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DOE's Office of Science and the FY2016 Budget Request

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Summary

The Department of Energy's Office of Science conducts basic research in six overarching program areas: advanced scientific computing research, basic energy sciences, biological and environmental research, fusion energy sciences, high-energy physics, and nuclear physics. Through primarily these programs, the Department of Energy was the third-largest federal funder of basic research and the largest federal funder of research in the physical sciences in FY2014.

This budget and appropriations tracking report describes selected major items from the Administration's FY2016 budget request for the Office of Science and tracks legislative action on FY2016 appropriations for the office. It also provides selected historical funding data. This report will be updated to include FY2016 House- and Senate-proposed amounts, as well as final enacted appropriations, when FY2016 appropriations bills pass their respective chambers.

Overall, the Obama Administration requests $5.340 billion for Science in FY2016, a $272 million (5%) increase over the FY2015 enacted level of $5.068 billion. By dollar amount, the largest increase is for Basic Energy Sciences (BES), which would gain $116 million (7%). The largest decrease is for Fusion Energy Sciences (FES), which would be reduced by $48 million (-10%). By percentage, the largest increase among Science's research programs would go to Advanced Scientific Computing Research (ASCR), which would receive $80 million (15%) more in FY2016.

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The Department of Energy's Office of Science conducts basic research in six overarching program areas: advanced scientific computing research, basic energy sciences, biological and environmental research, fusion energy sciences, high-energy physics, and nuclear physics. Through primarily these programs, the Department of Energy was the third-largest federal funder of basic research and the largest federal funder of research in the physical sciences in FY2014.[1]

This budget and appropriations tracking report describes selected major items from the Administration's FY2016 budget request for the Science account, which funds the Office of Science, and tracks legislative action on FY2016 appropriations. It also provides selected historical funding data.

Table 1 shows FY2014 current funding, FY2015 enacted funding, and the FY2016 request for Office of Science programs. This table will be updated to include FY2016 House- and Senate-proposed amounts, as well as final enacted appropriations, when FY2016 appropriations bills pass their respective chambers. Science appropriations are typically included in annual Energy and Water Development and Related Agencies Appropriations acts. (CRS tracks these acts each fiscal year. See the "Appropriations Status Table" on CRS.gov, at http://www.crs.gov/Pages/AppropriationsStatusTable.aspx.) Science budget requests are published on the Office of Science website at http://science.energy.gov/budget/.

For a longer perspective, **Table 2** provides the same data for FY2010 through the FY2016 request.

Figure 1 shows total Science funding in current and constant (FY2015) dollars between FY1998 and FY2015.[2] These trends do not adjust for policy changes or changes in the character of activities funded under the Science line.

FY2016 Science Budget Request and Appropriations

The Obama Administration is requesting $5.340 billion for Science in FY2016, a $272 million (5%) increase over the FY2015 enacted level of $5.068 billion. By dollar amount, the largest increase in the FY2016 Science budget request is for Basic Energy Sciences (BES), which would gain $116 million (7%). The largest decrease is for Fusion Energy Sciences (FES), which would decline by $48 million (-10%). By percentage, the largest increase among Science's research programs would go to Advanced Scientific Computing Research (ASCR), which would receive $80 million (15%) more in FY2016.

Policymakers have not enacted an authorized funding level for the Office of Science since the previous authorization expired in FY2013 (P.L. 111-358, America COMPETES Reauthorization

[1] Based on preliminary FY2014 data from Tables 7 and 22 of National Science Foundation, National Center for Science and Engineering Statistics, *Federal Funds for Research and Development: Fiscal Years 2012-14*, NSF 14-316 (September 2014).

[2] DOE established the Office of Science (as such) in FY2000. FY2000 budget documents provide comparable Science budget data back to FY1998.

Act of 2010). Bills to reauthorize the Office of Science were introduced, but not enacted, in the 113th Congress.[3]

Table 1. Office of Science Appropriations, FY2014-FY2016

(budget authority in $ millions, rounded)

	FY2014 Current	FY2015 Enacted	FY2016 Request	House	Senate	Final
Advanced Scientific Computing	463.5	541.0	621.0			
Basic Energy Sciences	1,662.7	1,733.2	1,849.3			
Biological and Environmental Research	593.6	592.0	612.4			
Fusion Energy Sciences	495.9	467.5	420.0			
High Energy Physics	774.9	766.0	788.0			
Nuclear Physics	554.8	595.5	624.6			
Workforce Development for Teachers and Scientists	26.5	19.5	20.5			
Science Laboratories Infrastructure	97.8	79.6	113.6			
Safeguards and Security	87.0	93.0	103.0			
Program Direction	185.0	183.7	187.4			
SBIR/STTR (Science portion)[a]	128.5	-	-			
Subtotal	**5,070.2**[b]	**5,071.0**	**5,339.8**			
SBIR/STTR (DOE-wide transfer)[a]	64.7	-	-			
Use of prior year balances	-3.8	-	-			
Rescission of prior year balances	-	-3.3	-			
Total	**5,131.0**	**5,067.7**	**5,339.8**			

Source: Department of Energy, Office of Science, "Office of Science: FY2014-FY2016 Appropriations Summary," January 30, 2015, http://science.energy.gov/~/media/budget/pdf/sc-budget-request-to-congress/fy-2016/FY_2014-2016_SC_Funding_Summary.pdf.

Notes:

a. "SBIR/STTR (Science Contribution)" includes funding reprogrammed from within the Office of Science to support the SBIR/STTR programs. "SBIR/STTR (DOE-wide transfer)" includes funding transferred from other DOE accounts to Science for the SBIR/STTR programs. For more information about the SBIR/STTR programs, see CRS Report R43695, *Small Business Innovation Research and Small Business Technology Transfer Programs*, by John F. Sargent Jr.

b. Includes a reduction of $4.6 million for the Office of Science share of a $7 million DOE-wide reduction for contractor foreign travel.

The following sections highlight selected FY2016 initiatives, programs, and activities within Science research programs, as well as their FY2016 budget and appropriations status. These sections are not intended to provide a comprehensive view of each account, but rather focus

[3] For more information, see CRS Report R43880, *The America COMPETES Acts: An Overview*, by Heather B. Gonzalez; and CRS Report R42779, *America COMPETES Acts: FY2008 to FY2013 Funding Tables*, by Heather B. Gonzalez.

mostly on large changes or on activities emphasized in House and Senate Appropriations Committee reports.

Advanced Scientific Computing (ASCR)

As described in the FY2016 Science budget request, ASCR's mission is to

> advance applied mathematics and computer science; deliver the most advanced computational scientific applications in partnership with disciplinary science; advance computing and networking capabilities; and develop future generations of computing hardware and tools for science, in partnership with the research community, including U.S. industry. The strategy to accomplish this has two thrusts: developing and maintaining world-class computing and network facilities for science; and advancing research in applied mathematics, computer science and advanced networking.[4]

For FY2016, the Administration seeks $621 million for ASCR, $80 million (15%) more than the FY2015 enacted funding level of $541 million. Most of this increase ($77 million) would go to High Performance Computing and Network Facilities, focused particularly on the Research and Evaluation Prototypes (REP) activity. REP funding will be used to further the design and development of exascale computing systems (i.e., node technologies, hardware, and software). Both Congress and the Administration have prioritized exascale computing in recent budget and appropriations cycles.[5] The FY2016 REP request also includes $10 million for the Computational Science Graduate Fellowship (CSGF), a $7 million increase from FY2015.

Basic Energy Sciences (BES)

Basic Energy Sciences (BES) supports

> fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support DOE missions in energy, environment, and national security.[6]

The FY2016 Administration request for BES is $1.849 billion, $116 million (7%) more than the FY2015 enacted funding level of $1.733 billion. About half of the increase ($62 million) would go toward the next phase of the Linac Coherent Light Source–II (LCLS–II) construction and installation activities. Although this amount is slightly less than projected in FY2015, the FY2016 budget request includes projected increases in out-year costs.[7] The FY2016 BES request also seeks an increase of $10 million for Energy Frontier Research Centers (EFRCs, $110 million total request). It would maintain funding for the Batteries and Energy Storage, as well as the Fuels

[4] Department of Energy, "Science: Advanced Research Projects Agency–Energy," *Department of Energy FY2016 Congressional Budget Request*, vol. 4, February 2015, p. 17, at http://science.energy.gov/budget/.

[5] For example, see H.Rept. 113-486, which accompanied H.R. 4923 (Energy and Water Development Appropriations Bill, 2015), p. 118. See also, H.Rept. 113-135, which accompanied H.R. 2609 (Energy and Water Development Appropriations Bill, 2014), p. 106; and S.Rept. 113-47, which accompanied S. 1245 (Energy and Water Development Appropriations Bill, 2014), pp. 79, 93.

[6] *Department of Energy FY2016 Congressional Budget Request*, vol. 4, p. 43.

[7] Ibid, pp. 100-101.

from Sunlight Energy Innovations Hubs at FY2015 levels ($24 million and $15 million, respectively).[8]

Biological and Environmental Research (BER)

> The mission of the Biological and Environmental Research (BER) program is to support fundamental research and scientific user facilities to achieve a predictive understanding of complex biological, climatic, and environmental systems for a secure and sustainable energy future.[9]

For FY2016, the Administration seeks $612 million for BER, $20 million (3%) more than the FY2015 enacted funding level of $592 million. The largest requested increase in BER is for Climate and Earth System Modeling (CESM, $31 million increase). The largest requested increase within CESM is for the Climate Model Development and Validation activity ($18 million request). The Administration sought funding for a similarly titled activity in FY2015, but appropriators ultimately rejected that proposal.[10] The FY2016 BER budget request seeks a $6 million reduction in Biological Systems Science; within this line, Genomic Science would increase and most other activities would decrease.

Fusion Energy Sciences (FES)

Fusion Energy Sciences (FES) seeks to

> expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation needed to develop a fusion energy source. This is accomplished through the study of plasma, the fourth state of matter, and how it interacts with its surroundings.[11]

The FY2016 Administration request for FES is $420 million, $48 million (-10%) less than the FY2015 enacted funding level of $468 million. Most FES activities would decline or remain flat relative to FY2015. The only increase in the FES request is for the GPE/GPP/Infrastructure[12] line within the Burning Plasma Science: Foundations subprogram. Among other things, these funds would support facility and utility improvements associated with full National Spherical Torus Experiment Upgrade (NSTX-U) operations, as well as improvements to the Princeton Plasma Physics Laboratory Computer Center. In FY2015, FES signaled its intention to shutter the Massachusetts Institute of Technology's Alcator C-Mod facility in late FY2016. The FY2016 budget request continues this planned shutdown.

FES provides funding for the U.S. contribution to the ITER project. ITER is an international effort to design and build an experimental fusion reactor, which is currently under construction in France. According to DOE, ITER "aims to generate fusion power 30 times the levels produced to

[8] The FY2016 BES request indicates that a decision to renew (or not) the Fuels from Sunlight Hub for a final, five-year term would be made in January 2015. As of March 25, 2015, DOE had not announced a decision.

[9] *Department of Energy FY2016 Congressional Budget Request*, v. 4, p. 103.

[10] See the explanatory statement printed in the December 11, 2014, *Congressional Record*, p. H9701.

[11] *Department of Energy FY2016 Congressional Budget Request*, v. 4, p. 131.

[12] The term "GPE" means General Purpose Equipment; "GPP" means General Plant Projects.

date and to exceed the external power applied to the plasma by at least a factor of ten."[13] Many U.S. analysts have expressed concern about ITER's cost, schedule, and management. The cost estimate for the U.S. contribution to ITER—which is 9.09% of the total project cost—has grown from between $1.45 billion and $2.2 billion in 2008 to between $4.0 billion and $6.5 billion under current assumptions.[14] Moreover, even the more recent cost estimates may not be reliable.[15] Criticism of the ITER project has generally focused on concerns about the international project, not U.S. ITER.[16] The Director-General of the international ITER project was replaced on March 5, 2015. An FY2015 draft Senate Appropriations Committee report recommended that the U.S. withdraw from ITER; the final FY2015 appropriations agreement included no such provision. The FY2016 request for the U.S. contribution to ITER is $150.0 million, equal to the FY2015 enacted level.

High Energy Physics (HEP)

The High Energy Physics (HEP) program examines

> how the universe works at its most fundamental level by discovering the elementary constituents of matter and energy, probing the interactions between them, and exploring the basic nature of space and time.[17]

The Administration seeks $788 million for HEP in FY2016, $22 million (3%) more than the FY2015 enacted funding level of $766 million. The FY2016 HEP budget request would make changes to HEP subprograms and activities in order to bring the HEP program into alignment with the recommendations of the Particle Physics Project Prioritization Panel (P5) report.[18] Among these changes is the "internationalization and re-scoping of the Long Baseline Neutrino Experiment" (LBNE), based on the Large Hadron Collider (LHC) project model.[19] The FY2016 LBNE request includes funding to make design changes in order to facilitate international participation.

The FY2016 Administration request for HEP also seeks construction funding to continue the Muon to Electron Conversion experiment (Mu2e) and would shift funding among the program's three major experimental areas—increasing funding for Energy Frontier Experimental Physics and Cosmic Frontier Experimental Physics, while decreasing funding for Intensity Frontier Experimental Physics by a similar amount.

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[13] *Department of Energy FY2016 Congressional Budget Request*, v. 4, p. 155.

[14] *Department of Energy FY2016 Congressional Budget Request*, v. 4, p. 165.

[15] U.S. Government Accountability Office, *Fusion Energy: Actions Need to Finalize Cost and Schedule Estimates for U.S. Contributions to an International Experimental Reactor*, GAO-14-499, June 5, 2014.

[16] A sizeable portion of the U.S. contribution to the international ITER project is in the form of in-kind hardware that is designed and fabricated in the United States. These hardware contributions are managed by U.S. ITER, an Office of Science project hosted by Oak Ridge National Laboratory in Tennessee. More information about U.S. ITER is available at https://www.usiter.org/about/index.shtml.

[17] *Department of Energy FY2016 Congressional Budget Request*, v. 4, p. 173.

[18] DOE and the National Science Foundation charged the High Energy Physics Advisory Panel (HEPAP) with convening the P5 in September 2013. In May 2014, HEPAP unanimously approved the P5 report. The report is available at http://science.energy.gov/hep/hepap/reports/.

[19] As described by the FY2016 budget request, the LHC model involves engaging foreign funding agencies to contribute in-kind to a host laboratory that would coordinate and integrate contributions. *Department of Energy FY2016 Congressional Budget Request*, v. 4, pp. 174, 205.

Nuclear Physics (NP)

The mission of the Nuclear Physics (NP) program is "to discover, explore, and understand all forms of nuclear matter."[20] For FY2016, the Administration seeks $625 million for NP, $29 million (5%) over the FY2015 enacted funding level of $596 million. The request provides increases for research, facilities operations, and construction. In the construction account, a reduction for the 12 GeV Continuous Electron Beam Accelerator Facility (CEBAF) upgrade is as planned in the approved project profile.

Workforce Development for Teachers and Scientists (WDTS)

The Workforce Development for Teachers and Scientists (WDTS) program mission is "to help ensure that DOE has a sustained pipeline of science, technology, engineering, and mathematics (STEM) workers."[21]

The FY2016 Administration request for WDTS is $21 million, $1 million (5%) more than the FY2015 enacted funding level. The request includes funding for Science Undergraduate Laboratory Internships (SULI), Community College Internships (CCI), Office of Science Graduate Student Research (SCGSR), the Visiting Faculty Program (VFP), Albert Einstein Distinguished Educator Fellowship, and the National Science Bowl. The FY2016 request includes increases for SULI, CCI, and the VFP. Other activities would be funded at FY2015 levels.

Historical Appropriations

Table 2 shows Office of Science current dollar appropriations from FY2010 to FY2014, as well as FY2015 enacted appropriations and the FY2016 request. The Office of Science subtotal (not including transfers from other accounts, or the use or rescission of prior-year balances) increased by $241 million (5%) between FY2010 and FY2014.[22] Most of the increase—$222 million or 92%—went to ASCR, BES, and FES. Funding for High Energy Physics was reduced by about -2% during this period.

[20] *Department of Energy FY2016 Congressional Budget Request*, v. 4, p. 235.

[21] *Department of Energy FY2016 Congressional Budget Request*, v. 4, p. 285.

[22] This calculation does not compare against FY2015 enacted funding levels because FY2015 program funding levels do not reflect the reallocation of SBIR/STTR program funding within the Office of Science. At least with regard to SBIR/STTR, the most recent five-year period of comparable funding is FY2010 to FY2014.

Table 2. Office of Science Appropriations, FY2010-FY2016

(budget authority in $ millions, rounded)

	FY2010	FY2011	FY2012[a]	FY2013[b]	FY2014[c]	FY2015 Enacted	FY2016 Request
Advanced Scientific Computing	383.2	410.3	428.3	405.0	463.5	541.0	621.0
Basic Energy Sciences	1,599.0	1,638.5	1,644.8	1,551.3	1,662.7	1,733.2	1,849.3
Biological and Environmental Research	588.0	595.2	592.4	560.7	593.6	592.0	612.4
Fusion Energy Sciences	417.7	367.3	393.0	377.8	495.9	467.5	420.0
High Energy Physics	790.8	775.6	770.5	727.5	774.9	766.0	788.0
Nuclear Physics	522.5	527.7	534.6	507.2	554.8	595.5	624.6
Workforce Development for Teachers and Scientists	20.7	22.6	18.5	17.5	26.5	19.5	20.5
Science Laboratories Infrastructure	127.6	125.7	111.8	105.7	97.8	79.6	113.6
Safeguards and Security	83.0	83.8	80.6	77.5	87.0	93.0	103.0
Program Direction	189.4	202.5	185.0	174.9	185.0	183.7	187.4
SBIR/STTR (Science Contribution)	107.4	108.4	114.1	116.1	128.5	–	–
Subtotal	**4,829.1**	**4,857.7**	**4,873.6**	**4,621.1**	**5,070.2**	**5,071.0**	**5,339.8**
SBIR/STTR (DOE-wide transfer)	60.2	54.6	61.3	60.1	64.7	–	–
Use of prior year balances	-153.0	-15.0	–	–	-3.8	–	–
Rescission of prior year balances	–	–	–	–	–	-3.3	–
Total	**4,963.9[d]**	**4,897.3**	**4,935.0**	**4,681.2**	**5,131.0**	**5,067.7**	**5,339.8**

Source: Office of Science annual budget requests to Congress and related materials from http://science.energy.gov/budget/.

Notes: "SBIR/STTR (Science Contribution)" includes funding reprogrammed from within the Office of Science to support the SBIR/STTR programs. "SBIR/STTR (DOE-wide transfer)" includes funding transferred from other DOE accounts to Science for the SBIR/STTR programs. For more information about the SBIR/STTR programs, see CRS Report R43695, *Small Business Innovation Research and Small Business Technology Transfer Programs*, by John F. Sargent Jr.

a. The FY2012 column reflects the original Science appropriation minus the allocation of a DOE-wide general reduction for a contractor pay freeze.

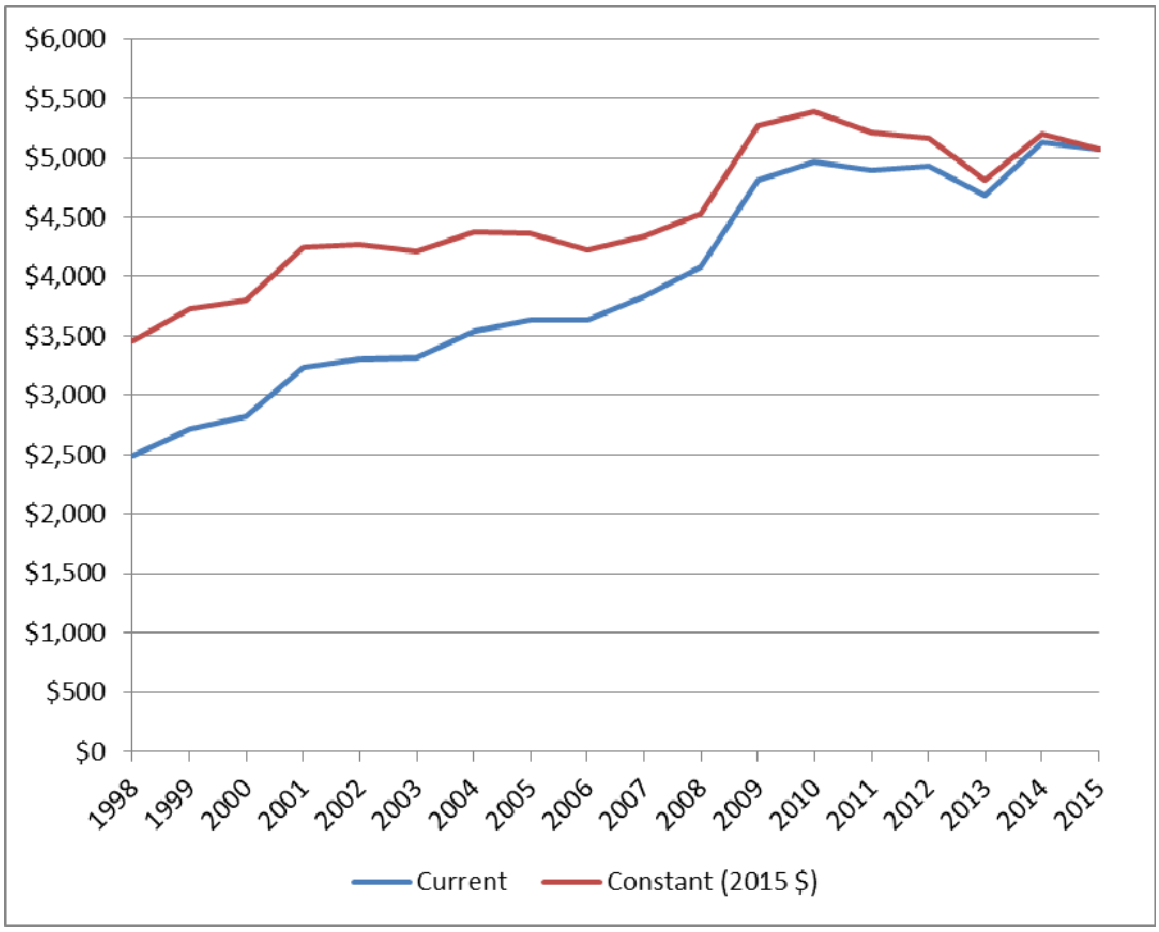
b. The FY2013 column includes the original appropriation and the allocation of a 5.2% reduction for the sequester and rescissions from P.L. 113-6 (Consolidated and Further Continuing Appropriations Act, 2013).

c. The FY2014 column contains a reduction of $4.6 million for the Science share of a $7 million DOE-wide reduction for contractor foreign travel.

d. This FY2010 total also includes $74.7 million in congressionally directed spending.

Figure 1. Office of Science Appropriations, FY1998-FY2015

(budget authority in $ millions, rounded)



Source: FY2000 to FY2016 Office of Science budget requests from the Office of Science, "Budget" website at http://science.energy.gov/budget/.

Notes: These trends do not adjust for changes in policy or in the character of Science activities over the examined time period. DOE may have increased or decreased program responsibilities—such as expanding or reducing the number of programs or changing the workload within programs—within this account during the observed period.

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