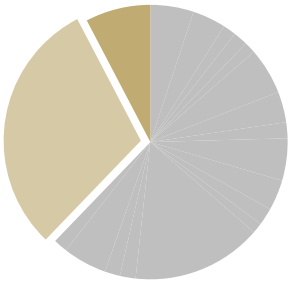
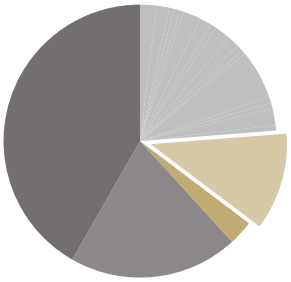
Federal Energy R&D: Basic Energy Sciences

BY DAVID M. HART AND COLIN CUNLIFF | APRIL 2018

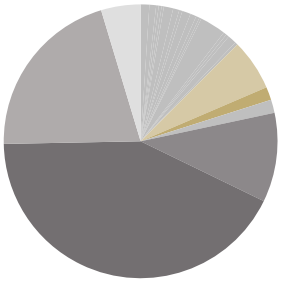
This briefing is part of a series on the U.S. energy budget. See: itif.org/energy-budget.



Basic Energy Sciences (brown)
Energy Science (brown)
Energy R&D (light gray)



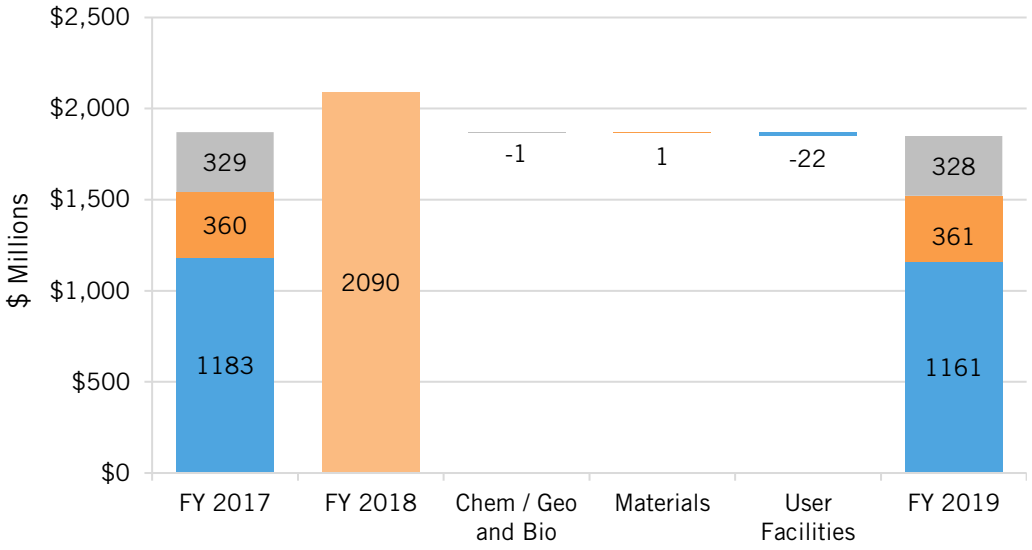
Basic Energy Sciences
Energy R&D
Basic Science R&D
Defense R&D



Basic Energy Sciences,
Energy, Basic Science,
Defense, Environ Mngmt,
Other DOE

Basic Energy Sciences (BES) support fundamental research into understanding and controlling matter and energy, thereby helping to build the foundation for new energy technologies. BES research—in condensed matter and materials physics, chemistry, geosciences, and aspects of biosciences—touches virtually every important facet of energy production, transmission, storage, and waste mitigation. BES also operates open-access scientific user facilities that serve researchers from private industry, national laboratories, and universities.[1]

Figure 1: The FY 2019 Budget Request Would Cut Basic Energy Sciences R&D by 11 Percent



What's At Risk

Research in basic energy sciences is a key component of the energy innovation ecosystem. In response to a bipartisan congressional requests to identify challenges to American competitiveness, the National Academy of Sciences found that "the scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength," and called for a doubling of basic science research, including basic energy sciences, as a means of addressing those challenges.[2] BES supports 36 Energy Frontier Research Centers, which are partnerships among universities, national laboratories, and industry that integrate the talents and insights of leading scientists and engineers to confront critical energy challenges across sectors.

In addition, DOE set up interdisciplinary, integrative centers of excellence that bring together researchers from across sectors to address "grand energy challenges" and use-inspired basic research needs. BES houses two of these energy innovation hubs: the Fuels from Sunlight Hub, which seeks to generate fuels directly from sunlight, carbon dioxide, and water in a manner similar to natural photosynthesis; and the Batteries and Energy Storage Hub, which researches nanoscale phenomena to develop next-generation, beyond-lithium-ion-energy storage systems. The hubs connect basic research to real-world challenges and enable fast technology transitions from the lab to the market.

Basic Energy Sciences R&D Activities

R&D in basic energy is distributed across three subprograms:

- **Materials Science and Engineering** supports research on materials synthesis, behavior, and performance for a wide range of energy-generation and end-use challenges, with a focus on the origin of macroscopic-material behaviors; their fundamental connections to atomic, molecular, and electronic structures; and their evolution as materials move from nanoscale building blocks to mesoscale systems.

- **Chemical Sciences, Geosciences, and Biosciences** supports research on chemical reactivity and energy conversion, which is the foundation for energy-relevant chemical processes—such as catalysis, synthesis, and light-induced chemical transformation—to achieve a fully predictive understanding of complex chemical, geochemical, and biochemical systems at the same level of detail as simple molecular systems.

- **Scientific User Facilities** supports the operation of a diverse suite of research facilities that provide thousands of researchers from universities, industry, and government laboratories unique tools to advance a wide range of science research. These user facilities are operated on an open-access, competitive merit review basis, enabling public and private researchers from every discipline to take advantage of the facilities' unique capabilities and instrumentation.

Key Elements of the FY 2019 Budget Proposal

- **Near-flat funding for Materials Science and Engineering Research**. Research using x-ray, neutron-scattering, and electron-microscopy techniques focused on superconductivity and organic electronics would be de-emphasized, with a shift in focus to understanding quantum phenomena and materials research. Funding for Energy Frontier Research Centers and the Energy Innovation Hub for Batteries and Energy Storage would remain flat at FY 2017 levels.

- **Near-flat funding for Chemical Sciences, Geosciences, and Biosciences**. Chemical-transformations research will emphasize chemical processes that occur in nuclear environments, with an aim toward better understanding the structure, dynamics, and energetics of molten salt coolants and fuels that can inform the development of advanced nuclear power. Photochemistry and biochemistry

research will de-emphasize efforts in plant cell-wall biosynthesis and light signaling. Funding for Energy Front Research Centers and the Fuels from Sunlight Energy Innovation Hub would remain flat at FY 2017 levels.

- **Modest reductions in funding for research conducted at User Facilities.** This would include discontinuation of research activities for detectors and optics instrumentation. Upgrades to x-ray-light and neutron sources, including the Advanced Light Source (soft x-rays), Advanced Photon Source (hard x-rays), and Linac Coherent Light Source-II (ultrafast x-rays) facilities would remain ongoing.

ENDNOTES

1. DOE, "FY 2019 Congressional Budget Justification," volume 4, DOE/CF-0142 (Washington, D.C.: DOE Chief Financial Officer, February 2018), 149, https://www.energy.gov/sites/prod/files/2018/03/f49/DOE-FY2019-Budget-Volume-4_0.pdf.
2. National Academies of Sciences, Engineering, and Medicine, "Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5" (Washington, D.C. The National Academies Press, 2010), https://doi.org/10.17226/12999; Robert D. Atkinson, "An Innovation-Based Clean Energy Agenda for America" (Washington, D.C.: Information Technology and Innovation Foundation, June 2015), http://www2.itif.org/2015-energy-innovation-agenda.pdf; American Energy Innovation Council, "Restoring American Energy Innovation Leadership: Report Card, Challenges, and Opportunities" (Washington, D.C.: Bipartisan Policy Center, February 2015), http://americanenergyinnovation.org/2015/02/restoring-american-energy-innovation-leadership-report-card-challenges-and-opportunities/.

ABOUT THE AUTHORS

David M. Hart is a senior fellow at ITIF and professor of public policy and director of the Center for Science, Technology, and Innovation Policy at George Mason University's Schar School of Policy and Government.

Colin Cunliff is a policy analyst for clean energy innovation at ITIF.

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