18. RESEARCH AND DEVELOPMENT

Innovation in science and technology has been a cornerstone of America's economic progress since the founding of this nation. The most recent estimate of total U.S. research and development (R&D) spending was about $495 billion, an amount greater than any other country and more than a quarter of the global total.[1] While the private sector funds and performs the majority of U.S. R&D, the Federal government has an important role in funding R&D in areas that industry does not have a strong incentive to invest in and in areas of critical importance to national and economic security. The Federal government has been the leading source of support for basic research and provides more than 25 times the amount funded by state and local governments in total R&D.[2] Prior Federally funded R&D has greatly advanced human knowledge, and applications of that knowledge permeate our lives—from the phones we carry, to the cars we drive, to the medicines that return us to health. Recognizing the critical importance of fostering innovation to promote America's interests, including competitiveness, economic and job growth, and national security, the 2019 Budget continues support of investments in basic research, early-stage applied research, and technology transfer efforts that will lead to the breakthroughs of the future.

The President's 2019 Budget provides $118.1 billion for Federal R&D, including the conduct of R&D and investments in R&D facilities and equipment (see Table 18-2). This figure applies a change to the R&D definitions introduced in July 2016 per OMB Circular A-11. Under the former R&D definitions, the President's 2019 Budget provides $156.8 billion for R&D, a $2.8 billion (or 2%) increase over the FY 2018[3] level, and includes an $18.1 billion increase for Defense-related R&D. Detailed R&D definitions and a discussion of the definition change are available in Section II. Table 18-1 shows a breakout of FY 2019 R&D funding by major funding agencies at the bureau or account level.

[1] National Science Board. 2018 Science and Engineering Indicators. January 2018.

[2] NSF National Center for Science and Engineering Statistics (Dec. 2017). InfoBrief - NSF 18-306.

[3] Because an appropriation for FY 2018 was not passed by the time this chapter went to print, the chapter calculates FY 2018 estimates using an annualized version of the FY 2018 Continuing Resolution.

Table 18–1. TOTAL FEDERAL R&D FUNDING BY AGENCY AT THE BUREAU OR ACCOUNT LEVEL

(Mandatory and discretionary budget authority[1,2], dollar amounts in millions)

	2017 Actual	2018 Annualized CR	2019 Proposed	Dollar Change: 2018 to 2019	Percent Change: 2018 to 2019
By Agency					
Agriculture	2,585	2,487	1,914	–573	–23%
Agriculture Research Service	1,298	1,289	855	–434	–34%
Animal and Plant Health Inspection Service	40	39	34	–5	–13%
Economic Research Service	87	86	45	–41	–48%
Forest Service	282	281	235	–46	–16%
National Agricultural Statistics Service	9	9	9	0	0%
National Institute of Food and Agriculture	869	783	736	–47	–6%
Commerce	1,794	1,833	1,361	–472	–26%
Bureau of the Census	232	237	165	–72	–30%
National Institute of Standards and Technology	750	746	564	–182	–24%
National Oceanic and Atmospheric Administration	804	839	619	–220	–26%
National Telecommunications and Information Administration	8	11	13	2	18%
Defense[3]	49,197	43,616	57,156	13,540	31%
Military Construction	155	37	53	16	43%
Military Personnel	410	439	455	16	4%
Defense Health Program	1,452	336	362	26	8%
Research, Development, Test, and Evaluation	47,180	42,804	56,286	13,482	31%
Education	254	243	240	–3	–1%
Institute of Education Sciences	226	219	216	–3	–1%
Office of Postsecondary Education	3	0	0	0	0%
Office of Special Education and Rehabilitative Services	23	24	24	0	0%
Office of Career, Technical, and Adult Education	2	0	0	0	0%

Table 18–1. TOTAL FEDERAL R&D FUNDING BY AGENCY AT THE BUREAU OR ACCOUNT LEVEL—Continued

(Mandatory and discretionary budget authority[1,2], dollar amounts in millions)

	2017 Actual	2018 Annualized CR	2019 Proposed	Dollar Change: 2018 to 2019	Percent Change: 2018 to 2019
Energy	14,896	15,006	12,685	–2,321	–15%
Fossil Energy Research and Development	399	419	292	–127	–30%
Science	5,438	5,307	4,127	–1,180	–22%
Electricity Delivery	144	144	46	–98	–68%
Nuclear Energy	764	955	754	–201	–21%
Energy Efficiency and Renewable Energy	1,445	1,492	524	–968	–65%
Advanced Research Projects Agency--Energy	306	295	0	–295	–100%
Cybersecurity, Energy Security, and Emergency Response	0	0	40	40	n/a
Defense Environmental Cleanup	28	28	28	0	0%
National Nuclear Security Administration	6,357	6,351	6,859	508	8%
Power Marketing Administration	15	15	15	0	0%
Environmental Protection Agency	497	496	269	–227	–46%
Science and Technology	481	480	256	–224	–47%
Hazardous Substance Superfund	15	15	12	–3	–20%
Inland Oil Spill Programs	1	1	1	0	0%
Health and Human Services	34,222	33,772	24,742	–9,030	–27%
Administration for Children and Families	16	5	89	84	1680%
Centers for Disease Control and Prevention	511	464	296	–168	–36%
Centers for Medicare and Medicaid Services	278	19	17	–2	–11%
Departmental Management	116	131	158	27	21%
Food and Drug Administration	390	410	410	0	0%
Health Resources and Services Administration	30	30	22	–8	–27%
National Institutes of Health[4]	32,881	32,713	23,750	–8,963	–27%
Homeland Security	724	672	548	–124	–18%
National Protection and Programs Directorate	6	6	48	42	700%
Science and Technology	597	527	371	–156	–30%
Transportation Security Administration	5	5	21	16	320%
United States Coast Guard	38	38	21	–17	–45%
United States Secret Service	3	2	3	1	50%
Management Directorate	3	3	3	0	0%
Countering Weapons of Mass Destruction Office	72	91	81	–10	–11%
Interior	953	964	759	–205	–21%
Bureau of Indian Affairs and Bureau of Indian Education	5	5	5	0	0%
Bureau of Land Management	23	23	23	0	0%
Bureau of Reclamation	72	104	83	–21	–20%
Bureau of Safety and Environmental Enforcement	27	27	21	–6	–22%
Department-Wide Programs	6	3	0	–3	–100%
National Park Service	27	26	24	–2	–8%
Office of Surface Mining Reclamation and Enforcement	1	1	1	0	0%
United States Fish and Wildlife Service	32	15	15	0	0%
United States Geological Survey	687	683	503	–180	–26%
Bureau of Ocean Energy Management	73	77	84	7	9%
National Aeronautics and Space Administration	10,704	10,243	10,651	408	4%
Science	5,668	5,666	5,820	154	3%
Aeronautics	517	508	488	–20	–4%
Low Earth Orbit and Spaceflight Operations	2,542	2,166	1,727	–439	–20%
Safety, Security and Mission Services	269	262	257	–5	–2%
Deep Space Exploration Systems	976	937	1,392	455	49%
Construction and Environmental Compliance and Restoration	52	22	54	32	145%
Exploration Research and Technology	680	682	913	231	34%
National Science Foundation	5,938	6,030	4,177	–1,853	–31%
Research and Related Activities	5,314	5,412	3,821	–1,591	–29%
Education and Human Resources	409	410	290	–120	–29%
Major Research Equipment and Facilities Construction	215	208	66	–142	–68%
Patient-Centered Outcomes Research Trust Fund	463	501	622	121	24%

Table 18–1. TOTAL FEDERAL R&D FUNDING BY AGENCY AT THE BUREAU OR ACCOUNT LEVEL—Continued

(Mandatory and discretionary budget authority[1,2], dollar amounts in millions)

	2017 Actual	2018 Annualized CR	2019 Proposed	Dollar Change: 2018 to 2019	Percent Change: 2018 to 2019
Transportation	904	929	826	–103	–11%
Federal Aviation Administration	433	439	351	–88	–20%
Federal Highway Administration	317	311	334	23	7%
Federal Motor Carrier Safety Administration	11	9	9	0	0%
Federal Railroad Administration	43	43	24	–19	–44%
Federal Transit Administration	0	28	22	–6	–21%
Maritime Administration	0	1	0	–1	–100%
National Highway Traffic Safety Administration	63	60	62	2	3%
Office of the Secretary	17	17	13	–4	–24%
Pipeline and Hazardous Materials Safety Administration	20	21	11	–10	–48%
Smithsonian Institution	251	242	271	29	12%
Veterans Affairs	1,346	1,338	1,345	7	1%
Medical Services	673	669	618	–51	–8%
Medical and Prosthetic Research	673	669	727	58	9%

[1] This table shows funding levels for Departments or Independent agencies with more than $200 million in R&D activities in 2019.

[2] The Experimental Development definition is used in this table across all three fiscal years.

[3] Unlike previous years, totals for Experimental Development spending in FY 2017-2019 do not include the DOD Budget Activity 07 (Operational System Development) due to changes in the definition of development. These funds are requested in the FY 2019 Budget request and support the development efforts to upgrade systems that have been fielded or have received approval for full rate production and anticipate production funding in the current or subsequent fiscal year.

[4] The FY 2019 Budget proposes to consolidate the activities of the Agency for Healthcare Research and Quality (AHRQ) within NIH. The NIH total includes R&D funding that previously occurred in AHRQ.

I. PRIORITIES FOR FEDERAL RESEARCH AND DEVELOPMENT

The President's Budget provides support for Federal R&D to enhance our national security, increase American economic prosperity, create well-paying American jobs, and improve the national science and technology enterprise. This section highlights key areas of R&D funding in the 2019 Budget.

Protecting the Homeland against Physical and Cyber Attacks

Worldwide advances in technology mean that the threats to our national security are changing. Nations best able to employ precision-guided weapons, track enemy movements in real-time, disrupt communications, and work seamlessly in the fight will prevail. The President's National Security Strategy affirms the importance of peace through strength, reiterating that U.S. military strength remains a vital component of our nation's security, and renewing calls for American military overmatch. Historically, Federal R&D investments in military technology have led to the development of breakthrough technologies with tremendously useful civil applications, and the President's 2019 Budget encourages programs with dual-use potential to be leveraged for Federal nonmilitary advancements.

The Department of Defense (DOD) will invest more than $84 billion in research, engineering, and prototyping activities in 2019 to maintain technical superiority and promote U.S. national security innovation. For example, DOD is the centerpiece of a government-wide effort to outinnovate competitors and bolster the U.S. engineering and design communities in the area of trusted microelectronics, semiconductors, and future computing. Electronics, such as computer chips and their integrated circuits, are in everything from cell phones to jet aircraft. The Defense Advanced Research Projects Agency (DARPA) announced its Electronics Resurgence Initiative, investing more than $150 million per year —not including matching funds from industry – toward chip innovation. In addition, DOD is investing in hypersonics research for non-nuclear weapons, which can deter our potential adversaries and are able to strike any point on the globe within an hour. DOD will also support intelligence, surveillance, and reconnaissance along with kinetic and non-kinetic technologies that will disrupt and defeat missiles prior to launch. The 2019 Budget provides $6.8 billion for R&D efforts at the Missile Defense Agency to develop missile defeat, detection, and defense capabilities to protect the United States, our deployed forces, allies, and partners from missile attacks.

Beyond DOD, the 2019 Budget also supports a number of critical investments to protect the homeland at the Department of Homeland Security (DHS) and the Department of Health and Human Services (HHS). In particular, at DHS, the President's Budget requests $80.4 million in R&D funding to detect radiological and nuclear threats in order to defend against weapons of mass de-

struction, $25 million for biodefense-related R&D, $71.1 million in R&D to improve border surveillance and law enforcement capabilities to detect and interdict illegal activity, including the smuggling of contraband, and $70.6 million for cybersecurity R&D. In alignment with the President's National Security Strategy call to bolster transportation security, the 2019 Budget will also invest $20.6 million in R&D at the Transportation Security Administration to counter emerging threats to our aviation, surface, and intermodal transportation systems. At HHS, the Budget also provides $1 billion to develop enhanced medical countermeasures to respond to potential public health emergencies.

Improving Preparedness for and Response to Natural Disasters

In the wake of natural disasters, including a devastating hurricane season and catastrophic forest fires, it is more important than ever to invest in the tools necessary to predict, protect against, mitigate, respond to, and recover from natural disasters. The Budget supports investments in high-priority Earth observations that contribute to the nation's ability to predict the weather and respond to natural disasters. Within the National Aeronautics and Space Administration (NASA), the Budget provides $1.8 billion to maintain progress toward satellite missions and research that will improve our understanding of the Earth, including natural hazards. The joint NASA-Indian Space Research Organization Synthetic Aperture Radar (NISAR) mission will provide unprecedented, detailed views of Earth and will enhance our understanding and response to hazards such as earthquakes, tsunamis, and landslides. The Budget also supports National Oceanic and Atmospheric Administration (NOAA) research on seasonal to subseasonal atmospheric behavior to improve our ability to understand, predict and communicate information associated with hazardous weather. The Budget also funds the U.S. Geological Survey to conduct research to quantify earthquake likelihoods and to develop a nationwide capability to release aftershock advisories during major earthquake sequences. The Budget also continues to support space weather-related R&D, since space weather can affect not just the nation's satellites and space explorers, but can potentially cause significant damage to our electrical grid and electronic systems.

Expanding Human Exploration and Commercialization of Space

The Budget supports more innovative and sustainable approaches for exploration with commercial and international partners to enable the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations. As it pioneers the space frontier, NASA will support growth of the nation's space economy, increase understanding of the universe and our place in it, and advance America's aerospace technology.

This Budget continues investments to once again launch Americans into space from American soil. Additionally, it initiates new industry partnerships for landing robotic missions on the surface of the Moon in the next few years, paving the way for a return of our astronauts—this time not just to visit, but to lay the foundation for further journeys of exploration and the expansion of our economy into space. The Budget supports a space exploration program that we can be proud of—one that reflects American ingenuity, ambition, and leadership. One key to an affordable and dynamic exploration program is the development of new technologies and the Budget spends over $750 million on exploration technology. The Budget also provides $150 million for a program to expand commercial activities in low Earth orbit, with a focus on developing and deploying commercial space stations that can be used by NASA and other customers as a successor to the International Space Station.

Harnessing Artificial Intelligence and High Performance Computing

The development of artificial intelligence (AI) is advancing at a rapid pace, and the 2019 Budget invests in fundamental AI research and computing infrastructure to maintain U.S. leadership in this field. AI holds the potential to transform the lives of Americans through improved technology integration in the workplace and enhanced standards of living at home. The Budget funds basic research related to AI at the National Science Foundation and applied R&D in the Department of Transportation for the further development of autonomous and unmanned systems. In defense applications, DOD is working to deliver AI-driven algorithms to warfighting systems, which can rapidly turn volumes of data into decision-quality insights. And in the health realm, NIH is supporting the use of high performance computing to analyze large data sets to drive cancer research forward.

The Budget also funds high performance computing through supporting investments in computing infrastructure, which hold the potential for AI technology use and other purposes. The Budget provides $811 million to the Department of Energy's Advanced Scientific Computing Research Program to support research and facility upgrades to supercomputing infrastructure at Argonne and Oak Ridge National Laboratories, including the development of exascale high performance computers. These supercomputers will rank among the fastest and most powerful in the world, and will leverage strong partnerships with industry and academia in their development and use.

Combating Drug Abuse and the Opioid Overdose Epidemic

The Administration is committed to combating drug abuse and the opioid overdose epidemic, which poses an urgent threat to public safety and public health. The Administration's declaration of a nationwide public health emergency on October 26, 2017 highlighted the need for improved R&D to prevent and treat drug addiction. The President's Commission on Combating Drug Addiction and the Opioid Crisis provided recommendations for related research to the President. In addition, the White House Office of Science and Technology Policy is convening an

interagency body to facilitate efforts across agencies on health science and technology in response to the opioid crisis, and to develop an R&D roadmap designed to enhance the national opioid response.

The 2019 Budget supports a number of important R&D efforts at agencies to understand and fight this critical problem. For instance, the Budget invests in research into the biological and social-behavioral basis of drug addiction to improve the fundamental understanding of opioid addiction, and in the development of technologies to measure brain function, which can potentially improve our understanding of addictive behavior, brain systems, and related phenomena. In addition, NIH has launched an initiative in partnership with innovator companies and the Food and Drug Administration (FDA) to address the urgent need for non-addictive alternatives to opioids for pain relief. With the 2019 Budget's investment of $100 million, this public-private partnership will facilitate the development of new treatments for addiction, overdose-reversal, and non-addictive therapies for pain. Furthermore, the 2019 Budget supports R&D at DHS to develop cost-effective detection systems to rapidly collect information useful for detecting opioids and fentanyls at land borders and international mail handling facilities - enhancing efforts to prevent illicit drugs from entering the country.

Stimulating Biomedical Innovation for American Health

Encouraging biomedical innovation is key to preventing, treating, and defeating disease and maintaining America's global leadership in healthcare. Achieving these goals requires effective and efficient transfer of research results from bench to bedside. To ensure that the work of the National Institutes of Health (NIH) continues to drive biomedical innovation that improves health, the 2019 Budget supports the expansion of policies that promote technology transfer, including policies that encourage investigators to seek intellectual property protection for their inventions. The Budget also supports the highest priority research at NIH to continue to make progress on finding cures for major diseases and illnesses.

Integrating Autonomous and Unmanned Systems into the Transportation Network

Autonomous and unmanned systems, such as drones and self-driving cars, can provide novel, low-cost capabilities across a broad range of commercial sectors, including transportation. In order to leverage these benefits, research is needed on how these systems and technologies can be safely integrated into the existing transportation network.

The 2019 Budget provides $17.3 million to the Federal Aviation Administration for R&D related to the integration of unmanned aircraft systems (UAS) into the national airspace system. The Budget will also provide $57 million to NASA for research on further development of the UAS traffic management system and UAS operating standards. This funding will allow NASA to complete its current UAS-related projects, which will contribute to the integration of UAS into the national aerospace system. The Budget also proposes accelerating the start of advanced autonomous systems research to ensure the safe integration of autonomous vehicle systems, such as advanced UAS and passenger-carrying urban air mobility aircraft, into the national airspace.

The Budget provides $10 million to the National Highway Transportation Safety Administration's Automated Driving Systems program for critical research that will assist the agency in the development of an advanced regulatory approach for a new generation of transportation technologies. The Budget also provides $100 million to the Federal Highway Administration's Intelligent Transportation Systems program to support R&D on connected and autonomous vehicles and related technologies.

Leveraging Biotechnologies for Agriculture and Rural Prosperity

The report from the President's Interagency Task Force on Agriculture and Rural Prosperity called for an increased focus on leveraging agricultural biotechnology to further improve agricultural efficiency and the quality of food products. Therefore, the Budget prioritizes the U.S. Department of Agriculture (USDA) research portfolio by providing formula funding at the FY 2017 Enacted level for research and extension activities at land-grant universities and competitive research through the Department's flagship competitive research grant program, the Agriculture and Food Research Initiative. The Budget also proposes over $800 million for in-house basic and applied research conducted by the Agriculture Research Service.

The Budget also proposes to transfer operational responsibility of the National Bio-and Agro-Defense Facility (NBAF) from the Department of Homeland Security to USDA. NBAF is a laboratory facility designed to study diseases that threaten the animal agricultural industry and public health, and given that USDA is already responsible for the research programs that will be conducted at this facility once construction is completed, it makes sense for USDA to manage the facility itself.

Unleashing an Era of Energy Dominance through Strategic Support for Innovation

The United States has among the most abundant and diverse energy resources in the world, including oil, gas, coal, nuclear, and renewables. The ability of our entrepreneurs and businesses to commercialize technologies that take full advantage of those resources is paramount to promoting U.S. economic growth, security, and competitiveness. That is why the Budget invests approximately $1.7 billion across the applied energy offices at the Department of Energy (DOE) for early-stage research and development that will enable the private sector to deploy the next generation of technologies and energy services that usher in a more secure, resilient, and integrated energy system. Through balanced support across generation types and fuel sources, the Budget helps usher in a new era of US energy dominance.

II. FEDERAL R&D DATA

R&D is 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 (OMB) has used those or similar categories in its collection of R&D data since 1949. Starting with the FY 2018 Budget, OMB implemented a refinement to the categories by more narrowly defining "development" as "experimental development" to better align with the data collected by the National Science Foundation on its multiple R&D surveys, and to be consistent with international standards. An explanation of this change is included below. Please note that R&D cross-cuts in specific topical areas as mandated by law will be reported separately in forthcoming Supplements to the President's 2019 Budget.

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 18-2 shows agency-by-agency spending on basic research, applied research, experimental 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.

Experimental development is creative and systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes or improving existing products or processes. Like research, experimental development will result in gaining additional knowledge.

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.

Comprehensive government-wide efforts are currently underway to increase the accuracy and consistency of the R&D budget via a collaborative community of practice of Federal agencies which have been working to identify best practices and standards for the most accurate classification and reporting of R&D activities. For example, to better align with National Science Foundation R&D surveys and international standards, starting with the FY 2018 Budget OMB has narrowed the definition of development to "experimental development." This definition, unlike the previous definition of development, excludes user demonstrations of a system for a specific use case and pre-production development (i.e., non-experimental work on a product or system before it goes into full production). Because of this recent change, the experimental development amounts reported are significantly lower than the development amounts shown in past Budgets. In particular, the change in definition of experimental development reduces R&D spending compared to what it would have been under the previous definition by approximately $38.7 billion in FY 2019.

III. OTHER SOURCES OF FEDERAL SUPPORT FOR R&D

The President's 2019 Budget seeks to build on strong private sector R&D investment by prioritizing Federal resources on areas that industry is not likely to support over later-stage applied research and development

Table 18–2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING

(Mandatory and discretionary budget authority[1], dollar amounts in millions)

	2017 Actual	2018 Annualized CR	2019 Proposed	Dollar Change: 2018 to 2019	Percent Change: 2018 to 2019
By Agency					
Defense[3]	49,197	43,616	57,156	13,540	31%
Health and Human Services	34,222	33,772	24,742	–9,030	–27%
Energy	14,896	15,006	12,685	–2,321	–15%
NASA	10,704	10,243	10,651	408	4%
National Science Foundation	5,938	6,030	4,177	–1,853	–31%
Agriculture	2,585	2,487	1,914	–573	–23%
Veterans Affairs	1,346	1,338	1,345	7	1%
Commerce	1,794	1,833	1,361	–472	–26%

Table 18–2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING—Continued

(Mandatory and discretionary budget authority[1], dollar amounts in millions)

	2017 Actual	2018 Annualized CR	2019 Proposed	Dollar Change: 2018 to 2019	Percent Change: 2018 to 2019
Transportation	904	929	826	–103	–11%
Interior	953	964	759	–205	–21%
Patient-Centered Outcomes Research Trust Fund	463	501	622	121	24%
Homeland Security	724	672	548	–124	–18%
Smithsonian Institution	251	242	271	29	12%
Environmental Protection Agency	497	496	269	–227	–46%
Education	254	243	240	–3	–1%
Other	561	629	490	–139	–22%
TOTAL[2]	125,289	119,001	118,056	–945	–1%
Total (using the former definition of Development)	***154,983***	***153,932***	***156,777***	***2,845***	***2%***
Basic Research					
Defense	2,215	2,244	2,284	40	2%
Health and Human Services	16,701	16,859	12,114	–4,745	–28%
Energy	4,802	4,601	3,398	–1,203	–26%
NASA	3,607	3,713	4,150	437	12%
National Science Foundation	4,739	4,818	3,402	–1,416	–29%
Agriculture	1,119	1,038	921	–117	–11%
Veterans Affairs	538	538	540	2	0%
Commerce	234	232	197	–35	–15%
Transportation	.....	.....	.....	.....	.....
Interior	54	54	40	–14	–26%
Patient-Centered Outcomes Research Trust Fund	.....	.....	.....	.....	.....
Homeland Security	49	53	31	–22	–42%
Smithsonian Institution	224	220	225	5	2%
Environmental Protection Agency	.....	.....	.....	.....	.....
Education	34	28	28	0	0%
Other	11	11	11	0	0%
SUBTOTAL	**34,327**	**34,409**	**27,341**	**–7,068**	**–21%**
Applied Research					
Defense	5,276	5,101	5,239	138	3%
Health and Human Services	17,356	16,685	12,348	–4,337	–26%
Energy	6,491	6,693	5,885	–808	–12%
NASA	2,476	2,517	2,713	196	8%
National Science Foundation	778	773	546	–227	–29%
Agriculture	1,070	1,055	904	–151	–14%
Veterans Affairs	780	774	779	5	1%
Commerce	979	961	733	–228	–24%
Transportation	594	602	497	–105	–17%
Interior	745	744	580	–164	–22%
Patient-Centered Outcomes Research Trust Fund	463	501	622	121	24%
Homeland Security	184	179	125	–54	–30%
Smithsonian Institution	.....	.....	.....	.....	.....
Environmental Protection Agency	420	418	228	–190	–45%
Education	133	135	132	–3	–2%
Other	403	421	317	–104	–25%
SUBTOTAL	**38,148**	**37,559**	**31,648**	**–5,911**	**–16%**
Experimental Development[2]					
Defense[3]	41,545	36,219	49,579	13,360	37%
Health and Human Services	27	35	35	0	0%
Energy	2,488	2,533	1,865	–668	–26%
NASA	4,569	3,991	3,734	–257	–6%
National Science Foundation	.....	.....	.....	.....	.....
Agriculture	174	173	163	–10	–6%
Veterans Affairs	28	26	26	0	0%
Commerce	303	322	191	–131	–41%

Table 18–2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING—Continued

(Mandatory and discretionary budget authority[1], dollar amounts in millions)

	2017 Actual	2018 Annualized CR	2019 Proposed	Dollar Change: 2018 to 2019	Percent Change: 2018 to 2019
Transportation	275	293	296	3	1%
Interior	152	164	137	–27	–16%
Patient-Centered Outcomes Research Trust Fund	.....	.....	.....	.....	.....
Homeland Security	491	440	392	–48	–11%
Smithsonian Institution	.....	.....	.....	.....	.....
Environmental Protection Agency	75	75	41	–34	–45%
Education	87	80	80	0	0%
Other	149	199	157	–42	–21%
SUBTOTAL	50,363	44,550	56,696	12,146	27%
Subtotal (using the former definition of Development)	***80,057***	***79,481***	***95,417***	***15,936***	***20%***
Facilities and Equipment					
Defense	161	52	54	2	4%
Health and Human Services	138	193	245	52	27%
Energy	1,115	1,179	1,537	358	30%
NASA	52	22	54	32	145%
National Science Foundation	421	439	229	–210	–48%
Agriculture	222	221	–74	–295	–133%
Veterans Affairs	.....	.....	.....	.....	.....
Commerce	278	318	240	–78	–25%
Transportation	35	34	33	–1	–3%
Interior	2	2	2	0	0%
Patient-Centered Outcomes Research Trust Fund	.....	.....	.....	.....	.....
Homeland Security	.....	.....	.....	.....	.....
Smithsonian Institution	27	22	46	24	109%
Environmental Protection Agency	2	3	0	–3	–100%
Education	.....	.....	.....	.....	.....
Other	–2	–2	5	7	–350%
SUBTOTAL	**2,451**	**2,483**	**2,371**	**–112**	**–5%**

[1] This table shows funding levels for Departments or Independent agencies with more than $200 million in R&D activities in 2019.

[2] The total uses the new Experimental Development definition across the three fiscal years.

[3] The totals for Experimental Development spending in FY 2017-2019 do not include the DOD Budget Activity 07 (Operational System Development) due to changes in the definition of development. These funds are requested in the FY 2019 Budget request and support the development efforts to upgrade systems that have been fielded or have received approval for full rate production and anticipate production funding in the current or subsequent fiscal year.

that the private sector is better equipped to pursue. A key means of stimulating private sector investment and bridging Federal government research with industry development is through the transfer of technology. Federal technology transfer seeks to help enable domestic companies to develop and commercialize products derived from government-funded R&D, which can lead to greater productivity from U.S. R&D investments and ultimately promote the nation's economic growth. Recognizing the benefits of this mechanism, the 2019 Budget sustains funding for technology transfer efforts where appropriate. The Administration will also be launching a new initiative to enable and enhance the Federal government's transition of discoveries from laboratory to market as a Cross-Agency Priority Goal.

Because much of the Federally funded R&D is conducted outside of the government, the Administration seeks to reduce the associated burdens to funding recipients and partners in order to promote greater effectiveness and efficiency in our Federal spending. A significant effort to reduce the administrative and regulatory burdens associated with Federal R&D funding is currently underway through new interagency groups. One of these, an interagency working group on research regulation (as required by the Research and Development Efficiency Act), is examining ways to reduce the administrative burden on those performing Federally funded research. The Administration remains committed to reducing administrative burdens for all Federal grant recipients - not just those for R&D. Specifically, OMB plans to take actions on the recommendations outlined in the DATA Act Section 5 Pilot report, which identified specific opportunities to reduce recipient reporting burden.

The Federal Government also stimulates private investment in R&D through tax preferences. Historically, dating back to the 1950s, the private sector has performed the majority of U.S. R&D. As of 2015, businesses performed 72% of total U.S. R&D.[4] The research and experimentation (R&E) tax credit, which was made permanent through the Protecting Americans from Tax Hikes Act of 2015 (P.L. 114-113) and modified in the Tax Cut and Jobs Act of 2017 (P.L. 115-97), essentially provides a credit to qualified research expenses. R&E tax credit claims have at least doubled over the past two decades, growing from an estimated $4.4 billion in 1997 to $11.3 billion in 2013.[5] The manufacturing and the professional, scientific and technical services sectors account for about 70% of total claims in 2013.

[4] NSF National Center for Science and Engineering Statistics (Dec. 2017). InfoBrief - NSF 18-306.

[5] IRS Statistics of Income Division (August 2017). 1990-2013 Corporate Returns Data.