

19. RESEARCH AND DEVELOPMENT

The President is committed to making investments in research and development (R&D) that will grow our economy and enable America to remain the world leader in innovation. The Nation depends on science, technology, and innovation to promote sustainable economic growth and job creation, maintain a safe and sufficient food supply, improve the health of all Americans, move toward a clean energy future, address global climate change, manage competing demands on environmental resources, and ensure the Nation's security. Investing in science and technology-based innovation will produce vaccines that stay ahead of drug-resistant bacteria, find new answers in the fight against Alzheimer's and other diseases, devise new clean energy technologies, and promote new advanced manufacturing opportunities in areas such as robotics.

The President's 2017 Budget provides \$152 billion for Federal research and development (R&D), including the conduct of R&D and investments in R&D facilities and equipment (see Table 19-1). Detailed definitions and discussion are available in Section II below. The Administration continues to prioritize R&D, providing a

4 percent funding increase over 2016 enacted levels¹ for R&D. Reflecting the high priority of R&D in a time of limited discretionary funding, the FY 2017 Budget includes \$4 billion in R&D supported by new mandatory funding proposals across a range of topics from health to clean energy technologies. In conjunction with this investment, the 2017 Budget proposes to build on recently-enacted legislation expanding and making permanent the Research and Experimentation tax credit by proposing to simplify and further expand the credit, spurring increased private investment in R&D.

The 2017 Budget continues to strengthen U.S. international leadership by investing in the high-tech knowledge-based economy and innovation-fueled growth industries. The investments proposed in the 2017 Budget align with the recent update to the Strategy for American Innovation to help ensure that the United States continues its long-standing and robust leadership in public and private sector R&D and maintains the high quality of our R&D institutions and the entrepreneurial nature of our R&D enterprise.

¹ R&D spending figures for FY 2016 are preliminary and may change as agency operating plans are finalized.

I. PRIORITIES FOR FEDERAL RESEARCH AND DEVELOPMENT

The Budget provides support for a broad spectrum of research and development, including multidisciplinary research and exploratory, potentially transformative, high-risk research proposals that could fundamentally improve our understanding of nature, revolutionize fields of science, and lead to the development of radically new technologies. Federal Government funding for R&D is essential to address societal needs in areas in which the private sector does not have sufficient economic incentive to make the required investments. Key among these is the fundamental, curiosity-driven inquiry that has been a hallmark of the American research enterprise and a powerful driver of surprising, new technology. The Budget provides \$73 billion for basic and applied research, an increase of \$4 billion (6%) from 2016 enacted because research is a reliable source of the new knowledge that drives job creation and lasting economic growth.

Many research investments into the most promising areas for future industry, scientific discovery, and job creation are being addressed through multi-agency research activities coordinated through the National Science and Technology Council (NSTC) and other interagency forums. Most of these challenges simply cannot be addressed effectively by a single agency. Moreover, innovation often arises from combining the tools, techniques, and insights from multiple agencies.

The 2017 Budget proposes both discretionary and new mandatory funding to continue increasing the total Federal investment in the combined budgets of three key basic research agencies: the National Science Foundation (NSF), the Department of Energy (DOE) Office of Science, and the laboratories of the Department of Commerce (DOC) National Institute of Standards and Technology (NIST). The Budget proposes \$14.6 billion in 2017 for these three agencies, an increase of \$0.9 billion over the 2016 enacted level.

Moving Toward Cleaner American Energy

The President's Climate Action Plan outlines several key objectives for the United States to lead the world in clean energy. The Administration is committed to a future where the United States leads the world in research, development, demonstration, and deployment of clean-energy technologies to reduce air pollution, greenhouse-gas emissions, and dependence on oil, while creating high-wage, highly-skilled clean energy jobs and new businesses.

The 2017 Budget supports the United States' participation in Mission Innovation, the landmark 20-nation commitment to dramatically accelerate public and private global clean energy innovation that was launched at the start of the Paris climate change conference in November 2015. As part of its participation in Mission Innovation, the U.S. Government will seek to double its current level

of Federal fiscal year investment in clean energy R&D over five years, from \$6.4 billion in 2016 to \$12.8 billion in 2021. New funding will initially be strategically allocated to early stage research and development, which offers some of the greatest opportunities for breakthroughs and transformative change. However, this investment portfolio spans the full range of research and development – from basic research to demonstration activities. The 2017 Budget provides \$7.7 billion in discretionary funding for clean energy R&D, demonstrating a strong U.S. commitment to the Mission Innovation doubling pledge.

Funding for clean energy R&D is part of a broader portfolio of clean energy technology programs that includes investments in deployment and other related activities. In total, the 2017 Budget provides approximately \$9 billion in discretionary funding government-wide for clean energy technology programs.

In DOE, the 2017 Budget provides about \$6.8 billion in discretionary funding for clean energy technology programs, including \$5.9 billion for research, development, and demonstration activities that contribute to Mission Innovation. Specifically, it provides \$2.9 billion for the Office of Energy Efficiency and Renewable Energy, of which \$2.1 billion is part of Mission Innovation. This \$2.9 billion supports efforts to accelerate research and development, build on ongoing successes, increase the use of critical clean energy technologies, and further reduce costs and reflects increases above 2016 enacted levels of 37 percent for sustainable vehicle and fuel technologies, 28 percent for energy efficiency and advanced manufacturing activities, and 34 percent for innovative renewable power projects. The 2017 Budget also provides over \$1.8 billion for basic clean energy research in the Office of Science and supports investments in a modernized electric grid with \$177 million for clean energy R&D in the Office of Electricity Delivery and Energy Reliability. The Budget supports clean energy R&D through the Office of Nuclear Energy and Office of Fossil Energy, including funding for advanced reactors R&D, quantification and mitigation of methane emissions from natural gas infrastructure, and activities primarily dedicated to further lowering the costs of carbon capture and storage. In addition, the Budget includes \$500 million through a mix of discretionary and mandatory funding for the Advanced Research Projects Agency–Energy (ARPA-E).

The Budget also supports the Administration's 21st Century Clean Transportation Plan, a new mandatory proposal, which includes a number of R&D programs, as well as support for clean transportation system deployment. Through this Plan the Budget provides \$500 million in FY 2017 to scale-up clean transportation R&D through initiatives to accelerate cutting the cost of battery technology; advance the next generation of low carbon biofuels, in particular for intermodal freight and fleets; and establish a smart mobility research center to investigate systems level energy implications of vehicle connectivity and automation. Also as part of the Plan, the Budget provides \$100 million at NASA to support a new era of low carbon emission aircraft by initiating a series of experimental aircraft in partnership with indus-

try and universities, and \$200 million in Department of Transportation funding for safety research to accelerate the development of autonomous vehicles.

The Budget invests in breakthrough R&D that reduces the price, energy input, and carbon emissions levels of new water supply technology, which can provide communities in water-stressed regions with new and more effective options to meet their increasing water supply needs. Examples include \$45 million for the Department of Energy to launch a new Energy-Water Desalination Hub and conduct complementary R&D; \$98.6 million for the Department of the Interior's WaterSMART program, which promotes water conservation initiatives, improved water data, and technological breakthroughs; \$15 million in additional funding for Department of Agriculture's (USDA) research on water supplies and conservation practices such as building healthy soils that retain water; and \$88 million for the National Science Foundation (NSF) to support basic water research to enhance the scientific and engineering knowledge base.

Understanding and Responding to Global Climate Change and Its Impacts

While investing in clean energy, the President's Climate Action Plan also provides a blueprint for responsible national and international action to slow the effects of climate change. 2015, on the heels of record-warm 2014, was the warmest year on record, and by a record margin. One of the key activities supported in the Climate Action Plan is actionable climate science, which is critical in helping government officials, communities, and businesses better understand and manage the risks associated with climate change. In support of this goal, the Administration has continued, through the U.S. Global Change Research Program (USGCRP), to advance actionable climate science to improve our understanding of climate change and its impacts, requesting approximately \$2.8 billion for these programs. The USGCRP coordinates and integrates Federal research and applications to assist the Nation and the world in understanding, assessing, predicting, and responding to the human-induced and natural processes of climate change and their related impacts and effects. Within coordinated USGCRP inter-agency investments, the 2017 Budget supports the goals set forth in the program's 2012-2021 strategic plan, which include: advancing scientific knowledge of the integrated natural and human components of the Earth; providing the scientific basis to inform and enable timely decisions on adaptation and mitigation; building sustained assessment capacity that improves the United States' ability to document changes on the regional, landscape, and local level to understand, anticipate, and respond to climate change impacts and vulnerabilities; and advancing communications and education to broaden public understanding of climate change. The 2017 Budget also supports an integrated suite of climate change observations, process-based research, modeling and assessment, and adaptation science activities that serve as a foundation for providing timely and responsive information, including but not limited to technical reports, impact

and vulnerability assessments, and adaptation response strategies to a broad array of stakeholders. The Budget prioritizes the development and use of actionable data, information, and related tools needed to prepare for and reduce climate-related risks and prioritizes investments that support technical assistance for community climate-preparedness efforts. This includes \$20 million to continue expanding and improving the online Climate Resilience Toolkit, which provides scientific tools and information to help tribes, communities, citizens, businesses, planners, and others manage their climate-related risks and opportunities, and improve their resilience to extreme events.

Observing our Planet

Earth-observation data are instrumental to services that protect human life, property, the economy, and national security, and advance understanding of the Earth as a system. The Budget supports investments in Earth observations, such as Earth-observing satellites and monitoring of water, air, wildlife, invasive species, and ecosystems, consistent with the 2014 National Plan for Civil Earth Observations. Within the National Aeronautics and Space Administration (NASA), the Budget provides \$2.0 billion to sustain progress toward satellite missions and research that will improve our understanding of Earth, its atmosphere, and oceans. The Budget provides \$2.1 billion for the National Oceanic and Atmospheric Administration's (NOAA) satellite programs, including the next generation of polar-orbiting and geostationary satellite systems that are critical to weather forecasting. Satellite observations contribute directly to the National Weather Service's ability to issue public warnings to protect life and property. The Budget also supports space weather science and preparedness according to the 2015 National Space Weather Strategy and Action Plan; space weather observations and R&D are essential to address the growing societal needs for accurate and timely space weather information. The Budget begins planning for the next generation of NOAA space-weather satellites, increases funding for space weather-related research at NASA, and provides \$1.7 million at the U.S. Geological Survey for improved geomagnetic monitoring to support space weather alerts and warnings.

Promoting Advanced Manufacturing and Industries of the Future

The Administration is committed to the continued strengthening of America's manufacturing sector. The Budget continues to support the National Strategic Plan for Advanced Manufacturing, a blueprint for Federal efforts in partnership with industry and universities to develop and commercialize the emerging technologies that will create high-quality manufacturing jobs and sustain a renaissance in American manufacturing. The 2017 Budget provides \$2.0 billion for Federal R&D directly supporting advanced manufacturing at NSF, the Department of Defense (DOD), DOE, DOC, and other agencies, consistent with the goals and recommendations of the Strategic Plan. The Budget funds a national network of 45 manufacturing innovation institutes that will

position the United States as a global leader in advanced manufacturing technology. Specifically, the Budget builds on the 13 institutes already funded through 2016 with more than \$250 million in additional discretionary funds to support these and 5 new manufacturing innovation institutes in DOC, DOD, and DOE, which will solicit proposals on a wide-range of focus areas across the manufacturing sector. The Budget also includes a mandatory spending proposal of \$1.9 billion to fund the remaining 27 institutes in the network.

Improving Americans' Health through Innovation in Life Sciences, Biology, and Neuroscience

The Administration is committed to Federal R&D investments in fundamental biological discovery research that could generate unexpected, high-impact scientific and technological advances in health. The 2017 Budget strongly supports research that has the potential to foster innovations in health and to accelerate the pace of discovery in the life sciences, especially cancer, neuroscience, and Precision Medicine. These discoveries will help improve the prevention and treatment of diseases and support the bioeconomy of the future.

The 2017 Budget proposes \$33.1 billion for the National Institutes of Health (NIH), through a mix of discretionary, enacted mandatory, and new mandatory funding to support high-quality, innovative biomedical research both on-campus and at research institutions across the country. The Budget supports basic and translational research to increase understanding of the causes of disease and spur development of diagnostic tests, treatments, and cures. As a part of the cancer "moonshot," an effort that will be led by the Vice President, the Budget provides an increase of \$680 million to accelerate progress in preventing, diagnosing, and treating cancer. The Budget's multi-year cancer initiative, which begins in FY 2016, provides resources to improve health and outcomes for patients through investments in research and infrastructure, and brings together researchers across sectors and scientific disciplines. The Budget also increases NIH investments in the multi-agency BRAIN initiative and includes \$300 million for NIH's contribution to the Precision Medicine Initiative aimed at tailoring medical care to the individual patient.

The Budget includes \$530 million in mandatory R&D funding for the independent Patient-Centered Outcomes Research Institute to conduct clinical comparative effectiveness research, as authorized by the Affordable Care Act.

The Budget also proposes \$1.3 billion for medical and prosthetic research across the Department of Veterans Affairs (VA). VA supports a robust program of basic and clinical research with a focus on ensuring continuous lifecycle care for veterans with an emphasis on Precision Medicine.

Strengthening Our National and Homeland Security through Science and Technology

Federal R&D investments in security aim to meet the threats of the future and to develop new innovative se-

curity capabilities. DOD R&D investments in the 2017 Budget focus on areas deemed to have the greatest impact on our nation and future military requirements. To this end, the 2017 Budget provides \$72.8 billion for DOD R&D, an increase of 2.8 percent from the 2016 enacted level. The 2017 Budget proposes \$12.5 billion for DOD's Science & Technology program, a subset of DOD R&D which consists of basic research, applied research and advanced technology development.

The 2017 Budget also maintains DOD's critical role in fostering breakthrough approaches for promising technologies with \$3.0 billion for the Defense Advanced Research Projects Agency (DARPA), which promotes advanced research to create breakthrough technologies for tomorrow's military systems. Investing in DARPA's high-risk and high-reward science is an Administration priority and critical to maintaining the technological superiority of the U.S. military.

For DOE's National Nuclear Security Administration, the Budget proposes \$7.1 billion for investments in R&D to help effectively manage the Nation's nuclear stockpile, advance naval nuclear propulsion, and achieve our non-proliferation goals.

The Budget supports investments in state-of-the-art technologies and solutions for Federal, State, and local homeland security operators, including \$583 million in funding for the Department of Homeland Security R&D programs that protect the Nation's people and critical infrastructure from chemical, biological, radiological, nuclear, and cyber-attacks as well as other hazards.

Innovating in Information Technology and High-Performance Computing

High-performance computing (HPC) systems, through a combination of processing capability and storage capacity, can solve computational problems that are beyond the capability of small- to medium-scale systems. They are vital to the Nation's interests in science, medicine, engineering, technology, and industry. In July 2015, the Administration launched the National Strategic Computing Initiative (NSCI) as a whole-of-government effort to create a cohesive, multi-agency strategic vision and Federal investment strategy in HPC. This strategy will be executed in collaboration with industry and academia, maximizing the benefits of HPC for the United States. The NSCI will spur the creation and deployment of computing technology at the leading edge, helping to advance Administration priorities for economic competitiveness, scientific discovery, and national security. The 2017 Budget supports NSCI investments through many agencies, with major investments within DOE (\$285 million) and NSF (\$33 million).

Federal IT R&D, which launched and fueled the digital revolution, continues to drive innovation in scientific research, national security, communication, and commerce to sustain U.S. technological leadership. The multi-agency Networking and Information Technology Research and Development (NITRD) Program provides strategic planning for and coordination of agency research efforts in big data, cyber-physical systems, cybersecurity, health IT

high-confidence systems, high-end computing systems, human computer interaction, IT workforce development, large-scale networking, software design, wireless spectrum sharing, and other research relevant to advanced information technologies.

The 2017 Budget includes a focus on research to address the challenges and opportunities afforded by big data while providing appropriate privacy protections for personal data. The Budget continues to prioritize cybersecurity research to develop novel approaches and technologies that can protect U.S. systems from cyberattacks, consistent with the Federal Cybersecurity Research and Development Strategic Plan, to be released concurrently with the Budget.

Informing Better Stewardship of the Ocean and the Arctic

Sustainable stewardship of the ocean and the Arctic requires strong investments in research and development in the natural sciences to strengthen the scientific basis for decision-making. The 2017 Budget provides robust R&D funding to support responsible ocean stewardship, including observations, modeling, and data accessibility needed to support ecosystem-based management, as well as to advance understanding and inform responses to current and future climate impacts on oceans, Great Lakes, and surrounding communities. The Budget provides \$520 million for NOAA's oceanic and atmospheric research programs and \$63 million for NSF's arctic research programs. The 2017 Budget also advances the objectives of the Interagency Arctic Research Policy Committee Arctic Research Plan and the newly-created Arctic Executive Steering Committee, which coordinates efforts on Arctic science, resource management, conservation, indigenous peoples, and international engagement through the 2015-17 U.S. Chairmanship of the eight-nation Arctic Council.

Growing Agriculture Research for Future Generations

Agriculture has a significant impact on the economy and well-being of the United States. The Budget recognizes the importance of science and technology to meet the challenges and opportunities in agriculture, and provides significant investment increases, through a mix of discretionary, enacted mandatory, and new mandatory funding. There are three major agricultural R&D programs. They are (1) competitive research grants through the Department of Agriculture's flagship Agriculture and Food Research Initiative, which are funded at the authorized level of \$700 million, double the funding provided in FY 2016; (2) the Department's in-house research programs, which are funded at \$1.16 billion, and include increases for key initiatives: anti-microbial resistance, climate change, foreign animal diseases and Highly Pathogenic Avian Influenza, and water resources to support agricultural production; and (3) key infrastructure investments, which are funded at \$95 million, which would continue the Department's program to prepare its facilities for the 21st Century.

Expanding Our Capabilities in Space

The Budget provides \$19.0 billion for NASA to support the President's vision for innovation and scientific discovery on Earth and beyond, through a mix of discretionary and new mandatory funding proposals. NASA drives innovation in the aerospace sector and enhances the Nation's capabilities in space in areas such as communications, space-based observations, space transportation, and scientific discovery. The Budget provides \$1.2 billion for the Commercial Crew program, continuing the development of safe and affordable systems to transport astronauts to orbit and working to eliminate our sole reliance on Russia for crew transport to the International Space Station. The Budget also provides \$827 million for Space Technology and \$324 million for Advanced Exploration Systems to develop technologies that will reduce the cost and increase the capabilities of NASA, other government, and commercial space activities. Within this funding the Budget supports early-stage public-private partnerships leading to the development of habitation modules that will play an important part in human space exploration and may have spinoff benefits to the commercial space economy closer to Earth.

Nanotechnology R&D

Working cooperatively through the National Nanotechnology Initiative (NNI), Federal agencies continue to support R&D aimed at creating a future in which the ability to understand and control matter at the nanoscale leads to a revolution in technology and industry that benefits society. Agencies participating in the NNI conduct R&D on materials, devices, and systems that exploit the unique physical, chemical, and biological properties that emerge in materials at the nanoscale (approximately 1 to 100 nanometers). Participating agencies continue to support fundamental research for nanotechnology-based innovation, technology transfer, and nanomanufacturing through individual investigator awards; multidisciplinary centers of excellence; education and training; and infrastructure and standards development, including openly-accessible user facilities and networks. NNI agencies will also continue their strong support for R&D on the environmental, health, and safety aspects of nanotechnology needed to ensure responsible development. NNI agencies and the National Nanotechnology Coordination Office (NNCO) will work with the business community, state and local governments, and the private sector to explore new approaches and leverage existing programs to foster broader commercialization of nanotechnology-enabled products. In addition, NNI agencies and the NNCO will continue to expand stakeholder engagement to advance nanotechnology-based STEM education, training, and outreach. Budget information is available at www.nano.gov.

Bridging the Barriers from Lab-to-Market

After the work of research and technology development is completed, additional work is necessary to translate the results into new capabilities and products that can

spur economic growth and other societal benefits. The Federal R&D enterprise will continue to support fundamental research that is motivated primarily by our interest in expanding the frontiers of human knowledge, and will continue to diffuse this knowledge through open data and publications. At the same time, there remains significant potential to increase the public's return on this investment through effective partnerships with academia, industry, and regional innovation networks. For example, NASA has partnered with companies to make experimentation on the International Space Station more accessible to researchers – an approach that has played a significant role in jump-starting a new industry in very small satellites. In the case of the Department of Energy, industry partnerships can help broadly develop and deploy important next generation energy technologies and high-performance computers.

The Budget reflects the Administration's commitment to accelerating the transfer of the results of Federally funded research to the commercial marketplace by prioritizing funding for Lab-to-Market programs at the National Institute of Standards and Technology (NIST) (\$8 million) and for the National Science Foundation's (NSF) Innovation Corps (I-Corps) program (\$30 million). Both of these efforts are developing tools and best practices to commercialize the results of Federally-funded R&D. For example, the I-Corps program at NSF has 10 agreements with other Federal agencies that are using its experiential entrepreneurial curriculum to train research scientists, graduate students, and other entrepreneurs in how to identify and mature discoveries ripe for commercialization. In addition, I-Corps has a growing number of partnerships with non-Federal entities such as the State of Ohio. The Budget also provides \$50 million in mandatory funding for a new competitive grant program, building on the success of prior Economic Development Administration led activities, to incentivize partnerships between Federal Labs, academia and regional economic development organizations enabling the transfer of knowledge and technologies from Labs to private industry for commercialization. In addition, the Department of Energy (DOE) is making the technologies and tools developed by its national labs more available to small businesses and entrepreneurs through innovative approaches designed to unlock new business or productive opportunities. (For additional details on this Cross Agency Priority goal see performance.gov)

Preparing Our Students with Skills through Science, Technology, Engineering, and Mathematics (STEM) Education

Our Nation's competitiveness depends on our ability to improve and expand STEM learning in the United States. Over the past several years, the Administration has made considerable progress towards creating a more cohesive framework for delivering STEM education. Guided by the Federal STEM Education Five-Year Strategic Plan, agencies are increasing coordination, strengthening partnerships, and identifying ways to leverage existing resources to improve the reach of agency assets. The

2017 Budget builds on these efforts, ensuring that investments are aligned with the Strategic Plan and support effective programs with strategic approaches to evaluation. The Budget invests \$3.0 billion in STEM education programs, maintaining the level supported in 2016 en-

acted, including \$100 million for a new Computer Science for All program within the Department of Education; as well as \$332 million for graduate fellowships, \$59 million for graduate traineeships, and \$109 million for improving undergraduate education at NSF.

II. FEDERAL R&D DATA

R&D is defined as the collection of efforts directed toward gaining greater knowledge or understanding and applying knowledge toward the production of useful materials, devices, and methods. R&D investments can be characterized as basic research, applied research, development, R&D equipment, or R&D facilities. The Office of Management and Budget has used those or similar categories in its collection of R&D data since 1949.

Background on Federal R&D Funding

More than 20 Federal agencies fund R&D in the United States. The character of the R&D that these agencies fund depends on the mission of each agency and on the role of R&D in accomplishing it. Table 19–1 shows agency-by-agency spending on basic research, applied research, development, and R&D equipment and facilities.

Basic research is systematic study directed toward a fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. Basic research, however, may include activities with broad applications in mind.

Applied research is systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.

Development is systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

Research and development equipment includes acquisition or design and production of movable equipment, such as spectrometers, research satellites, detectors, and other instruments. At a minimum, this category includes programs devoted to the purchase or construction of R&D equipment.

Research and development facilities include the acquisition, design, and construction of, or major repairs or alterations to, all physical facilities for use in R&D activities. Facilities include land, buildings, and fixed capital equipment, regardless of whether the facilities are to be used by the Government or by a private organization, and regardless of where title to the property may rest. This category includes such fixed facilities as reactors, wind tunnels, and particle accelerators.

While the definitions for R&D activities have been stable for decades, interpretations of which programs are conducting R&D can vary with time. During the past year, DOE has been working to improve the consistency of their reporting of administrative activities that support R&D, consistent with the international standards. Because of these efforts, the DOE R&D amounts have increased in comparison to previous years. This effort is an example of more comprehensive Government-wide efforts currently underway to increase the accuracy and consistency of the R&D budget. The Federal executive agencies are working collaboratively, under a NSTC working group, to identify best practices and standards for the most accurate classification and reporting of R&D activities.

Table 19-1. FEDERAL RESEARCH AND DEVELOPMENT SPENDING
(Mandatory and discretionary budget authority¹, dollar amounts in millions)

	2015 Actual	2016 Enacted	2017 Proposed	Dollar Change: 2016 to 2017	Percent Change: 2016 to 2017
By Agency²					
Defense	65,547	70,872	72,825	1,953	3%
Health and Human Services	30,453	31,942	32,714	772	2%
Energy ³	14,354	14,405	17,160	2,755	19%
NASA	12,145	12,410	12,043	-367	-3%
National Science Foundation	5,944	6,117	6,529	412	7%
Agriculture	2,452	2,674	2,923	249	9%
Commerce	1,524	1,913	1,888	-25	-1%
Veterans Affairs	1,178	1,220	1,252	32	3%
Interior	863	981	1,082	101	10%
Transportation	885	924	1,065	141	15%
Homeland Security	919	579	585	6	1%
Environmental Protection Agency	523	516	530	14	3%
Patient-Centered Outcomes Research Trust Fund	396	472	530	58	12%
U.S. Agency for International Development	250	275	287	12	4%
Smithsonian Institution	246	250	270	20	8%
Education	279	242	248	6	2%
Other	320	346	402	56	16%
TOTAL	138,278	146,138	152,333	6,195	4%
Basic Research					
Defense	2,225	2,320	2,115	-205	-9%
Health and Human Services	15,055	15,972	16,323	351	2%
Energy	4,477	4,609	4,932	323	7%
NASA	3,198	3,562	3,537	-25	-1%
National Science Foundation	4,878	4,941	5,257	316	6%
Agriculture	993	1,028	1,162	134	13%
Commerce	214	223	239	16	7%
Veterans Affairs	484	505	542	37	7%
Interior	53	54	63	9	17%
Transportation					
Homeland Security	41	41	40	-1	-2%
Environmental Protection Agency					
Patient-Centered Outcomes Research Trust Fund					
U.S. Agency for International Development	1	1	4	3	300%
Smithsonian Institution	210	218	237	19	9%
Education	7	18	16	-2	-11%
Other	18	18	18	0	0%
SUBTOTAL	31,854	33,510	34,485	975	3%
Applied Research					
Defense	4,653	5,056	4,884	-172	-3%
Health and Human Services	15,199	15,760	16,138	378	2%
Energy	5,624	5,346	7,108	1,762	33%
NASA	2,402	2,757	3,012	255	9%
National Science Foundation	691	752	813	61	8%
Agriculture	1,114	1,113	1,357	244	22%
Commerce	891	942	1,015	73	8%
Veterans Affairs	618	639	634	-5	-1%
Interior	685	790	886	96	12%
Transportation	688	612	758	146	24%
Homeland Security	207	176	168	-8	-5%
Environmental Protection Agency	442	430	446	16	4%
Patient-Centered Outcomes Research Trust Fund	396	472	530	58	12%
U.S. Agency for International Development	202	223	211	-12	-5%

Table 19-1. FEDERAL RESEARCH AND DEVELOPMENT SPENDING—Continued
(Mandatory and discretionary budget authority¹, dollar amounts in millions)

	2015 Actual	2016 Enacted	2017 Proposed	Dollar Change: 2016 to 2017	Percent Change: 2016 to 2017
Smithsonian Institution .....	.....	.....	.....	.....	.....
Education	159	135	132	-3	-2%
Other	207	236	269	33	14%
SUBTOTAL	34,178	35,439	38,361	2,922	8%
Development					
Defense	58,553	63,463	65,631	2,168	3%
Health and Human Services	26	30	30	0	0%
Energy	3,263	3,338	3,982	644	19%
NASA	6,481	5,954	5,357	-597	-10%
National Science Foundation .....	.....	.....	.....	.....	.....
Agriculture	177	176	179	3	2%
Commerce	188	348	303	-45	-13%
Veterans Affairs	76	76	76	0	0%
Interior	89	135	131	-4	-3%
Transportation	172	277	272	-5	-2%
Homeland Security	356	354	377	23	6%
Environmental Protection Agency	76	81	79	-2	-2%
Patient-Centered Outcomes Research Trust Fund .....	.....	.....	.....	.....	.....
U.S. Agency for International Development	47	51	72	21	41%
Smithsonian Institution .....	.....	.....	.....	.....	.....
Education	113	89	100	11	12%
Other	102	94	115	21	22%
SUBTOTAL	69,719	74,466	76,704	2,238	3%
Facilities and Equipment					
Defense	116	33	195	162	491%
Health and Human Services	173	180	223	43	24%
Energy	990	1,112	1,138	26	2%
NASA	64	137	137	0	0%
National Science Foundation	375	424	459	35	8%
Agriculture	168	357	225	-132	-37%
Commerce	231	400	331	-69	-17%
Veterans Affairs .....	.....	.....	.....	.....	.....
Interior	36	2	2	0	0%
Transportation	25	35	35	0	0%
Homeland Security	315	8	0	-8	-1
Environmental Protection Agency	5	5	5	0	0%
Patient-Centered Outcomes Research Trust Fund .....	.....	.....	.....	.....	.....
U.S. Agency for International Development .....	.....	.....	.....	.....	.....
Smithsonian Institution	36	32	33	1	3%
Education .....	.....	.....	.....	.....	.....
Other	-7	-2	0	2	100%
SUBTOTAL	2,527	2,723	2,783	60	2%

¹ This table shows funding levels for Departments or Independent agencies with more than \$200 million in R&D activities in 2017.

² Some numbers in the chapter text include non-R&D activities and thus will be different from the R&D numbers in this table.

³ In this Budget, Department of Energy began reporting additional administrative expenses, consistent with international and government-wide standards. This led to an increase in reporting of R&D investments on the order of \$2 to \$3 billion a year.