

17. RESEARCH AND DEVELOPMENT

Over the past 70 years, America has emerged as the unquestioned global leader in science and technology (S&T). Nearly uninterrupted growth in combined public, private, academic, and nonprofit research and development (R&D) investment—together with the freedom to chase bold ideas; a diverse, highly-skilled, and entrepreneurial U.S. workforce; and world class universities and Federal and National laboratories—have resulted in the discoveries and innovations that have fueled improvements in national health, prosperity, and security. Today, the world is faced with extraordinary opportunities and profound challenges that require U.S. leadership. From leveraging international R&D collaborations and partnerships, to countering global threats to our economic and national security, to navigating the impact of technology both at home and in the workplace, we must commit to taking the wise and bold steps necessary to ensure America remains the global S&T leader for generations to come.

The Administration is deeply committed to this important goal by investing \$142.2 billion in Federal R&D. For 2021, the Administration is prioritizing the science and technology that underpin the Industries of the Future

(IoT)—artificial intelligence (AI), quantum information science (QIS), 5G/advanced communications, biotechnology, and advanced manufacturing. Relative to the 2020 President's Budget, this includes major increases in QIS and non-defense AI R&D as part of a commitment to double Federal AI and QIS R&D investments by 2022. R&D investments in AI and QIS, in particular, act as innovation multipliers and employment drivers, not only by promoting S&T progress across many disciplines, but also by helping to build a highly-skilled American workforce. Other IoT areas, such as biotechnology and advanced manufacturing, are poised for potentially transformative advances. Together, IoT investments are vital to the Nation's global competitiveness and the health, prosperity, and security of the American people.

These and other high priority investments, combined with thoughtful reallocations in lower priority areas, will revolutionize our ability to solve previously intractable problems, foster new industries and jobs, and keep the American people safe while remaining responsible stewards of taxpayer dollars. Table 17-1 shows a breakout of 2021 R&D funding.

Table 17-1. TOTAL FEDERAL R&D FUNDING BY AGENCY AT THE BUREAU OR ACCOUNT LEVEL

(Mandatory and Discretionary Budget Authority^{1,2}, Dollar Amounts In Millions)

	2019 Actual	2020 Estimate ³	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
By Agency					
Agriculture	3,026	2,941	2,769	-172	-6%
Agriculture Research Service	1,702	1,625	1,435	-190	-12%
Animal and Plant Health Inspection Service	39	40	40	0	0%
Economic Research Service	88	85	62	-23	-27%
Forest Service	306	309	255	-54	-17%
National Agricultural Statistics Service	9	9	9	0	0%
National Institute of Food and Agriculture	882	873	968	95	11%
Commerce	1,959	1,948	1,506	-442	-23%
Bureau of the Census	122	155	163	8	5%
National Institute of Standards and Technology	763	807	653	-154	-19%
National Oceanic and Atmospheric Administration	1,066	978	678	-300	-31%
National Telecommunications and Information Administration	8	8	12	4	50%
Defense ⁴	54,691	64,544	59,831	-4,713	-7%
Military Construction	22	1,853	0	-1,853	-100%
Military Personnel	441	437	447	10	2%
Defense Health Program	1,716	1,979	308	-1,671	-84%
Research, Development, Test, and Evaluation	52,512	60,275	59,076	-1,199	-2%
Education	248	259	230	-29	-11%
Institute of Education Sciences	230	241	213	-28	-12%

Table 17–1. 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)

	2019 Actual	2020 Estimate ³	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
Office of Innovation and Improvement	0	1	0	-1	-100%
Office of Postsecondary Education	1	1	1	0	0%
Office of Special Education and Rehabilitative Services	14	14	14	0	0%
Office of Career, Technical, and Adult Education	3	2	2	0	0%
Energy	18,271	19,219	16,051	-3,168	-16%
Fossil Energy Research and Development	682	709	696	-13	-2%
Science	6,640	6,924	5,760	-1,164	-17%
Electricity	136	155	175	20	13%
Nuclear Energy	1,293	1,161	1,082	-79	-7%
Energy Efficiency and Renewable Energy	1,796	2,054	672	-1,382	-67%
Advanced Research Projects Agency--Energy	366	425	-311	-736	-173%
Cybersecurity, Energy Security, and Emergency Response	49	36	62	26	72%
Defense Environmental Cleanup	25	30	28	-2	-7%
National Nuclear Security Administration	7,280	7,723	7,885	162	2%
Power Marketing Administration	4	2	2	0	0%
Environmental Protection Agency	489	492	318	-174	-35%
Science and Technology	473	473	299	-174	-37%
Hazardous Substance Superfund	15	18	18	0	0%
Inland Oil Spill Programs	1	1	1	0	0%
Health and Human Services	38,511	40,818	37,875	-2,943	-7%
Administration for Children and Families	5	5	4	-1	-20%
Centers for Disease Control and Prevention	466	435	435	0	0%
Centers for Medicare and Medicaid Services	20	20	20	0	0%
Departmental Management	7	18	18	0	0%
Food and Drug Administration	491	410	410	0	0%
Health Resources and Services Administration	23	23	23	0	0%
National Institutes of Health ⁵	37,499	39,907	36,965	-2,942	-7%
Homeland Security	668	532	450	-82	-15%
Science and Technology	510	422	357	-65	-15%
Transportation Security Administration	21	23	30	7	30%
United States Coast Guard	4	1	10	9	900%
United States Secret Service	3	11	0	-11	-100%
Management Directorate	3	0	0	0	0%
U.S. Customs and Border Protection	67	0	0	0	0%
Cybersecurity and Infrastructure Security Agency	13	14	6	-8	-57%
Countering Weapons of Mass Destruction Office	47	61	47	-14	-23%
Interior	958	973	725	-248	-25%
Bureau of Land Management	25	21	21	0	0%
Bureau of Reclamation	129	115	76	-39	-34%
Bureau of Safety and Environmental Enforcement	27	27	25	-2	-7%
Department-Wide Programs	3	3	3	0	0%
National Park Service	27	26	26	0	0%
Office of Surface Mining Reclamation and Enforcement	1	1	1	0	0%
United States Fish and Wildlife Service	15	15	15	0	0%
United States Geological Survey	640	660	460	-200	-30%
Bureau of Ocean Energy Management	86	100	93	-7	-7%
Bureau of Indian Affairs	5	5	5	0	0%
National Aeronautics and Space Administration	10,698	14,057	13,334	-723	-5%
Science	6,154	7,019	6,261	-758	-11%
Aeronautics	565	575	630	55	10%
Low Earth Orbit and Spaceflight Operations	1,586	1,551	1,496	-55	-4%
Safety, Security and Mission Services	272	237	245	8	3%
Deep Space Exploration Systems	1,288	3,576	3,139	-437	-12%
Construction and Environmental Compliance and Restoration	117	54	48	-6	-11%

Table 17–1. 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)

	2019 Actual	2020 Estimate ³	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
Exploration Technology	716	1,045	1,515	470	45%
National Science Foundation	6,586	6,752	6,328	-424	-6%
Research and Related Activities	5,823	6,033	5,613	-420	-7%
Education and Human Resources	467	476	485	9	2%
Major Research Equipment and Facilities Construction	296	243	230	-13	-5%
Transportation	1,071	1,134	594	-540	-48%
Federal Aviation Administration	501	533	447	-86	-16%
Federal Highway Administration	375	404	0	-404	-100%
Federal Motor Carrier Safety Administration	9	9	12	3	33%
Federal Railroad Administration	45	44	45	1	2%
Federal Transit Administration	28	36	33	-3	-8%
National Highway Traffic Safety Administration	76	68	19	-49	-72%
Office of the Secretary	13	16	14	-2	-13%
Pipeline and Hazardous Materials Safety Administration	24	24	24	0	0%
Smithsonian Institution	339	330	328	-2	-1%
Veterans Affairs	1,370	1,313	1,351	38	3%
Medical Care Support	591	563	563	0	0%
Medical and Prosthetic Research	779	750	788	38	5%

¹ This table shows funding levels for Departments or Independent agencies with more than \$200 million in R&D activities in 2021.² The Experimental Development definition is used in this table across all three fiscal years.³ The FY 2020 Estimate column applies the main FY 2021 President's Budget volume approach of using FY 2020 enacted appropriations.⁴ Totals for Experimental Development spending in FY 2019-2021 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 2021 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.⁵ NIH includes Agency for Healthcare Research and Quality (AHRQ) funding as the FY 2021 Budget proposes that AHRQ be consolidated within NIH as a new institute.

I. PRIORITIES FOR FEDERAL RESEARCH AND DEVELOPMENT

The President's Budget provides support for Federal R&D to keep America prosperous, resilient, healthy, and safe. This section highlights key R&D priorities in the 2021 Budget, with a focus on strategic investments in AI, QIS, and national security.

American Leadership in the Industries of the Future

America's multisector U.S. R&D enterprise continues to enable the Nation to pursue, realize, and lead in critical and emerging areas of S&T. Private industry working in a robust free market can bring the best ideas forward, leading to new and better products and processes and in some cases creating entirely new industries. These innovations often start with Federal contributions in early-stage R&D, particularly in S&T areas that require sustained support before becoming ready for private sector investment. Beginning in 2017, the Administration identified several S&T areas critical to advancing America's leadership in the IotF and since then has made R&D investments, and enacted several key policies, to realize their full promise to improve the prosperity, health, and security of the American people.

Artificial intelligence (AI) is transforming every segment of American life, with applications ranging from medical diagnostics and precision agriculture, to autonomous transportation, job reskilling and upskilling and

national defense, and beyond. The Administration has taken a forward-looking approach to fortify American leadership in AI, including considerations about its effective and trustworthy use. In 2019, the President signed an Executive Order launching the American AI Initiative, the national AI strategy of the United States, which is taking a multipronged approach to accelerating our national leadership in AI. The Administration also released the National AI R&D Strategic Plan: 2019 Update to define priority areas of Federal investment in AI R&D, and the 2016-2019 Progress Report on Advancing AI R&D to document the depth and breadth of agency investments that are transforming the state of the field, consistent with the strategic research plan. The 2021 Budget includes a major increase in non-defense AI funding compared to the 2020 Budget and is on a path to double Government-wide spending on AI R&D by 2022. The Budget includes over \$850 million for AI R&D at the National Science Foundation (NSF), which represents a 70-plus percent increase over the 2020 Budget. This increase will advance NSF's ability to invest in both core and AI-related research, and it will enable NSF to create several National AI Research Institutes, in collaboration with the Departments of Agriculture, Homeland Security, Transportation, and Veterans Affairs. These institutes serve as focal points for multisector, multidisciplinary research and workforce efforts among academia, industry,

Federal agencies, and nonprofits, helping to ensure that America remains the global AI leader.

QIS promises to enable new technologies and opportunities for the Nation over the next two decades. Researchers will be able to tackle previously unsolvable problems and explore new domains of communication, sensing, and computation. QIS will improve our industrial base, creating new jobs and entirely new industries in the process, while helping keep America safe. Recognizing the potential of QIS, in late 2018 the President signed into law the National Quantum Initiative Act. The 2021 Budget greatly bolsters Federal QIS R&D funding with aggregate investment across key agencies increasing by over 50 percent compared to the 2020 Budget on the path to doubling by 2022. NSF investment will more than double with an additional \$120 million supporting the National Quantum Initiative. The Department of Energy (DOE) will bolster quantum information efforts at the national laboratories and in academia and industry with an approximate increase of \$75 million. Additional efforts at the National Institute for Standards and Technology (NIST) will ensure the standards and science for engineering quantum systems can progress while enabling supporting technology from industrial investments. Expanded QIS defense and intelligence R&D will enable new applications and improve industrial engagement while sustaining their multi-decade effort to encourage quantum information science and technology. Initial funding is included to allow NASA to explore the potential for a space-based quantum entanglement experiment.

The Administration is also prioritizing other S&T areas critical to American leadership in IoT. Advanced manufacturing—which includes both new manufacturing methods and the production of new products enabled by cutting-edge technologies—is an engine of America’s economic power and a pillar of its national security. For example, NIST will invest \$20 million for a new Manufacturing USA Institute—a public-private partnership that brings together industry, academia, and Government partners to nurture manufacturing innovation and accelerate commercialization. In addition, the 2021 Budget puts an additional \$100 million into the Department of Agriculture’s flagship competitive grants program (AFRI), which will be invested in artificial intelligence and machine learning to promote advanced manufacturing in the food and agricultural sciences, as well as continue efforts in robotics and application of big data required for future advancements in precision agriculture. In terms of biotechnology, the Budget will support AFRI’s continued investments in areas such as gene editing to improve production traits and enhance resistance to disease in crops and livestock. Finally, though not categorized as R&D, investments in STEM education and workforce are critical to creating a diverse, highly skilled, and entrepreneurial workforce that can discover, invent, build, and transform the Industries of the Future. The 2021 Budget will help empower the workforce of the future by investing an additional \$50 million at NSF compared to the 2020 Budget Request on education and workforce development for AI and QIS, with focused ef-

forts in outreach to community colleges, Historically Black Colleges and Universities, and Minority Serving Institutions.

American Security

The 2018 National Defense Strategy calls for leadership in research, technology, invention, and innovation to “ensure we will be able to fight and win the wars of the future.” As adversaries leverage emerging and disruptive technologies to threaten the Nation, it is imperative that we invest in R&D to remain at the leading edge of S&T, maintain military superiority, remain agile in the face of existing and new threats, and keep the American people safe. The President’s 2021 Budget continues to prioritize R&D in technologies that contribute to the security of the American people. The Department of Defense (DOD) will invest more than \$59 billion in research, engineering, and prototyping activities in 2021 to enable advanced military capabilities that will help meet emerging threats and protect American security into the future, including offensive and defensive hypersonic weapons capabilities, resilient national security space systems, and modernized and flexible strategic and nonstrategic nuclear deterrent capabilities.

In addition to DOD funding, the 2021 Budget also supports critical investments to protect the Nation. For instance, at the Department of Homeland Security, the 2021 Budget requests \$83 million in R&D funding to further detect and defend against radiological, nuclear, chemical, and biological threats; \$44 million in R&D to improve resilience to natural disasters and physical threats, for first responder technologies and public safety, and for fundamental R&D to ensure cross-border threat screening and supply chain defense; and \$38 million for cybersecurity R&D. To enhance border security, the 2021 Budget will invest \$89 million in R&D for air security technologies, to gain efficiencies in immigration service technology, and for ensuring the security of land and maritime borders.

American Space Exploration and Commercialization

In December 2017, the President signed Space Policy Directive 1 which called for the “United States [to] lead the return of humans to the Moon for long-term exploration and utilization”. Subsequently in March 2019, the Vice President on behalf of the President declared “it is the stated policy of this [A]dministration and the United States of America to return American astronauts to the Moon within the next five years.” Given these policy objectives, the 2021 Budget focuses R&D efforts to accomplish the goal of sustainable deep space exploration, starting with the lunar surface with an eye to Mars.

Within the 2021 Budget, a substantial commitment is made to promote innovation, such as the Lunar Surface Innovation Initiative. Technologies are prioritized that enable a sustainable presence on the lunar surface that also feed forward directly to Mars including in-situ resource utilization, cryogenic fuel storage and management, surface excavation, manufacturing and construction, and advanced space power (e.g. small nuclear fission reactors).

A robust and competitive commercial space sector is vital to continued progress in space and will enable the expansion of America's economic sphere of influence to low Earth orbit, the Moon and then beyond. To that end, space exploration activities will focus on maximizing pub-

lic-private partnerships. Allowing American industry to innovate will benefit the American taxpayer by increasing the capability of private companies to provide quality space services but at a lower cost.

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 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 crosscuts in specific topical areas as mandated by law will be reported separately in forthcoming Supplements to the President's 2021 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 17-2 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 toward 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 2018 Budget OMB 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 earlier change, the experimental development amounts reported are significantly lower than the development amounts shown in past Budgets.

Table 17-2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING
(Mandatory and Discretionary Budget Authority¹, Dollar Amounts In Millions)

	2019 Actual	2020 Estimate ²	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
By Agency					
Defense⁴	54,691	64,544	59,831	-4,713	-7%
Health and Human Services	38,511	40,818	37,875	-2,943	-7%
Energy	18,271	19,219	16,051	-3,168	-16%
NASA	10,698	14,057	13,334	-723	-5%
National Science Foundation	6,586	6,752	6,328	-424	-6%
Agriculture	3,026	2,941	2,769	-172	-6%
Commerce	1,959	1,948	1,506	-442	-23%
Veterans Affairs	1,370	1,313	1,351	38	3%
Transportation	1,071	1,134	594	-540	-48%
Interior	958	973	725	-248	-25%
Homeland Security	668	532	450	-82	-15%
Smithsonian Institution	339	330	328	-2	-1%
Environmental Protection Agency	489	492	318	-174	-35%
Education	248	259	230	-29	-11%
Other	1,249	661	495	-166	-25%
TOTAL³	140,134	155,973	142,185	-13,788	-9%
Basic Research					
Defense	2,492	2,628	2,331	-297	-11%
Health and Human Services	19,082	20,492	19,154	-1,338	-7%
Energy	5,103	5,514	5,461	-53	-1%
NASA	4,948	6,880	6,110	-770	-11%
National Science Foundation	5,139	5,322	5,018	-304	-6%
Agriculture	1,213	1,264	1,256	-8	-1%
Commerce	232	242	208	-34	-14%
Veterans Affairs	600	559	576	17	3%
Transportation	0	16	18	2	13%
Interior	80	82	65	-17	-21%
Homeland Security	42	47	27	-20	-43%
Smithsonian Institution	269	276	281	5	2%
Environmental Protection Agency .....	.....	.....	.....	.....	.....
Education	60	70	70	0	0%
Other	56	68	63	-5	-7%
SUBTOTAL	39,316	43,460	40,638	-2,822	-6%
Applied Research					
Defense	6,071	6,288	5,506	-782	-12%
Health and Human Services	19,110	20,026	18,336	-1,690	-8%
Energy	8,318	8,351	6,526	-1,825	-22%
NASA	2,743	3,002	3,409	407	14%
National Science Foundation	784	807	787	-20	-2%
Agriculture	1,126	1,154	1,150	-4	-0%
Commerce	976	1,046	809	-237	-23%
Veterans Affairs	738	725	745	20	3%
Transportation	705	736	314	-422	-57%
Interior	710	717	533	-184	-26%
Homeland Security	203	165	71	-94	-57%
Smithsonian Institution .....	.....	.....	.....	.....	.....
Environmental Protection Agency	415	416	250	-166	-40%
Education	118	126	117	-9	-7%
Other	947	371	252	-119	-32%
SUBTOTAL	42,964	43,930	38,805	-5,125	-12%
Experimental Development³					
Defense⁴	46,106	53,775	51,994	-1,781	-3%

Table 17-2. FEDERAL RESEARCH AND DEVELOPMENT SPENDING—Continued(Mandatory and Discretionary Budget Authority¹, Dollar Amounts In Millions)

	2019 Actual	2020 Estimate ²	2021 Proposed	Dollar Change: 2020 to 2021	Percent Change: 2020 to 2021
Health and Human Services	76	35	35	0	0%
Energy	2,606	2,982	1,935	-1,047	-35%
NASA	2,890	4,121	3,767	-354	-9%
National Science Foundation .....	.....	.....	.....	.....	.....
Agriculture	165	176	172	-4	-2%
Commerce	267	263	200	-63	-24%
Veterans Affairs	32	29	30	1	3%
Transportation	326	344	234	-110	-32%
Interior	162	172	125	-47	-27%
Homeland Security	356	320	329	9	3%
Smithsonian Institution .....	.....	.....	.....	.....	.....
Environmental Protection Agency	74	76	68	-8	-11%
Education	70	63	43	-20	-32%
Other	239	222	180	-42	-19%
SUBTOTAL	53,369	62,578	59,112	-3,466	-6%
Facilities and Equipment					
Defense	22	1,853	0	-1,853	-100%
Health and Human Services	243	265	350	85	32%
Energy	2,244	2,372	2,129	-243	-10%
NASA	117	54	48	-6	-11%
National Science Foundation	663	623	523	-100	-16%
Agriculture	522	347	191	-156	-45%
Commerce	484	397	289	-108	-27%
Veterans Affairs .....	.....	.....	.....	.....	.....
Transportation	40	38	28	-10	-26%
Interior	6	2	2	0	0%
Homeland Security	67	0	23	23	.....
Smithsonian Institution	70	54	47	-7	-13%
Environmental Protection Agency .....	.....	.....	.....	.....	.....
Education .....	.....	.....	.....	.....	.....
Other	7	0	0	0	0%
SUBTOTAL	4,485	6,005	3,630	-2,375	-40%

¹ This table shows funding levels for Departments or Independent agencies with more than \$200 million in R&D activities in 2021.² The FY 2020 Estimate column applies the main FY 2021 President's Budget volume approach of using FY 2020 enacted appropriations.³ The total uses the Experimental Development definition across the three fiscal years.⁴ The totals for Experimental Development spending in FY 2019-2021 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 2021 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.

III. OTHER SOURCES OF FEDERAL SUPPORT FOR R&D

The President's 2021 Budget seeks to build on strong private sector R&D investment by prioritizing Federal investments in areas that industry is not likely to support in comparison to later-stage applied research and development that the private sector is better equipped to pursue. This complementary relationship is enhanced by public-private partnerships. Partnerships between Federal departments and agencies and industry and multisector partnerships facilitated by Federal funding can serve as force multipliers, enabling partnering organizations to achieve higher returns on investment, create efficiencies, and advance their respective missions. In addition, 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 domestic companies 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 2021 Budget sustains funding for technology transfer efforts where appropriate. In addition, the Administration is working to enable and enhance the Federal Government's transition of discoveries from laboratory to market through a Cross-Agency Priority Goal under the President's Management Agenda.

Because much of the federally funded R&D is conducted outside of the Government, the Administration seeks to reduce the associated workload on 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 workload associated with Federal R&D funding is currently underway through an interagency working group on research regulation (as required by the Research and

Development Efficiency Act). More broadly, beyond just R&D, the Administration is working under a President's Management Agenda Cross-Agency Priority Goal to reduce administrative burdens for all Federal grant recipients and promoting results-oriented accountability.

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 2018, it is estimated that businesses performed 73 percent of total U.S. R&D.¹ Businesses have also been a predominant source of U.S. R&D funding since the 1980s with an estimated \$404.2 billion invested by this sector in 2018, which accounts for about 70 percent of total U.S. funding.² 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 \$12.6 billion in 2014.³ The manufacturing and the professional, scientific, and technical services sectors account for about 70 percent of total claims in 2014.

¹ NSF National Center for Science and Engineering Statistics (Jan 2020). National Patterns of R&D Resources: 2017-2018 Data Update. NSF 20-307.

² NSF National Center for Science and Engineering Statistics (Jan 2020). National Patterns of R&D Resources: 2017-2018 Data Update. NSF 20-307.

³ IRS Statistics of Income Division (Nov 2019). SOI Tax Statistics – Corporate Research Credit.