18. RESEARCH AND DEVELOPMENT

The President's 2018 Budget provides $117.7 billion for Federal research and development (R&D), including the conduct of R&D and investments in R&D facilities and equipment (see Table 18-2). This figure applies the new change to the R&D definitions starting with the FY 2018 Budget per OMB Circular A-11, which was released in July 2016 under the previous Administration. Under the former R&D definitions, the President's 2018 Budget provides $151.2 billion for R&D. This is a $2.8 billion (or 2%) increase over the FY 2017 annualized Continuing Resolution level. Detailed R&D definitions and a discussion of the definition change are available in Section II.

I. FEDERAL RESEARCH AND DEVELOPMENT FUNDING

Since the founding of this nation, innovation in science and technology has been a cornerstone of America's economic progress. The private sector funds and performs the majority of U.S. R&D, but 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 special concern. 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 growth, and national security, the 2018 Budget supports investments in basic research, early-stage applied research, and technology transfer efforts that will lead to the breakthroughs of the future.

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

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

	2016 Actual	2017 Annualized CR	2018 Proposed[2]	Dollar Change: 2017 to 2018	Percent Change: 2017 to 2018
By Agency					
Agriculture	2,657	2,614	1,991	–623	–24%
Agriculture Research Service	1,380	1,378	805	–573	–42%
Animal and Plant Health Inspection Service	39	40	40	0	0%
Economic Research Service	85	85	77	–8	–9%
Foreign Agricultural Service	1	1	1	0	0%
Forest Service	304	264	253	–11	–4%
National Agricultural Statistics Service	9	9	9	0	0%
National Institute of Food and Agriculture	839	837	806	–31	–4%
Commerce	1,681	1,811	1,567	–244	–13%
Bureau of the Census	227	224	228	4	2%
National Institute of Standards and Technology	762	762	651	–111	–15%
National Oceanic and Atmospheric Administration	681	812	675	–137	–17%
National Telecommunications and Information Administration	11	13	13	0	0%
Defense[3]	71,421	71,196	53,396	–17,800	–25%
Military Construction	90	11	0	–11	–100%
Military Personnel	432	408	442	34	8%
Defense Health Program	1,359	296	335	39	13%
Research, Development, Test, and Evaluation	69,540	70,481	52,619	–17,862	–25%
Education	254	257	246	–11	–4%
Institute of Education Sciences	230	233	222	–11	–5%
Office of Postsecondary Education	2	3	3	0	0%
Office of Special Education and Rehabilitative Services	22	21	21	0	0%
Energy	15,217	15,007	13,408	–1,599	–11%
Fossil Energy Research and Development	608	622	270	–352	–57%
Science	5,377	5,295	4,433	–862	–16%
Electricity Delivery and Energy Reliability	141	135	114	–21	–16%

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

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

	2016 Actual	2017 Annualized CR	2018 Proposed [2]	Dollar Change: 2017 to 2018	Percent Change: 2017 to 2018
Nuclear Energy	889	887	701	–186	–21%
Energy Efficiency and Renewable Energy	1,434	1,434	572	–862	–60%
Advanced Research Projects Agency—Energy	291	290	0	–290	–100%
Defense Environmental Cleanup	22	23	28	5	22%
National Nuclear Security Administration	6,440	6,306	7,275	969	15%
Power Marketing Administration	15	15	15	0	0%
Environmental Protection Agency	516	510	277	–233	–46%
Science and Technology	496	494	264	–230	–47%
Hazardous Substance Superfund	19	15	12	–3	–20%
Inland Oil Spill Programs	1	1	1	0	0%
Health and Human Services	32,243	32,322	26,144	–6,178	–19%
Administration for Children and Families	4	16	17	1	6%
Centers for Disease Control and Prevention	398	477	479	2	0%
Centers for Medicare and Medicaid Services	21	21	18	–3	–14%
Departmental Management	89	102	109	7	7%
Food and Drug Administration	502	410	410	0	0%
Health Resources and Services Administration	31	31	18	–13	–42%
National Institutes of Health [4]	31,198	31,265	25,093	–6,172	–20%
Homeland Security	582	707	564	–143	–20%
Domestic Nuclear Detection Office	78	78	73	–5	–6%
National Protection and Programs Directorate	0	6	11	5	83%
Science and Technology	484	595	437	–158	–27%
Transportation Security Administration	0	5	20	15	300%
United States Coast Guard	20	20	20	0	0%
Office of the Undersecretary for Management	0	3	3	0	0%
Interior	973	989	818	–171	–17%
Bureau of Indian Affairs and Bureau of Indian Education	5	5	5	0	0%
Bureau of Land Management	22	23	24	1	4%
Bureau of Reclamation	96	120	81	–39	–33%
Bureau of Safety and Environmental Enforcement	27	27	25	–2	–7%
Department-Wide Programs	10	6	3	–3	–50%
National Park Service	27	27	26	–1	–4%
Office of Surface Mining Reclamation and Enforcement	4	1	0	–1	–100%
United States Fish and Wildlife Service	32	32	15	–17	–53%
United States Geological Survey	677	675	561	–114	–17%
Bureau of Ocean Energy Management	73	73	78	5	7%
National Aeronautics and Space Administration [5]	13,253	13,329	10,327	–3,002	–23%
Space Operations	2,700	2,722	2,139	–583	–21%
Science	5,532	5,522	5,652	130	2%
Exploration	3,601	3,603	963	–2,640	–73%
Aeronautics	494	476	502	26	5%
Space Technology	632	683	674	–9	–1%
Safety, Security and Mission Services	272	271	269	–2	–1%
Construction & Environmental Compliance Restoration	22	52	128	76	146%
National Science Foundation	6,010	6,106	5,371	–735	–12%
Research and Related Activities	5,387	5,476	4,840	–636	–12%
Education and Human Resources	405	430	348	–82	–19%
Major Research Equipment and Facilities Construction	218	200	183	–17	–9%
Patient-Centered Outcomes Research Trust Fund	469	463	533	70	15%
Transportation	927	914	923	9	1%
Federal Aviation Administration	425	423	410	–13	–3%
Federal Highway Administration	323	313	334	21	7%
Federal Motor Carrier Safety Administration	9	9	9	0	0%
Federal Railroad Administration	43	43	43	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], dollar amounts in millions)

	2016 Actual	2017 Annualized CR	2018 Proposed[2]	Dollar Change: 2017 to 2018	Percent Change: 2017 to 2018
National Highway Traffic Safety Administration	92	92	92	0	0%
Office of the Secretary	15	13	14	1	8%
Pipeline and Hazardous Materials Safety Administration	20	21	21	0	0%
Smithsonian Institution	251	255	304	49	19%
Veterans Affairs	1,222	1,346	1,357	11	1%
Medical Care Support	611	673	717	44	7%
Medical and Prosthetic Research	611	673	640	–33	–5%

[1] This table shows funding levels for Departments or Independent agencies with more than $200 million in R&D activities in 2018.

[2] The application of the new Experimental Development definition is shown starting in FY 2018. FY 2016 & 2017 numbers reflect use of the former Development definition.

[3] Unlike previous years, totals for development spending in FY 2018 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 2018 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] NIH includes AHRQ funding as the FY 2018 Budget proposes that AHRQ be consolidated within NIH.

[5] The decrease in NASA's FY 2018 development funding (compared to prior years) can be attributed to the application of the new experimental development definition starting in FY 2018 as well as the transition of several large Human Exploration and Space Operations programs from the development phase to operations in FY 2018.

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. 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 2018 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, OMB has this year 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 Development amounts reported are significantly lower than in previous years. In particular, the change in definition of experimental development reduces R&D spending by approximately $33.5 billion in FY 2018.[1]

[1] The new "experimental development" definition is only being applied in FY 2018 and not to prior year data (FY 2016 and 2017).

Table 18–2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING

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

	2016 Actual	2017 Annualized CR	2018 Proposed[2]	Dollar Change: 2017 to 2018	Percent Change: 2017 to 2018
By Agency					
Defense[3]	71,421	71,196	53,396	–17,800	–25%
Health and Human Services	32,243	32,322	26,144	–6,178	–19%
Energy	15,217	15,007	13,408	–1,599	–11%
NASA4	13,253	13,329	10,327	–3,002	–23%
National Science Foundation	6,010	6,106	5,371	–735	–12%
Agriculture	2,657	2,614	1,991	–623	–24%
Commerce	1,681	1,811	1,567	–244	–13%
Veterans Affairs	1,222	1,346	1,357	11	1%
Transportation	927	914	923	9	1%
Interior	973	989	818	–171	–17%
Homeland Security	582	707	564	–143	–20%
Patient-Centered Outcomes Research Trust Fund	469	463	533	70	15%
Smithsonian Institution	251	255	304	49	19%
Environmental Protection Agency	516	510	277	–233	–46%
Education	254	257	246	–11	–4%
Other	626	617	471	–146	–24%
TOTAL	148,302	148,443	117,697	–30,746	–21%
Total (using the former definition of Development)	***148,302***	***148,443***	***151,244***	***2,801***	***2%***
Basic Research					
Defense	2,243	2,121	2,238	117	6%
Health and Human Services	15,630	15,881	12,816	–3,065	–19%
Energy	4,609	4,668	3,978	–690	–15%
NASA	3,580	3,617	3,717	100	3%
National Science Foundation	4,841	4,900	4,280	–620	–13%
Agriculture	1,031	1,073	952	–121	–11%
Commerce	235	234	200	–34	–15%
Veterans Affairs	386	390	394	4	1%
Transportation	.....	.....	.....	.....	.....
Interior	54	54	44	–10	–19%
Homeland Security	41	50	42	–8	–16%
Patient-Centered Outcomes Research Trust Fund	.....	.....	.....	.....	.....
Smithsonian Institution	220	218	226	8	4%
Environmental Protection Agency	.....	.....	.....	.....	.....
Education	24	33	31	–2	–6%
Other	19	18	18	0	0%
SUBTOTAL	32,913	33,257	28,936	–4,321	–13%
Applied Research					
Defense	5,058	4,947	5,097	150	3%
Health and Human Services	16,422	16,235	13,158	–3,077	–19%
Energy	6,469	6,377	6,749	372	6%
NASA	2,457	2,403	2,527	124	5%
National Science Foundation	760	750	671	–79	–11%
Agriculture	1,119	1,036	973	–63	–6%
Commerce	868	920	755	–165	–18%
Veterans Affairs	804	924	936	12	1%
Transportation	615	619	623	4	1%
Interior	780	778	632	–146	–19%

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

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

	2016 Actual	2017 Annualized CR	2018 Proposed[2]	Dollar Change: 2017 to 2018	Percent Change: 2017 to 2018
Homeland Security	179	177	152	–25	–14%
Patient-Centered Outcomes Research Trust Fund	469	463	533	70	15%
Smithsonian Institution	.....	.....	.....	.....	.....
Environmental Protection Agency	433	429	234	–195	–45%
Education	132	132	130	–2	–2%
Other	482	439	315	–124	–28%
SUBTOTAL	37,047	36,629	33,485	–3,144	–9%
Development[2]					
Defense[3]	64,011	64,113	46,047	–18,066	–28%
Health and Human Services	30	26	26	0	0%
Energy	2,981	2,868	1,705	–1,163	–41%
NASA[4]	7,194	7,257	3,955	–3,302	–46%
National Science Foundation	.....	.....	.....	.....	.....
Agriculture	177	175	160	–15	–9%
Commerce	264	261	236	–25	–10%
Veterans Affairs	32	32	27	–5	–16%
Transportation	277	260	268	8	3%
Interior	137	155	140	–15	–10%
Homeland Security	354	480	370	–110	–23%
Patient-Centered Outcomes Research Trust Fund	.....	.....	.....	.....	.....
Smithsonian Institution	.....	.....	.....	.....	.....
Environmental Protection Agency	78	76	42	–34	–45%
Education	98	92	85	–7	–8%
Other	127	162	133	–29	–18%
SUBTOTAL	75,760	75,957	53,194	–22,763	–30%
Subtotal (using the former definition of Development)	***75,760***	***75,957***	***86,741***	***10,784***	***14%***
Facilities and Equipment					
Defense	109	15	14	–1	–7%
Health and Human Services	161	180	144	–36	–20%
Energy	1,158	1,094	976	–118	–11%
NASA	22	52	128	76	146%
National Science Foundation	409	456	420	–36	–8%
Agriculture	330	330	–94	–424	–128%
Commerce	314	396	376	–20	–5%
Veterans Affairs	.....	.....	.....	.....	.....
Transportation	35	35	32	–3	–9%
Interior	2	2	2	0	0%
Homeland Security	8	0	0	0	0%
Patient-Centered Outcomes Research Trust Fund	.....	.....	.....	.....	.....
Smithsonian Institution	31	37	78	41	111%
Environmental Protection Agency	5	5	1	–4	–80%
Education	.....	.....	.....	.....	.....
Other	–2	–2	5	7	–350%
SUBTOTAL	2,582	2,600	2,082	–518	–20%

[1] This table shows funding levels for Departments or Independent agencies with more than $200 million in R&D activities in 2018.

[2] The application of the new Experimental Development definition is shown starting in FY 2018. FY 2016 & 2017 numbers reflect use of the former Development definition.

[3] Unlike previous years, totals for development spending in FY 2018 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 2018 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 decrease in NASA's FY 2018 development funding (compared to prior years) can be attributed to the application of the new Experimental Development definition starting in FY 2018 as well as the transition of several large Human Exploration and Space Operations programs from the development phase to operations in FY 2018.

III. OTHER SOURCES OF FEDERAL SUPPORT FOR R&D

The Federal Government also stimulates private investment in R&D through tax preferences and technology transfer. Historically, dating back to the 1950s, the private sector has performed the majority of U.S. R&D. As of 2014, businesses performed 71% of total U.S. R&D expenditures.[2] The research and experimentation (R&E) tax credit, which was permanently extended through the Protecting Americans from Tax Hikes Act of 2015 (P.L. 114-113), 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.[3] The manufacturing and the professional, scientific and technical services sectors account for about 70% of total claims in 2013.

The President's 2018 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 that the private sector is better equipped to pursue. Another 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 2018 Budget sustains funding for technology transfer efforts where appropriate.

[2] NSF National Center for Science and Engineering Statistics (Sept. 2016). InfoBrief - NSF 16-316.

[3] IRS Statistics of Income Division (Sept. 2016). 1990-2013 Corporate Returns Data.