



Materials research promoted in US FY 2017 budget request

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President Barack Obama's budget request for fiscal year (FY) 2017, presented on February 9, 2016, pursues increases in materials research over the enacted FY 2016 budget across the entire domestic science and technology portfolio, notably for the National Science Foundation, Department of Energy Office of Science, and the National Institute of Standards and Technology. In marked contrast, however, the president's budget request could cut funding for research for the Department of Defense, with significant cuts for basic research. Following is the breakdown as compared to enacted FY 2016 budgets.

National Science Foundation (NSF)

Overall, the president's budget proposes a 6.7% increase, while the Directorate for Mathematical & Physical Sciences (MPS) would receive a 6.5% (or \$87.3 million) increase. This includes an increase of 6.3% for materials research and condensed-matter science in the Division of Materials Research (DMR).

Across NSF, the Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS) initiative increases by 0.3% to a total of \$257 million, with a specific focus on the Designing Materials to Revolutionize and Engineer our Future (DMREF) Program. The purpose of DMREF is to design and synthesize materials by integrating theory, computation, experimentation, and data mining. These programs are a direct response to the administration's Materials Genome Initiative. NSF intends to continue existing programs under the CEMMSS umbrella such as DMREF, Cyber Physical Systems, the NSF National Robotics Initiative, and programs related to advanced manufacturing.

Materials Centers funding in the FY 2017 proposed budget for the MPS Division of Materials Research is equivalent to FY 2016 funding at \$56.0 million, a level of funding that would support 21 Materials Research Science and Engineering Centers.

The DMR FY 2016 request includes other Foundation focus areas including

the Sustainable Chemistry, Engineering, and Materials effort under the NSF-wide Science, Engineering, and Education for Sustainability (SEES) Program area, including critical minerals and materials. SEES investments would drop to \$52 million for FY 2017, a reduction of 29.8%.

Programs impacting materials research are also found in two other divisions of MPS—Chemistry (6.4% increase), Physics (6% increase)—and in NSF's Engineering Directorate.

Department of Energy (DOE)

The president requests \$5.7 billion for the DOE Office of Science, a proposed increase of 4.2%. Basic Energy Sciences (BES) is the largest of the program areas within the Office of Science, due mainly to stewardship of national user facilities, and is projected to grow by 4.7% or \$87.73 million for a total of just over \$1.9 billion. Within non-facility-based research programs of BES, the Materials Science and Engineering (MSE) Division includes materials discovery, design, and synthesis; condensed-matter and materials physics; and scattering and instrumentation sciences. In FY 2017, funding for MSE will rise to \$395.845 million, an increase of over \$26 million over FY 2016.

DOE oversees 17 national laboratories. The BES program operates the Scientific User Facilities (SUF) Division, with large national user research facilities that provide researcher access to expensive and rare instrumentation, including synchrotron and neutron sources, nanoscience centers, and smaller user facilities for materials preparation and electron microscopy. BES also operates five Nanoscale Science Research Centers within SUF at national laboratories and, through their user programs, supports a wide range of individual programs on nanoscience.

BES also manages the Energy Frontier Research Centers (EFRCs), which are multi-investigator and multidisciplinary centers that pursue projects of high priority to energy research. The scientific directions for these centers cut across materials science and engineering, chemical sciences, geosciences, and biosciences.



DOE supports applied materials research for energy technologies through a number of programs in the Office of Energy Efficiency and Renewable Energy (EERE), proposed to be funded at \$2.898 billion and directed materials research for national security through the National Nuclear Security Administration's Weapons Activities account, within the Science and Engineering programs. The Advanced Manufacturing Office in EERE focuses on materials technologies and production techniques that have broad applications for energy-intensive manufacturing methods. The Advanced Research Projects Agency-Energy (ARPA-E), which would see a 20.3% increase, is a source of funding for high-risk, high-payoff materials research projects. In addition, DOE has continued to manage Energy Innovation Hubs, including the Critical Materials Hub at Ames Laboratory as well as a multi-team Batteries and Energy Storage Hub led by Argonne National Laboratory.

Department of Defense (DoD)

Overall, the budget proposes a 9% decrease for basic research (6.1) and a 2.6% decrease for applied research (6.3). Army Science and Technology programs will see a 15.7% decrease and the Navy programs will see an 8.3% decrease, whereas the Air Force programs will see a slight 0.2% increase. Funding for the Defense Advanced Research Projects Agency (DARPA) would decrease by 3.7% in all defense research science programs being funded at just under \$3 billion.

National Institute of Standards and Technology (NIST)

Overall, NIST of the Department of Commerce would receive a significant increase of 211%, up to a total of just over \$3 billion under the proposed budget, with the Scientific and Technical Research and Services within NIST

receiving an overall 5.9% increase. The agency's budget request contains an expansion of the National Network for Manufacturing Innovation (NNMI) by 2025 that would be carried out through \$1.89 billion in mandatory funding in FY 2017. NIST develops measurements, standards, and data needed to advance the development of metals, ceramics, polymers, nanomaterials, biomaterials, electronics, and semiconductor materials that are critical to national needs related to commerce. The budget emphasizes manufacturing technologies, network infrastructure, and support for the Materials Genome Initiative Program that also receives funds from NSF.

Other agencies and initiatives

Other agencies that support materials research, though they do not separately report materials science budget line items, include the National Aeronautics and Space Administration (NASA), the Department of Homeland Security (DHS), and the National Institute of Biomedical Imaging and Bioengineering (NIBIB) within the National Institutes of Health (NIH). NIBIB is an important funding agency for materials research with an emphasis on health-related science and applications. For FY 2017, the NIBIB would receive \$342.5 million, essentially the same level of funding from the previous year.

The National Institute of General Medical Sciences (NIH) would be flat-funded as well, at \$2.5 billion, while research project grants that support investigator-initiated research would increase by 3.6% across the institute.

Funding for the Division of Biomedical Technology, Bioinformatics, and Computational Biology (NIH) would stay virtually flat; decreasing by \$60,000 from the FY 2016 enacted level. The request highlights new and continuing NIH initiatives,

including \$69.1 million to the Big Data to Knowledge Program through the Common Fund to stimulate broad use of biomedical big data by supporting the development of big data software, reference data sets, data analysis, and dissemination methods. This would be a \$6.2 million (9.8%) increase over FY 2016 to make big data software innovations more user-friendly and support innovative approaches using crowdsourcing and interactive digital media, as well as create a comprehensive data commons for NIH data resources.

The 2017 budget request also provides \$2 billion for federal research and development directly supporting advanced manufacturing, consistent with the goals and recommendations of the National Strategic Plan for Advanced Manufacturing. The budget funds a national network of 45 manufacturing innovation institutes.

The administration's request furthermore includes directives for mandatory spending, which would fund a specific program using revenue generated by the sale of a government asset, such as oil in the strategic petroleum reserve, or a particular tax or license fee. This new directive, in essence, sidesteps the annual congressional appropriations process that disburses what is known as discretionary spending, money from the government's general pot of tax and other revenue.

Typically, mandatory funding streams continue indefinitely—and do not have to be revisited and approved each year—unless Congress specifies otherwise. Overall, two-thirds of next year's proposed \$6 billion increase in overall federal research spending—a 4% boost to \$152 billion—would come from mandatory sources. All totals for budgets appearing earlier in this article include mandatory spending increases.

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