources transitioning to the Systems Integration subprogram.

- **An 18 percent increase in Systems Integration, Analysis, and Workforce subprograms,** including continued funding for gird modernization activities; the distributed wind Microgrid, Infrastructure Resilience and Controls Launchpad (MIRACL), which supports integrating distributed wind in hybrid wind/solar/storage systems and microgrid applications; and new funding for advanced planning and operation models and tools for offshore wind integration.

ENDNOTES

1. U.S. Department of Energy (DOE), "FY 2021 Congressional Budget Justification," Volume 3 Part 1, 107-123, (DOE/CF-0163, February 2020), https://www.energy.gov/sites/prod/files/2020/02/f72/doe-fy2021-budget-volume-3-part-1_1.pdf.
2. DOE, "FY 2021 Congressional Budget Justification" Volume 3 Part 1, 103.
3. For comparison, the levelized cost of electricity from a natural gas combined-cycle power plant was $0.044–0.068/kWh in 2019. Lazard, "Lazard's Levelized Cost of Energy Analysis—Version 13.0" (Lazard, November 2019), https://www.lazard.com/perspective/lcoe2019; DOE, "2018 Wind Technologies Market Report" (DOE, 2019), xii, https://www.energy.gov/sites/prod/files/2019/08/f65/2018%20Wind%20Technologies%20Market%20

Report%20FINAL.pdf; DOE, "Wind Energy Technologies Office Accomplishments" (Washington, D.C.: DOE, 2017), https://www.energy.gov/sites/prod/files/2017/05/f34/108630-Wind%20Accomplishments-FactSheet-web150.pdf;

4. Katherine Dykes et al., "Enabling the SMART Wind Power Plant of the Future Through Science-Based Innovation" (Washington, D.C.: DOE NREL, August 2017) https://www.nrel.gov/docs/fy17osti/68123.pdf; DOE, "Congressional Budget Justification," Volume 3 Part 2, 115.
5. DOE, "2018 Offshore Wind Technologies Market Report" (September 2019), p. ix, https://www.energy.gov/sites/prod/files/2019/09/f66/2018%20Offshore%20Wind%20Technologies%20Market%20Report.pdf; Potential capacity includes installed projects, projects under construction, projects moving through permitting and offtake processes, projects with site control, the Bureau of Ocean Energy Management's unleased wind energy areas, and unsolicited lease applications submitted by developers.
6. DOE, "2018 Offshore Wind Technologies Market Report," p. xii.
7. Matthew Stepp, "What Interior's Lease Auction Says about Offshore Wind Innovation," Innovation files (June 12, 2013), https://www.innovationfiles.org/what-interiors-lease-auction-says-about-offshore-wind-innovation/.
8. DOE, "FY 2021 Congressional Budget Justification," Volume 3 Part 1, 107–123.
9. Sandia National Laboratories, "Scaled Wind Farm Technology (SWiFT)," https://energy.sandia.gov/programs/renewable-energy/wind-power/wind_plant_opt/, accessed March 9, 2020.
10. Ibid.

ACKNOWLEDGMENTS

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