



Congressional Research Service
Informing the legislative debate since 1914

Federal Research and Development Funding: Global Context and the FY2019 Request

John Sargent

May 8, 2018

Congressional Research Service

Research and analysis for Congress on current and emerging issues

- Comprehensive
- Authoritative
- Objective
- Non-partisan
- Balanced
- Confidential

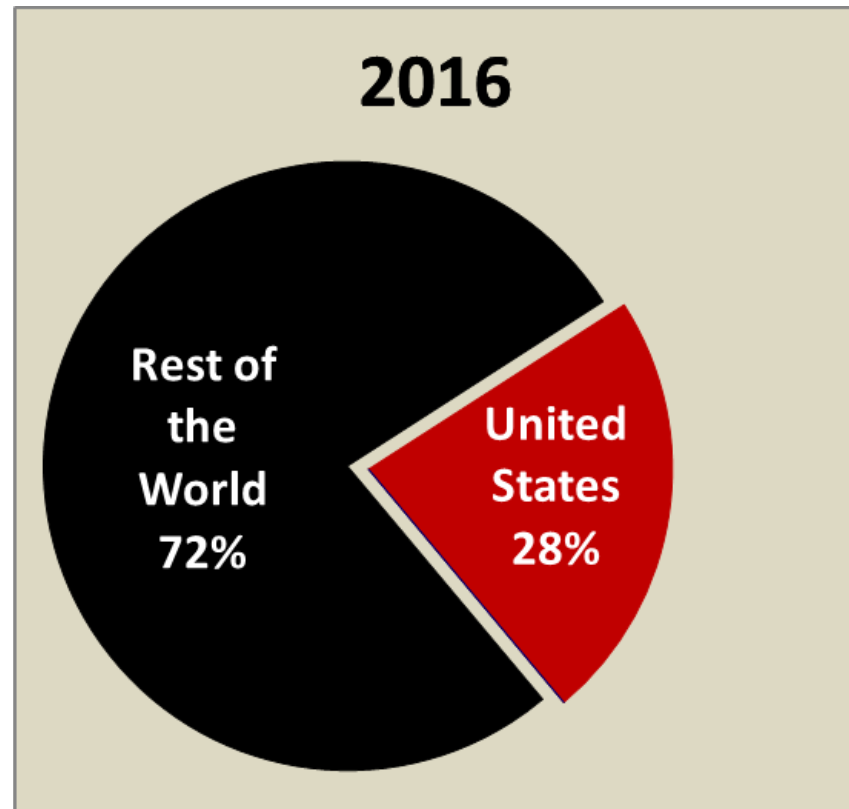
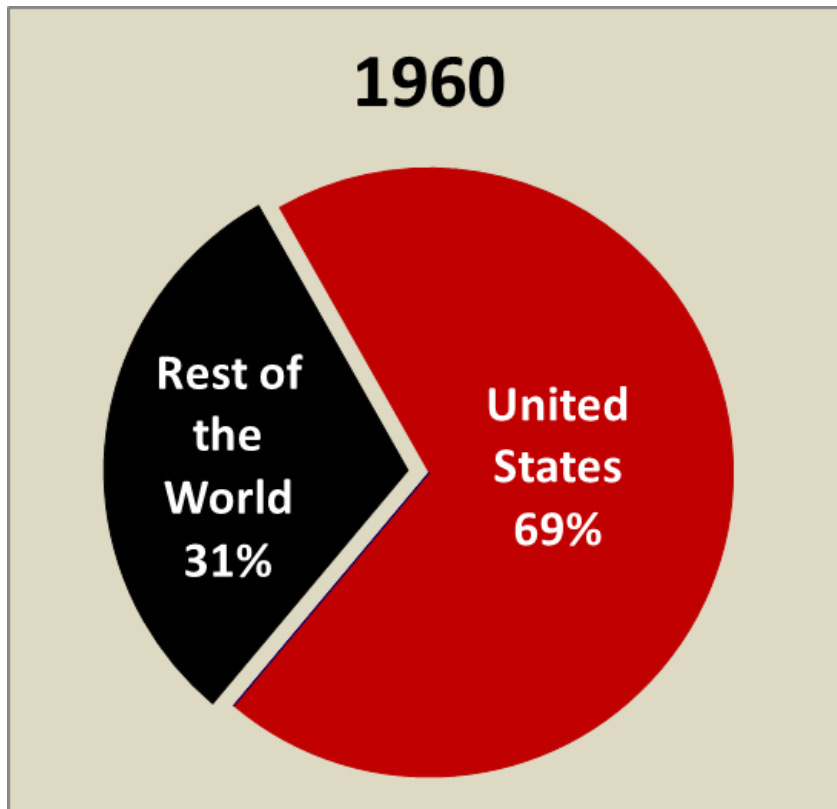


Context for Federal R&D

- Meet federal mission needs
- Expand the frontiers of human knowledge
- Develop science and engineering workforce
- Address societal issues
- Promote U.S. technological leadership, innovation, and competitiveness
- Support federal decision making



Context: Composition of Global R&D



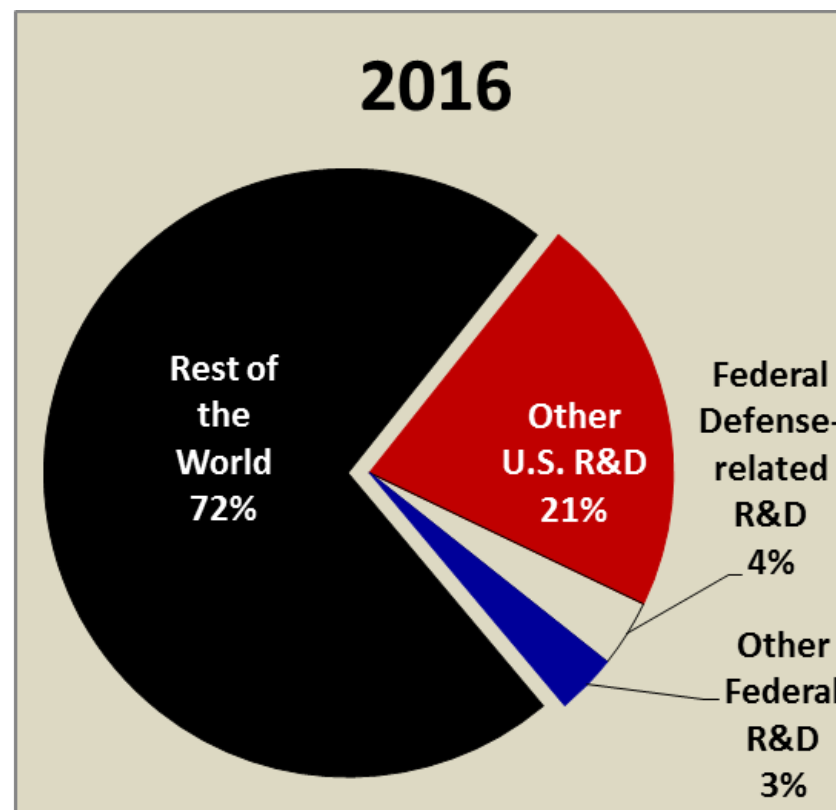
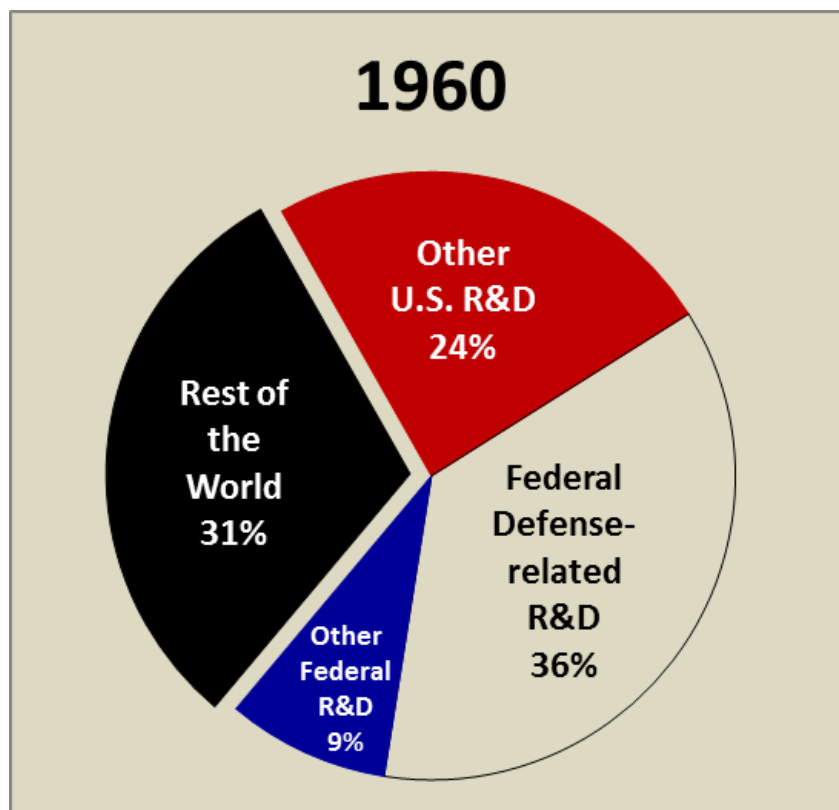
SOURCES:

1960: U.S. and Rest of the World shares based on data from U.S. Department of Commerce, Office of Technology Policy, *The Global Context for U.S. Technology Policy*, Summer 1997 (hard copy)

2016: U.S. and Rest of the World share from OECD, Main Science and Technology Indicators, OECD.Stat, accessed February 16, 2018.



Context: Composition of Global R&D



SOURCES:

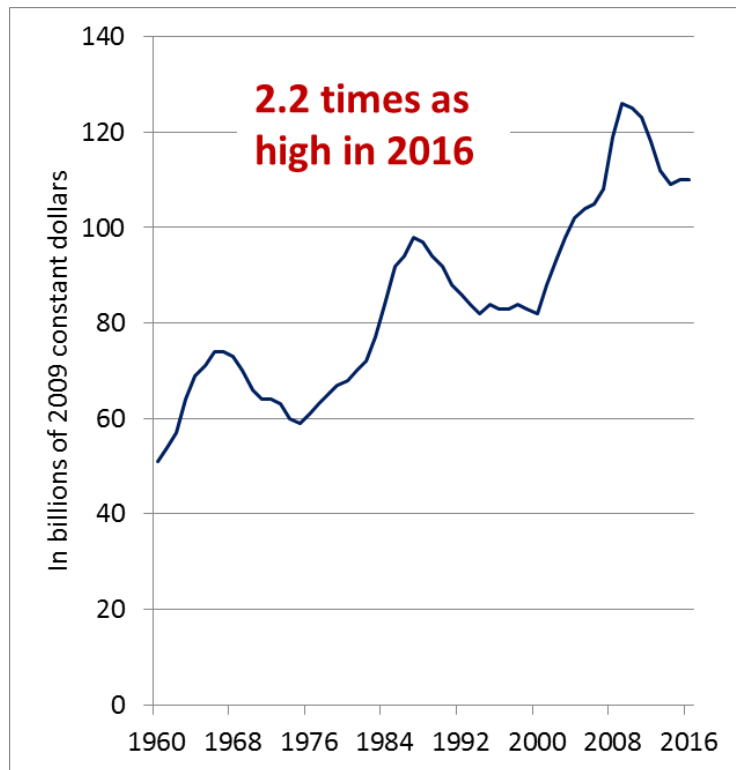
1960: U.S. and Rest of the World shares based on data from U.S. Department of Commerce, Office of Technology Policy, *The Global Context for U.S. Technology Policy*, Summer 1997 (hard copy)

2016: U.S. and Rest of the World share from OECD, Main Science and Technology Indicators, OECD.Stat, accessed February 16, 2018.

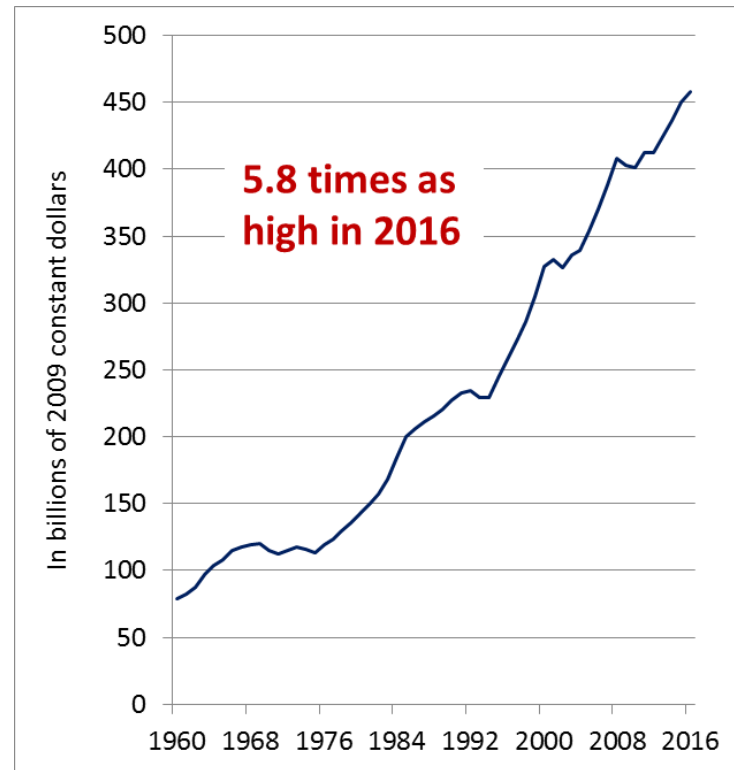


Context: Inflation-adjusted Growth in Federal and U.S. R&D

Federal R&D Funding FY1960-FY2016



Total U.S. R&D Funding FY1960-FY2016

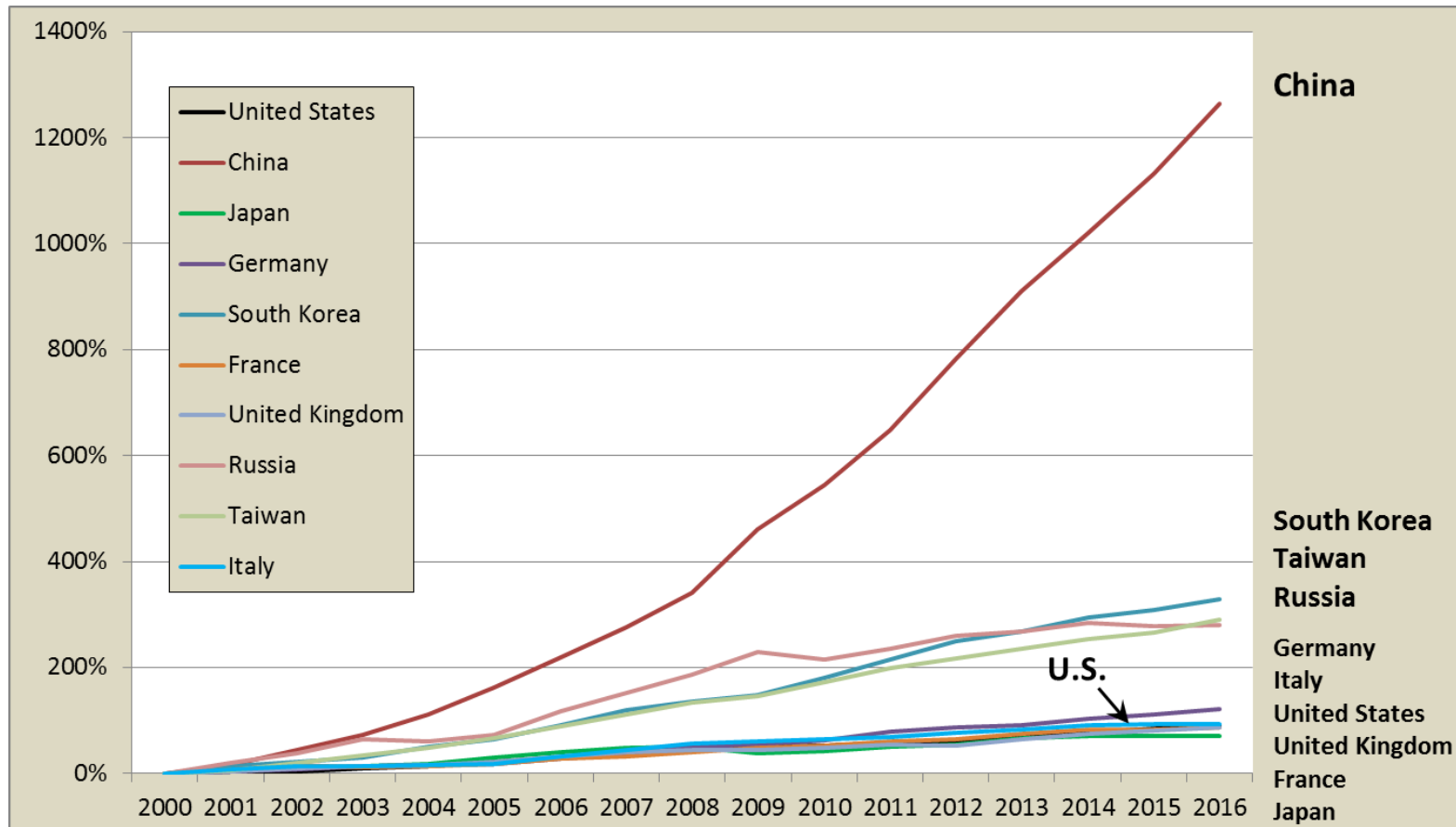


SOURCES: CRS analysis of data from the National Science Foundation, *National Patterns of R&D Resources* (unpublished data).



Context: Comparative Growth in R&D Funding of Selected Nations Since 2000

(current PPP dollars)



SOURCE: CRS analysis of OECD website data, Gross Expenditures on R&D (GERD).



Context: Comparative Total R&D Expenditures, Selected Countries, Public and Private

2016 Gross Expenditures on R&D in billions of current PPP dollars

Top 10 countries account for more than 85% of global R&D	United States	\$511
	China	451
	Japan	169
	Germany	118
	South Korea	79
	France	62
	United Kingdom	47
	Russian Federation	40
	Taiwan	36
	Italy	30

SOURCE: CRS analysis of OECD website data, Gross Expenditures on R&D (GERD), 2016.

NOTE: PPP=Purchasing Power Parity

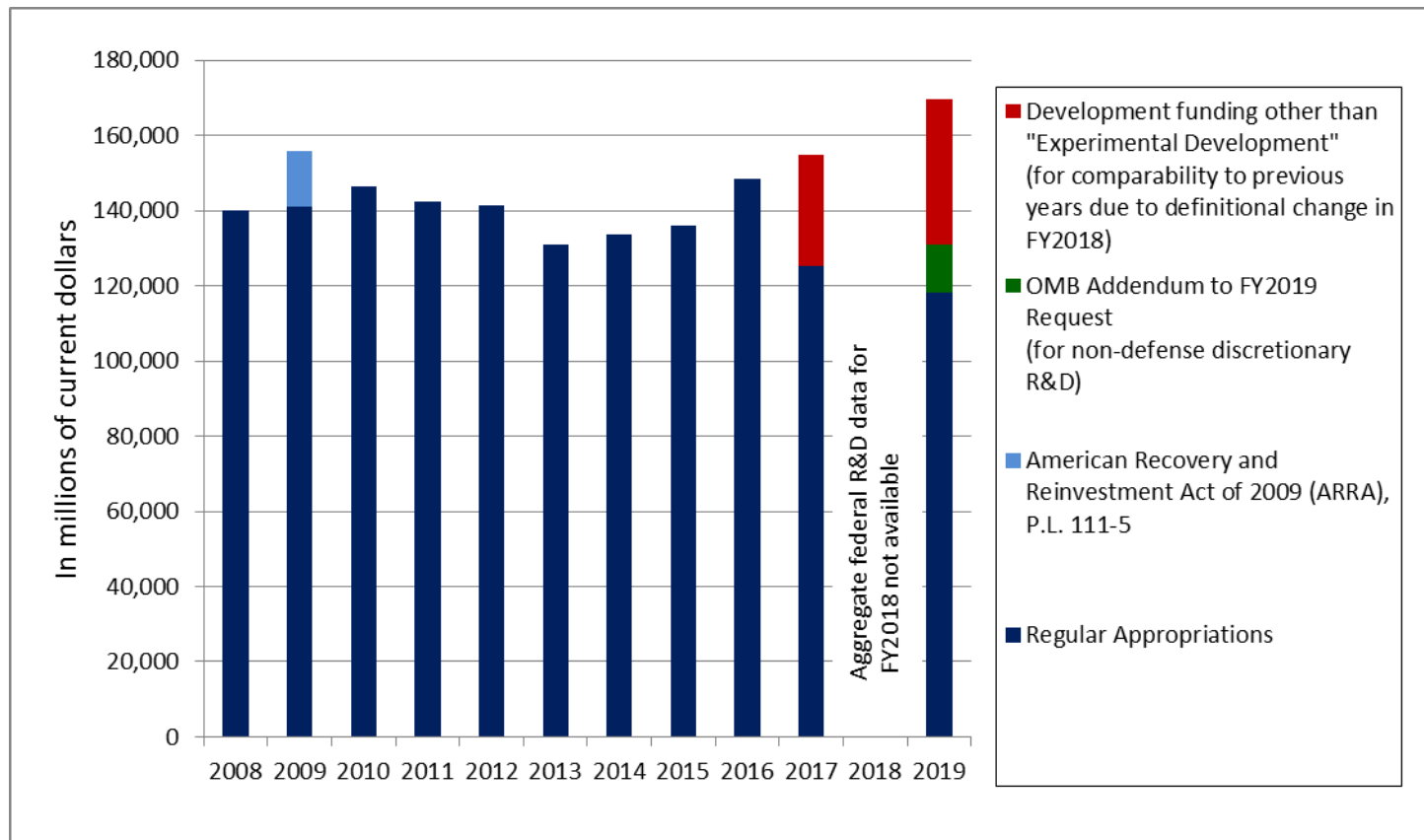


Budget Data Caveats

- Late completion of the FY2018 appropriations process; comparison of FY2019 request levels to FY2017 enacted levels
- Enactment of the Bipartisan Budget Act of 2018
 - Raises spending caps for FY2018, FY2019
 - Followed by Addendum to the President's budget
 - Adds estimated \$12.9 billion in additional non-defense discretionary R&D
- Change in definition of “development” beginning in FY2018
 - Now “experimental development”
 - Attempt to better align U.S. data with international standards
 - Applied to FY2017 and FY2019 figures in the FY2019 request
 - Old definition:
 - Total requested R&D in FY2019 up \$36.1 billion to ~ \$170 billion
 - Total requested R&D in FY2017 up \$27.0 billion to ~ \$155 billion
 - Nominal reductions mostly in DOD, some NASA (still requested; not counted as R&D)
- Differences in OMB, agency reporting of R&D data
 - Inconsistency in ways agencies report R&D
 - R&D activities in accounts with both R&D, non-R&D activities



Overview: Federal R&D Budget Authority FY2008-FY2017, FY2019 (Request), in millions of **current dollars**



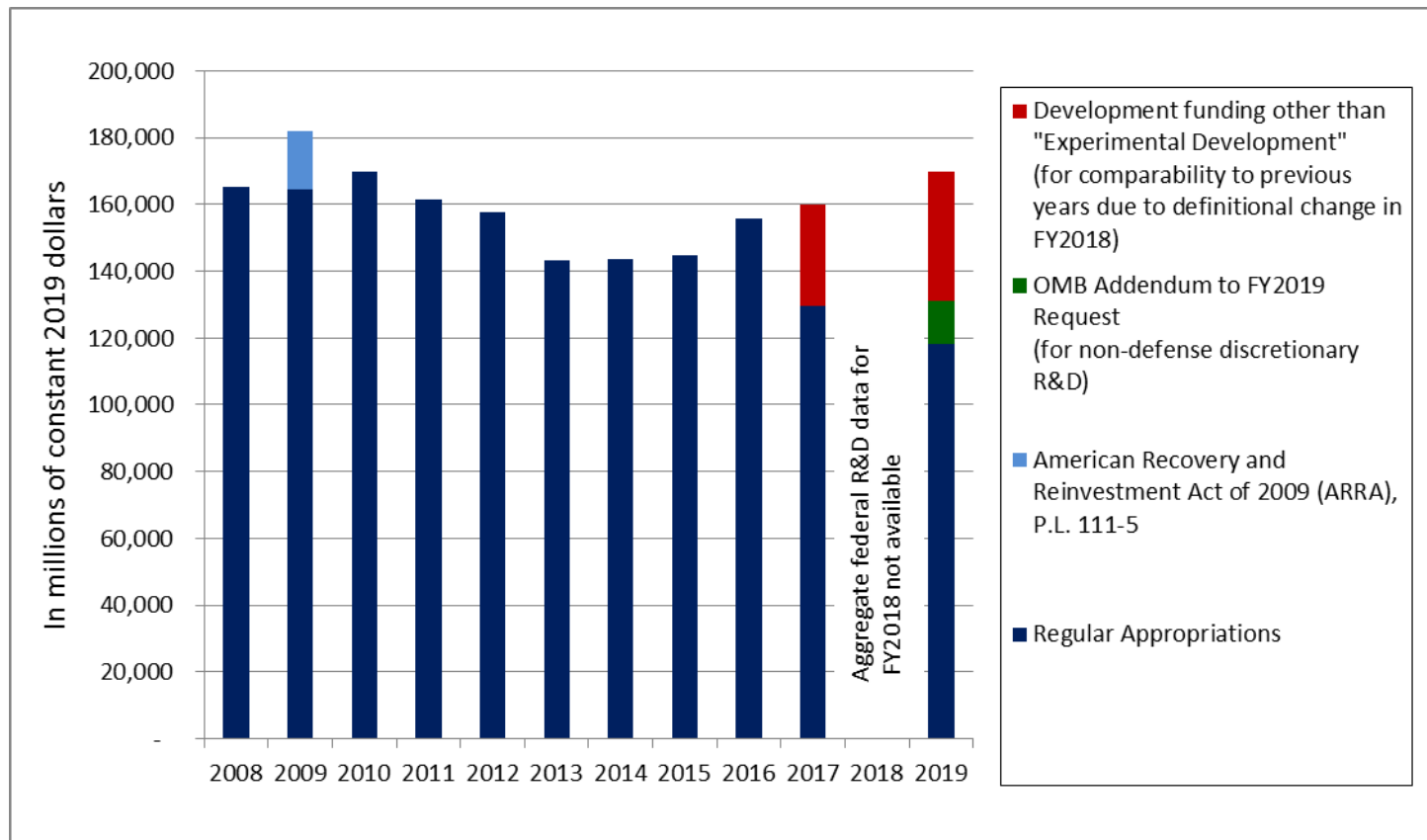
SOURCES: Data from FY2008-FY2016 are from agencies' submissions to OMB per MAX Schedule C, budget justification documents, and supplemental data obtained from agencies' budget offices; data for FY2017 and FY2019 from *Budget of the U.S. Government: FY2018* and OMB email communication with CRS.



Overview:

Federal R&D Budget Authority

FY2008-FY2017, FY2019 (Request), in millions of **2019 constant dollars**



SOURCES: Data from FY2008-FY2016 are from agencies' submissions to OMB per MAX Schedule C, budget justification documents, and supplemental data obtained from agencies' budget offices; data for FY2017 and FY2019 from *Budget of the U.S. Government: FY2019* and OMB email communication with CRS; constant dollar adjustments made using GDP chained price index from Table 10.1 of Historical Tables, *Budget of the U.S. Government: FY2019*.



Overview:

Federal R&D Budget, by Agency, FY2017 (Actual), FY2019 (Request) (in millions of current dollars)

Department/Agency	FY2017 Actual	FY2019 Request	Change, \$	Change, %
Department of Defense	49,197	57,156	7,959	16.2%
Dept. of Health and Human Services	34,222	24,742	-9,480	-27.7%
Department of Energy	14,896	12,685	-2,211	-14.8%
NASA	10,704	10,651	-53	-0.5%
National Science Foundation	5,938	4,177	-1,761	-29.7%
Department of Agriculture	2,585	1,914	-671	-26.0%
Department of Commerce	1,794	1,361	-433	-24.1%
Department of Veterans Affairs	1,346	1,345	-1	-0.1%
Department of Transportation	904	826	-78	-8.6%
Department of the Interior	953	759	-194	-20.4%
Patient-Centered Outcomes Research Trust Fund	463	622	159	34.3%
Department of Homeland Security	724	548	-176	-24.3%
Smithsonian Institution	251	271	20	8.0%
Environmental Protection Agency	497	269	-228	-45.9%
Department of Education	254	240	-14	-5.5%
Other	561	490	-71	-12.7%
OMB addendum (non-defense, discretionary R&D)		12,900	12,900	
Total	\$125,289	\$130,956	\$5,667	4.5%
Add'l Development Funding (non-Experimental)	29,694	38,721	9,027	30.4%
Total (adjusted)	\$154,983	\$169,677	\$14,694	9.5%

SOURCE: Office of Management and Budget, *Budget of the United States Government, FY2019, Analytical Perspectives*.
NOTE: Components may not add to totals due to rounding.



Amendment to FY2019 Budget Request: Additional R&D (\$ in millions)

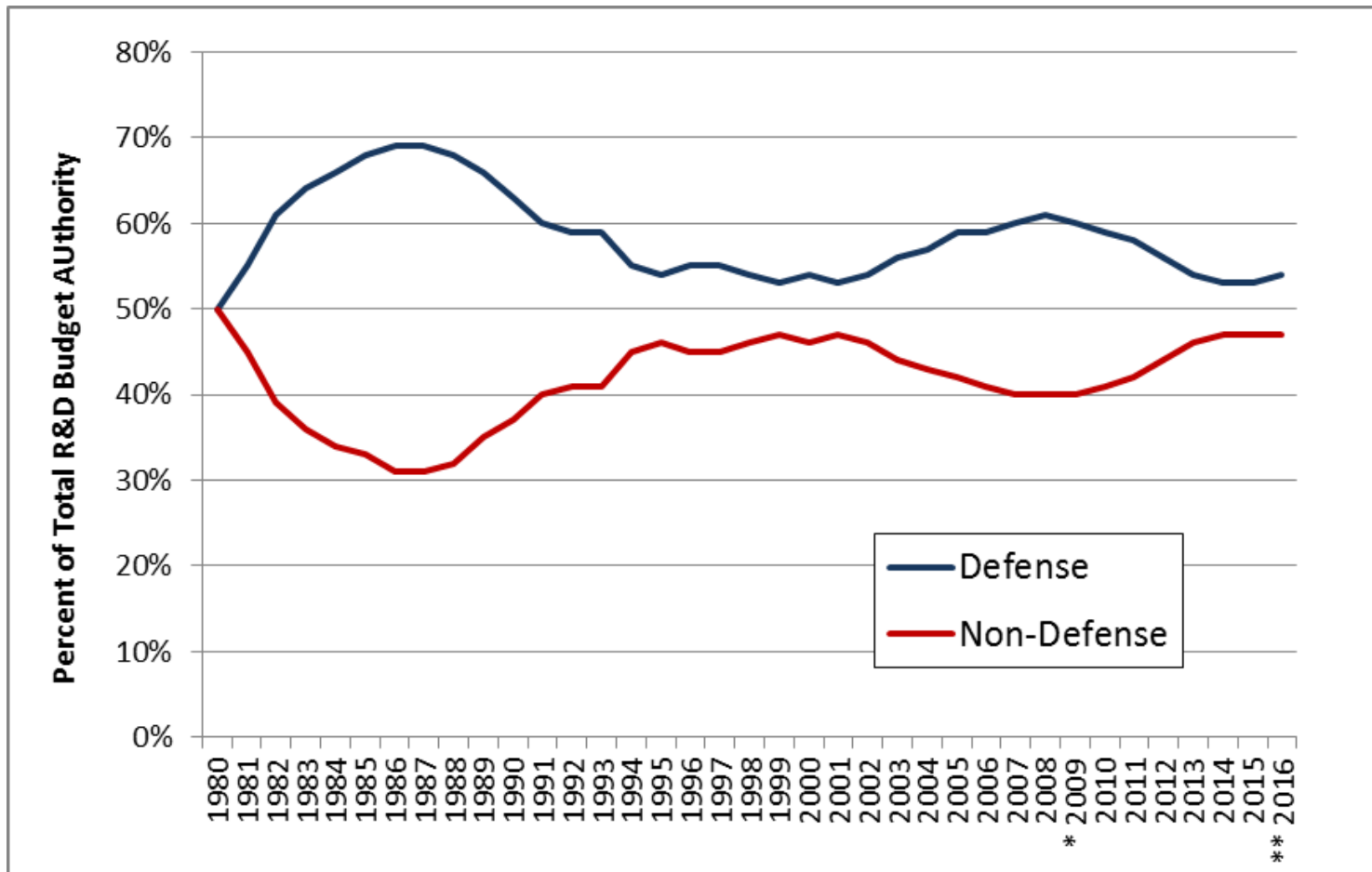
<u>Agency</u>	<u>Amount</u>
Department of Agriculture	\$ 192
Department of Energy	\$1,533
Science	(1,213)
Fossil Energy	(200)
Energy Efficiency and Renewable Energy	(120)
National Institutes of Health	\$9,167
NASA	\$ 145
National Science Foundation	<u>~ 1,900</u>
TOTAL	~ \$12,900

SOURCE: CRS analysis of Office of Management and Budget, amendments to the *Budget of the United States Government, FY2019*, April 13, 2018, https://www.whitehouse.gov/wp-content/uploads/2018/04/FY_2019_Budget_Amendment_Package.pdf

NOTE: Numbers in parentheses are components of the agency number above.



Overview: Federal Defense and Non-Defense R&D



Notes:

* FY2009 includes regular appropriations only; does not include R&D funding provided by ARRA.

** FY2016 is based on preliminary data

SOURCES: National Science Foundation, *Federal R&D Funding by Budget Function: Fiscal Years 2015–17*, NSF 17-304, Table 24, December 13, 2016.



Overview:

Federal R&D Budget by Character of R&D

(in millions of dollars)

	FY2017 Actual	FY2019 Request	Change, FY2017-FY2019		
			Dollar	Percent, Total	Percent, CAGR
Basic research	34,327	27,341	-6,986	-20.4%	-10.8%
Applied research	38,148	31,648	-6,500	-17.0%	-8.9%
Development	50,363	56,696	6,333	12.6%	6.1%
Facilities and Equipment	2,451	2,371	-80	-3.3%	-1.6%
Total	125,289	118,056	-7,233	-5.8%	-2.9%

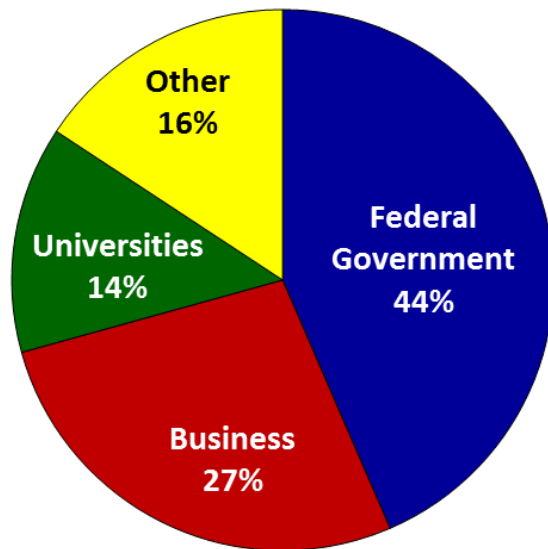
SOURCE: CRS analysis of data from Office of Management and Budget, *Budget of the United States Government, FY2019, Analytical Perspectives*.

NOTES: Does not include non-experimental development or the \$12.9 requested via the OMB addendum. Components may not add to totals due to rounding.

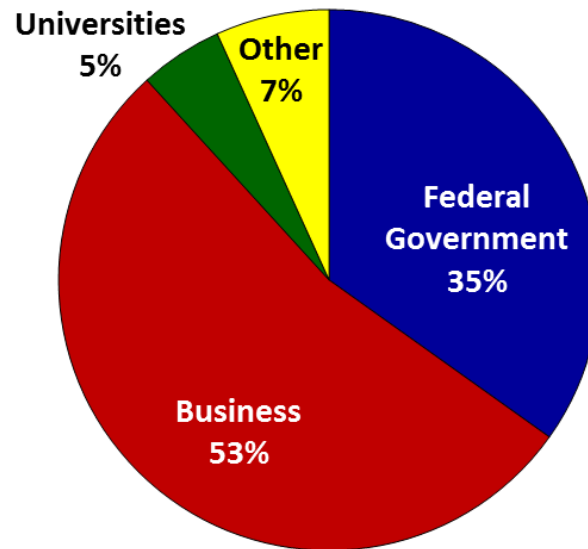


Overview: Sectoral Perspective on R&D: Who Funded What in 2016

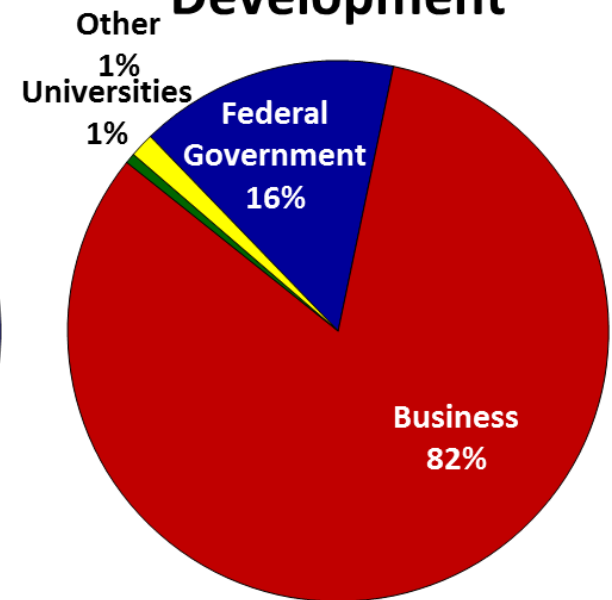
Basic Research



Applied Research



Development



SOURCE: National Science Foundation, *National Patterns of R&D Resources* (preliminary unpublished data).

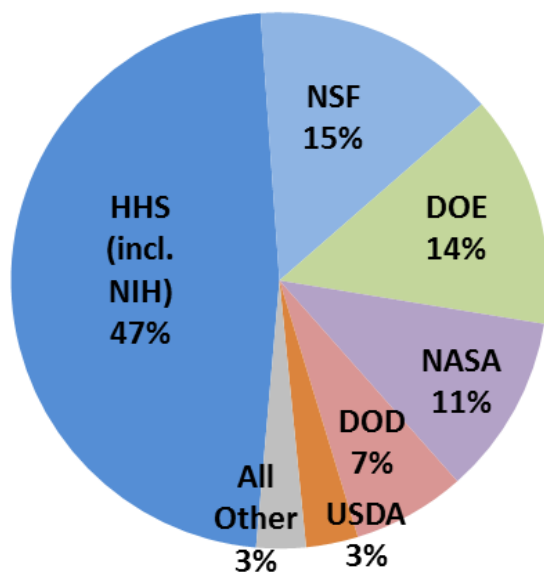
NOTE: Components may not add to 100% due to rounding.



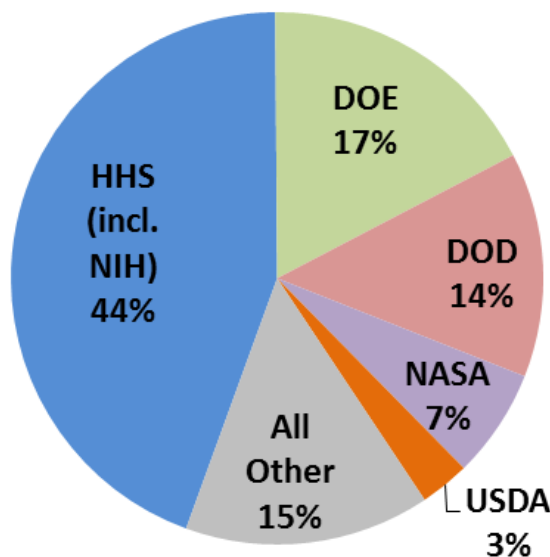
Overview: Agency Perspective on R&D: Who Funded What in 2017

(based on FY2017 actual levels)

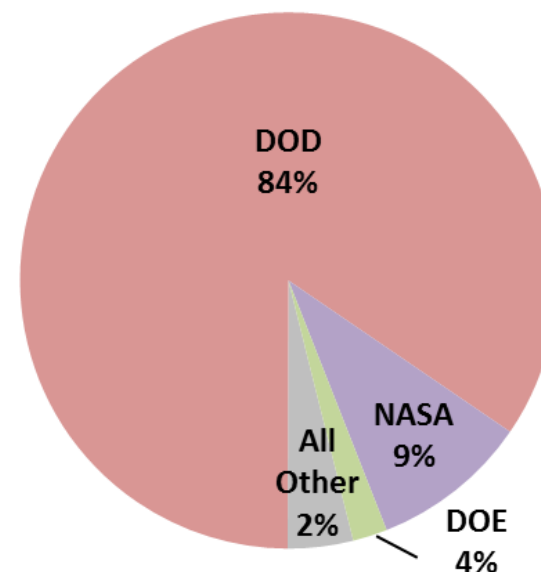
Basic Research



Applied Research



Development



SOURCE: CRS analysis of data from Office of Management and Budget, *Budget of the United States Government, FY2019, Analytical Perspectives*.

NOTES: Does not include non-experimental development or the \$12.9 requested via the OMB addendum. Components may not add to 100% due to rounding.



Other Crosscutting Initiatives

- National Nanotechnology Initiative (NNI)
- Networking and Information Technology Research and Development (NITRD)
- U.S. Global Change Research Program (USGCRP)
- National Network for Manufacturing Innovation (NNMI)
- Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative
- Materials Genome Initiative
- National Robotics Initiative



Observations

- Budget constraints reduced for FY2019
- Year-to-year funding decisions:
Potential broad policy implications over the longer term
- Growing R&D investments of other nations:
Possible implications for U.S. economic growth, national security
- Multi-national approaches to high-cost R&D opportunities:
Challenges associated with uncertain funding
- Disparities in flexibility given by Congress to agencies over use of funding

For More Information

Budget of the United States Government, Fiscal Year 2019

<https://www.whitehouse.gov/omb/budget/>

Analytical Perspectives, Research and Development

https://www.whitehouse.gov/wp-content/uploads/2018/02/ap_18_research-fy2019.pdf



QUESTIONS?



Backup Slides



Department of Defense RDT&E Overview (Base + OCO) (\$ in billions)

	FY2017 <u>Actual</u>	FY2018 <u>Enacted*</u>	FY2019 <u>Request</u>
RDT&E in...			
Title IV Base/OCO	\$ 74.817	\$ 90.582	\$ 92.365
Defense Health Program	\$ 2.102	\$ 2.039	\$ 0.711
Chemical Agents & Munitions Destruction	\$ 0.516	\$ 0.839	\$ 0.887
National Defense Sealift Fund	\$ 0.007	\$ 0.000	\$ 0.000
Office of Inspector General	<u>\$ 0.005</u>	<u>\$ 0.003</u>	<u>\$ 0.002</u>
TOTAL	\$ 77.447	\$ 93.463	\$ 93.964

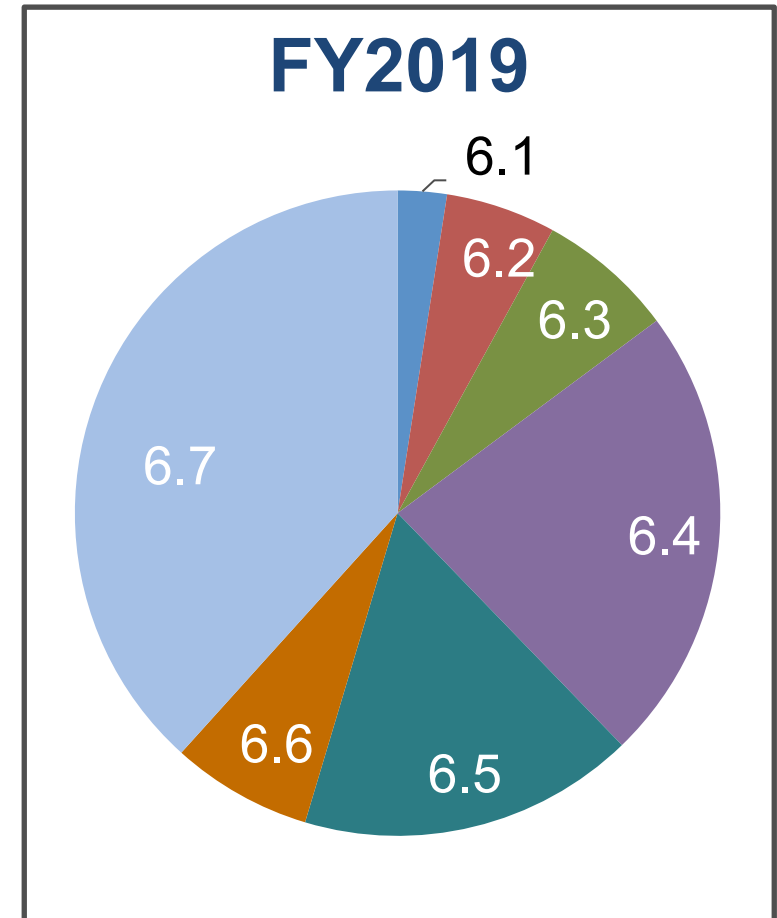
* FY2018 includes \$1.347 billion in RDT&E (emergency) funding provided to the services in the Department of Defense Missile Defeat and Defense Enhancements Appropriations Act, 2018 (P.L. 115-96).

DOD RDT&E funding includes non-experimental Development funding. This funding is excluded in the definition of Development now used by OMB.



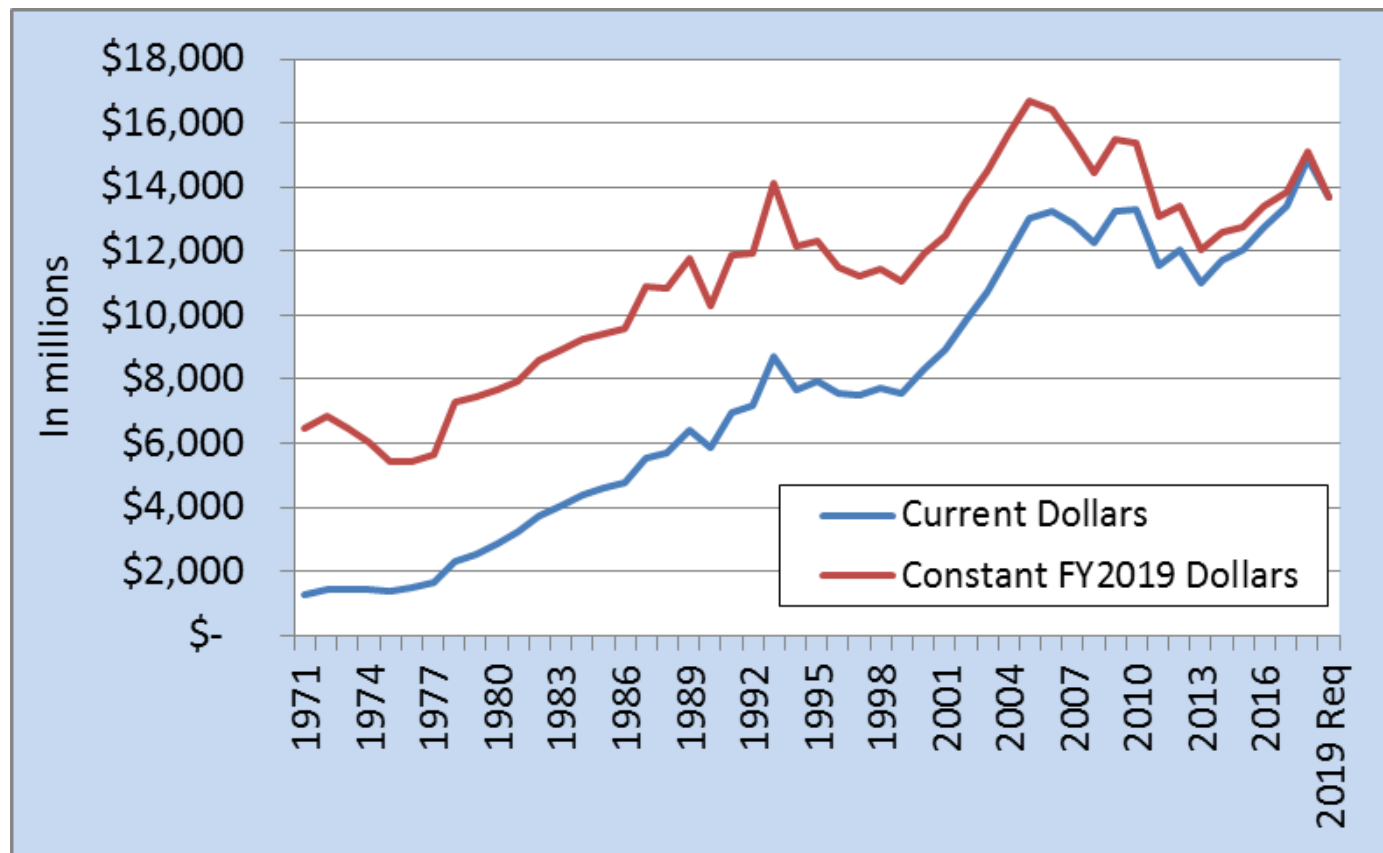
FY2017-FY2019 DOD Title IV RDT&E Budget Request (Base + OCO + Emergency) by Budget Activity (\$ in millions)

Budget Activity (Base + OCO)	FY2017 (actual)	FY2018 (enacted)	FY2019 (request)	Change, 2017- FY2019	
				Dollar	Percent
6.1 Basic Research	\$ 2,198	\$ 2,343	\$ 2,269	\$ 71	3.2%
6.2 Applied Research	5,125	5,682	5,100	-25	-0.5%
6.3 Advanced Technology Development	6,072	6,838	6,331	259	4.3%
6.4 Adv. Component Dev. & Prototypes	15,593	18,961	21,181	5,588	35.8%
6.5 System Development & Demonstration	13,035	14,516	15,577	2,542	19.5%
6.6 RDT&E Management Support	5,845	6,649	6,521	676	11.6%
6.7 Operational Systems Development	26,950	11,450	35,387	8,437	31.3%
Classified (Undistributed)		22,034			
Miscellaneous (Undistributed)		-164			



DOD Title IV Science and Technology (6.1-6.3) Funding (Base + OCO)

Total Obligational Authority; 1971-2017 (actual), 2018 and 2019 (request)

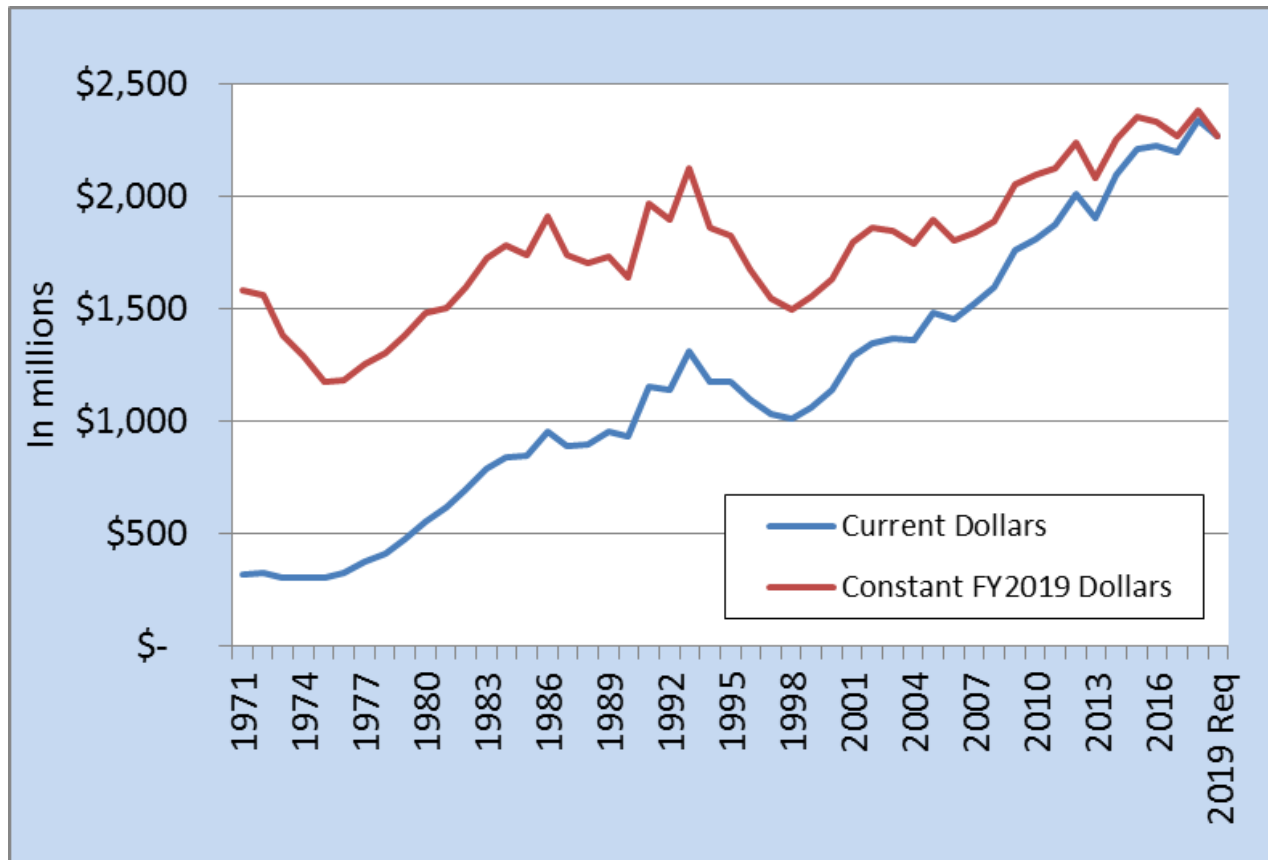


* Current dollars adjusted to FY2019 constant dollars using Table 10.1 from the Historical Tables, *Budget of the U.S. Government, FY2019*.



DOD Total Title IV Basic Research (6.1) Funding (Base + OCO)

Total Obligational Authority; 1971-2017 (actual), 2018 (enacted) and 2019 (request)



* Current dollars adjusted to FY2019 constant dollars using Table 10.1 from the Historical Tables, *Budget of the U.S. Government, FY2019*.



National Institutes of Health Overview (\$ in millions)

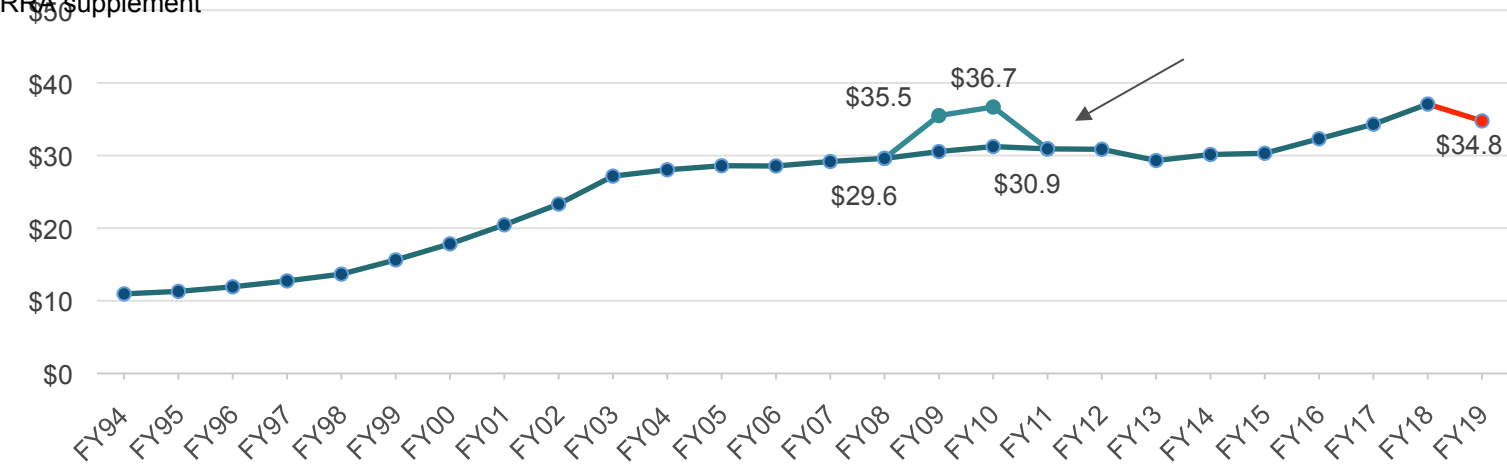
(Dollars in millions)	FY2017 Actual	FY2018 Enacted	FY2019 Proposed
Total, NIH program level	\$34,299	\$37,084	\$34,767

SOURCES: FY2017 and FY2019 totals come from HHS, *Fiscal Year 2019 Budget in Brief*, p. 40. FY2018 total comes from U.S. Congress, House Committee on Appropriations, *Division H - Departments of Labor, Health, and Human Services and Education, and Related Agencies Appropriations Act, 2018*, Draft Explanatory Statement, 115th Cong., March 2018, p. 28.

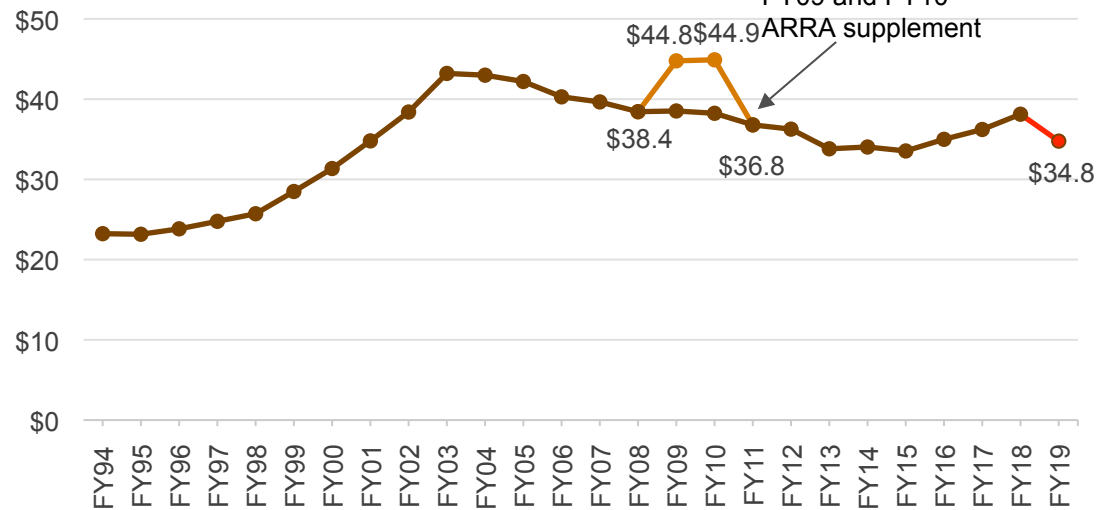


NIH Funding in Current & Constant Dollars FY1994-FY2019 (proposed)

FY09 and FY10
ARRA supplement



Constant 2019 Dollars (billions)



Department of Energy R&D Overview (\$ millions)

	FY2017 Enacted	FY2018 Enacted	FY2019 Request
Science	\$5,392	\$6,260	\$5,391
Basic Energy Sciences	1,872	2,090	1,850
High Energy Physics	825	908	770
Biological and Environmental Research	612	673	500
Nuclear Physics	622	684	600
Advanced Scientific Computing Research	647	810	899
Fusion Energy Sciences	380	532	340
Other	435	563	432
National Security	3,760	4,249	4,268
Weapons Activities RDT&E	1,842	2,034	1,995
Naval Reactors	1,420	1,620	1,789
Defense Nuclear Nonproliferation R&D	470	557	456
Defense Environmental Cleanup Technology Development	28	38	28
Energy	3,988	4,502	2,061
Energy Efficiency and Renewable Energy	1,812	2,016	696
Fossil Energy R&D	668	727	502
Nuclear Energy	1,017	1,205	757
Electricity Delivery R&D	123	125	36
Cybersecurity, Energy Security, Emergency Resp. R&D	62	76	70
Advanced Research Projects Agency–Energy	306	353	0
DOE, Total	13,140	15,011	11,720

NOTE: Components may not add to totals due to rounding.



National Aeronautics and Space Administration R&D Overview (\$ millions)

	Budget Authority		
	FY2017	FY2018 Estimate	FY2019 Request
Science	\$5,762	\$6,222	\$5,895
Earth Science	1,908	1,921	1,784
Planetary Science	1,828	2,228	2,235
Astrophysics	1,352	1,384	1,185
Heliophysics	675	689	691
Aeronautics	656	685	634
Exploration Research and Technology	827	~905	1,003
Deep Space Exploration Systems	4,184	~4,645	4,559
Exploration Systems Development	3,929	4,395	3,670
Advanced Exploration Systems	98	~100	889
Exploration R&D	157	~150	-
LEO and Spaceflight Operations [R&D only]	[2,636]	[~2,228]	[1,785]
International Space Station	1,451	~1,494	1,462
Commercial Crew	1,185	~734	173
Commercial LEO Development	-	-	150
Subtotal R&D	14,064	14,684	13,876
Non-R&D Programs	2,445	2,663	2,879
Safety, Security, and Mission Services	2,769	2,827	2,750
Associated with R&D	2,359	2,393	2,277
Construction & Environmental C&R	376	562	388
Associated with R&D	320	476	322
NASA, Total (R&D)	16,743	17,553	16,474
NASA, Total	19,653	20,736	19,892



NOTE: Components may not add to totals due to rounding.

National Science Foundation Budget Overview (\$ millions)

NSF Funding by Account, FY2017-FY2019 (budget authority)					
Account	FY2017 Actual	FY2018 Enacted	FY2019* Request	Request over FY2017 Actual	
				Amount	Percent
Research & Related Activities	\$6,006.5	\$6,334.5	\$6,150.7	\$144.2	2.4%
Education & Human Resources	873.4	902.0	873.4	0.0	0.0
Major Research Equipment & Facilities Construction	222.8	182.8	94.7	(128.1)	(57.5)
Agency Operations & Award Management	382.1	328.5	333.6	(48.4)	(12.7)
Office of the Inspector General	15.1	15.2	15.4	0.1	1.2
National Science Board	4.3	4.4	4.3	0.3	1.7
Total	\$7,504.1	\$7,767.4	\$7,472.0	(\$32.1)	(0.4%)

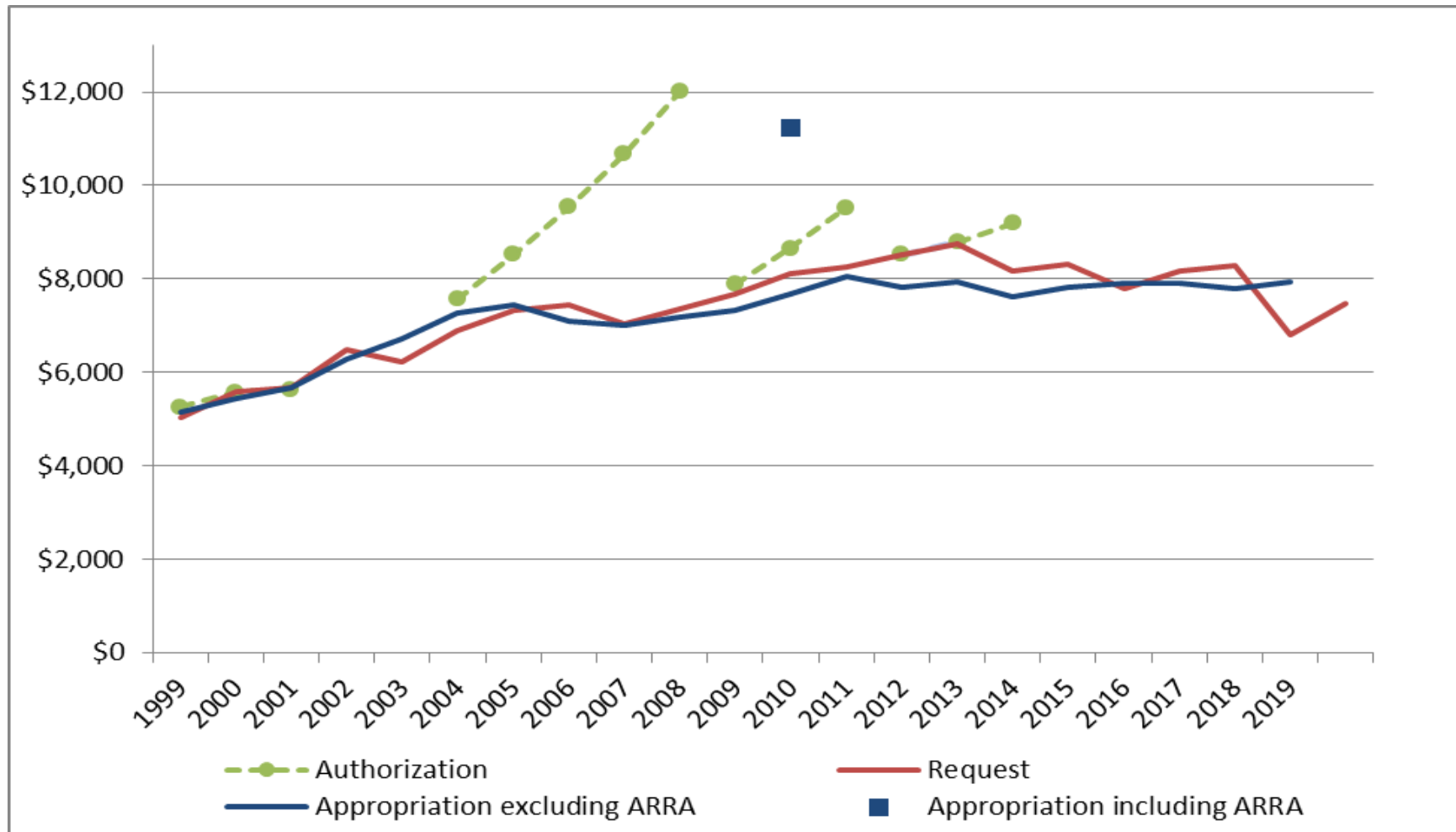
NOTE: Components may not add to totals due to rounding.



*FY2019 request numbers reflect an additional \$2.20 billion provided for NSF in the *Addendum to the President's FY19 Budget to Account for the Bipartisan Budget Act of 2018*.

NSF Authorizations, Budget Requests, and Appropriations, FY1998- FY2019 Request

(budget authority in millions of FY2019 constant dollars)



Source: CRS analysis of data from selected NSF authorization acts; the NSF Budget Internet Information System, “NSF Requests and Appropriations History,” <https://dellweb.bfa.nsf.gov>; and the NSF *FY2019 Budget Request to Congress*.

