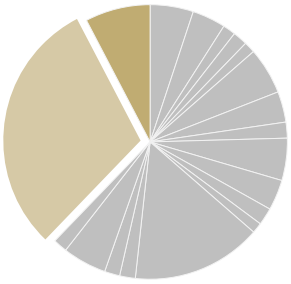
Federal Energy RD&D: Basic Energy Sciences

BY COLIN CUNLIFF | APRIL 2019

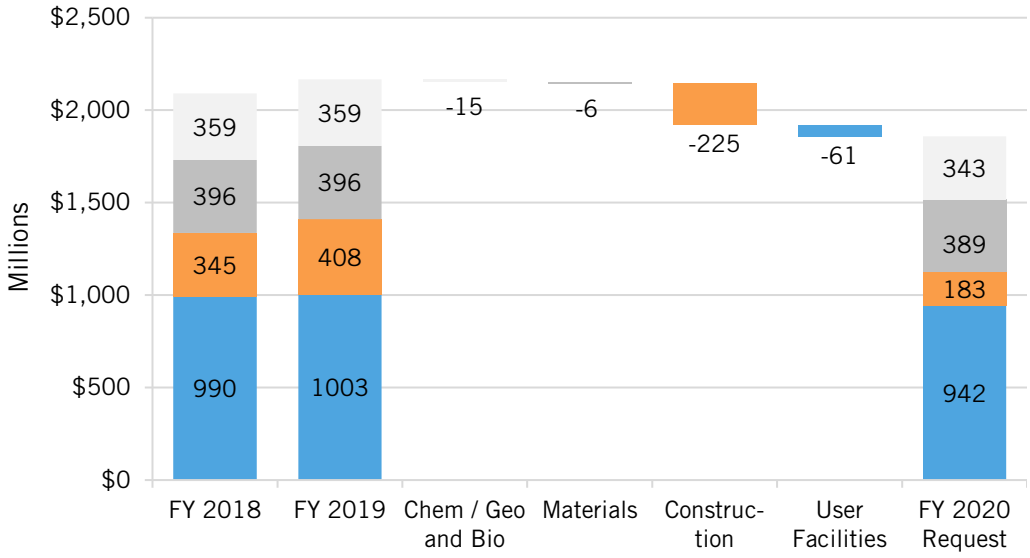
This briefing is part of a series on the U.S. energy budget. See: itif.org/energy-budget.



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

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 enable researchers from private industry, national laboratories, and universities to use advanced instruments and tools that are too expensive for a single university lab or private company to own and operate.[1]

Figure 1: The FY 2020 budget request would cut basic energy sciences R&D by 14 percent.[2]



What's At Risk

Research in basic energy sciences is a key component of the energy innovation ecosystem. In 2018, the BES Advisory Committee produced a retrospective report, "A Remarkable Return on Investment in Fundamental Research," identifying some of the groundbreaking discoveries made as a result of BES funding that—years, and often decades, later—have resulted in the commercialization of new technologies that shape the way we produce and consume energy.[3] The National Academy of Sciences has called for a doubling of basic science research, including basic energy sciences, as a means of addressing challenges to U.S. competitiveness.[4]

BES supports 46 Energy Frontier Research Centers (EFRCs), 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. BES also houses two 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. BES's 12 user facilities provide nearly 16,000 industry, government, and academic researchers access to advanced research capabilities, including x-ray lasers, accelerators, neutron sources, and tools to probe matter on the nano-scale.[5]

Basic Energy Sciences R&D Activities

R&D in basic energy is distributed across three subprograms:[6]

- **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 12 user facilities—five light sources, two neutron scattering facilities, and five nanoscale science research centers—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.
- **Construction** supports the construction of new user facilities and upgrades to existing facilities, including the Linac Coherent Light Source-II, which will be the world's most powerful x-ray free electron laser.

Key Elements of the FY 2020 Budget Proposal[7]

- **Funding the BES User Facilities at "87 percent optimum,"** which means the user facilities would only be operated for 87 percent of the total potential operating time. 1,710 fewer researchers would be able to use the BES User Facilities.

- **An 18 percent boost to funding for EFRCs,** with the additional funding going to new EFRCs in microelectronics and quantum information systems.

- **Flat funding for the Batteries and Energy Storage innovation hub**, which was recently extended for a second five-year term.

- **A 33 percent boost in funding for the Fuels from Sunlight innovation hub.** After completion of a second five-year term of the hub, led jointly by Caltech and LBNL, BES will hold an open competition to solicit proposal for a new hub.

- **A 62 percent cut to the Established Program to Stimulate Competitive Research (EPSCoR)**, a program to advance research capabilities in states and territories with historically lower levels of Federal research funding.

- **Near-flat funding for Materials Science and Engineering Research**. Scattering and instrumentation sciences research would get a $6 million cut; materials discovery research would get a $5.5 million cut; computational materials sciences would receive flat funding; and condensed matter research would get an $8 million boost.

- **Near-flat funding for Chemical Sciences, Geosciences, and Biosciences**. Research in fundamental interactions would be cut by $5 million; chemical transformations by $14 million; and photochemistry and biochemistry by $12 million. Computational chemical sciences would receive flat funding.

ENDNOTES

1. DOE, "FY 2020 Congressional Budget Justification," Volume 4, DOE/CF-0154 (Washington, D.C.: DOE Chief Financial Officer, March 2019), 47-97, https://www.energy.gov/sites/prod/files/2019/03/f61/doe-fy2020-budget-volume-4.pdf.
2. Ibid, 49-50.
3. Basic Energy Sciences Advisory Committee (BESAC), "A Remarkable Return on Investment in Fundamental Research: 40 Years of Basic Energy Sciences at the Department of Energy," (DOE, June 2018), https://science.energy.gov/~/media/bes/pdf/BESat40/BES_at_40.pdf.
4. 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; Colin Cunliff, "An Innovation Agenda for Deep Decarbonization: Bridging Gaps in the Federal Energy RD&D Portfolio," (Information Technology and Innovation Foundation, November 2018), http://www2.itif.org/2018-innovation-agenda-decarbonization.pdf.

5. DOE, "Energy Frontier Research Centers (EFRCs)," https://science.energy.gov/bes/efrc, accessed March 24, 2019; DOE, "DOE Energy Innovation Hubs," https://science.energy.gov/bes/research/doe-energy-innovation-hubs/, accessed March 24, 2019; DOE, "Office of Science User Facilities: Fiscal Year 2015," (DOE Office of Science), https://science.energy.gov/~/media/_/pdf/user-facilities/Reports/DOE-SC-User-Facilities-FY2015-report.pdf; DOE, "Annual Report on the State of the DOE National Laboratories," (DOE, January 2017), https://www.energy.gov/sites/prod/files/2017/02/f34/DOE%20State%20of%20the%20National%20Labs%20Report%2002132017.pdf; DOE, "FY 2020 Congressional Budget Justification," 95.
6. DOE, FY 2020 Congressional Budget Justification, 47-97.
7. Ibid.

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ABOUT THE AUTHOR

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