U.S. DEPARTMENT OF ENERGY | Office of Science

DOE Office of Science

Update and FY 2019 Budget

Presented to the

Biological and Environmental Research Advisory Committee

by

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October 18, 2018

Outline

- Message from DOE leadership
- Appointee status
- FY 2019 budget

Message from Secretary Perry

The President's Budget for FY 2019 requests $30.6B for the Department of Energy (DOE) to advance U.S. national security and economic growth through transformative science and technology innovation that promotes affordable and reliable energy through market solutions and meets our nuclear security and environmental cleanup challenges.

The FY 2019 Budget provides:

- $15.1B to modernize and restore the nuclear security enterprise aligned with the Nuclear Posture Review (NPR) and National Security Strategy
- **$6.585B to conduct cutting-edge, early-stage scientific research and development (R&D) and build state-of-the-art scientific tools and facilities to keep U.S. researchers at the forefront of scientific innovation, including achieving exascale computing in 2021**
- $2.5B to promote America's energy dominance through technologies that will make our energy supply more affordable, reliable, and efficient
- $6.6B to continue our commitment for the cleanup of sites resulting from five decades of nuclear weapons development and production and Government-sponsored nuclear energy research

Message from the DOE Office of Science

- Our job is to deliver the best science we can with the resources we are given by the President and Congress
- We pleased about the final passage of the Congressional Appropriation FY 2019
- As we proceed in the remainder of FY 2019, we remain focused on our priorities:
  - Deliver the best science we can with the resources we have
  - Continue the tradition of excellence in SC-funded university-based research, lab-based research, and operations of scientific facilities

Appointee Status

Deputy Secretary of Energy Nominee Dan Brouillette

- Nomination announced April 3, 2017
- Senate Hearing May 25, 2017
- Senate Confirmation on August 3, 2017
- Sworn in August 7, 2017

Under Secretary for Science Nominee Paul Dabbar

- Nomination announced July 12, 2017
- Senate Hearing July 20, 2017
- Senate Confirmation November 2, 2017
- Sworn in November 7, 2017

Appointee Status, continued

Director, Office of Science Nominee Christopher Fall

- Nomination announced May 18, 2018
- Senate Hearing June 26, 2018, voted out of Committee July 24, 2018
- Awaiting final Senate Confirmation

Director, Office of Science Nominee Christopher Fall

Dr. Chris Fall presently is the Principal Deputy Director of the Advanced Research Projects Agency – Energy.

Dr. Fall served most recently for over six years with the Office of Naval Research, including as Innovation Fellow, as Director of the International Liaison Office, as Deputy Director of Research for STEM and Workforce, and finally as acting Chief Scientist. During this time, he also served for three years at the White House Office of Science and Technology Policy as Assistant Director for Defense Programs and then as acting Lead for the National Security and International Affairs Division.

Dr. Fall earned a B.S. in Mechanical Engineering and a Ph.D. in Neuroscience from the University of Virginia, as well as a master of business administration from the Kellogg School of Management. He was previously at the University of California at Davis, New York University, and the University of Illinois at Chicago.

https://www.whitehouse.gov/presidential-actions/president-donald-j-trump-announces-intent-nominate-personnel-key-administration-posts-44/

DOE/CF-0144

Department of Energy

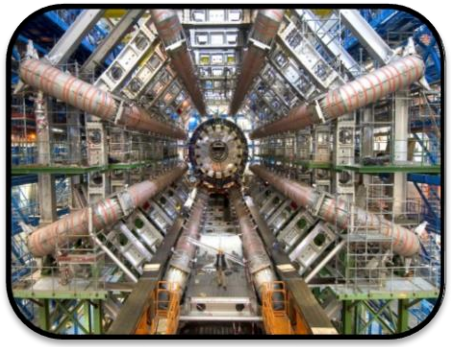
FY 2019 Congressional Budget Request

Budget in Brief

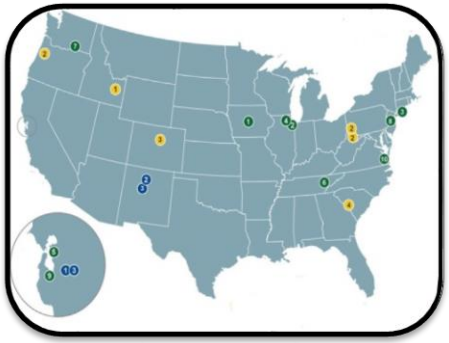
February 2018 Office of Chief Financial Officer

Office of Science at a Glance

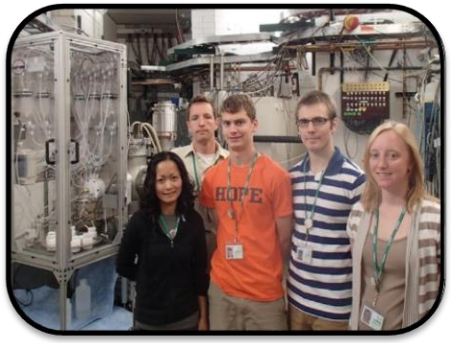
FY 2019 Enacted: $6.585B



Largest Supporter of Physical Sciences in the U.S.



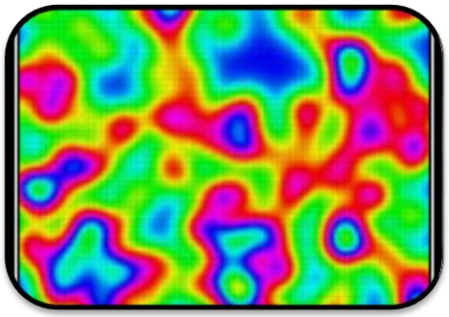
Funding at >300 Institutions including all 17 DOE Labs



Over 22,000 Scientists Supported

Nearly 32,000 Users of 26 SC Scientific Facilities

~40% of Research to Universities



Research: 40%

Facility Operations: 39%,

Projects/Other: 21%,

The Office of Science

The DOE Office of Science (SC) has as its mission the delivery of scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States.

- **SC is the largest Federal supporter of basic research in the physical sciences in the United States. SC supports research at the frontiers of science—discovering nature's mysteries, from the study of subatomic particles, atoms, and molecules that are the building blocks of the materials of our everyday world, to the DNA, proteins, and cells that are the building blocks of entire biological systems.**
- **SC also supports science for energy and the environment—advancing a clean energy agenda through fundamental research on energy production, conversion, storage, transmission, and use, and through advancing our understanding of the earth and its environment.**

The scale and complexity of the SC research portfolio provide a competitive advantage to the nation as multidisciplinary teams of scientists, using some of the most advanced scientific instruments in the world, are able to respond quickly to national priorities and evolving opportunities at the frontiers of science.

FY 2019 SC Budget Guidance

FY 2017 Enacted: $5.391B

FY 2018 Enacted: $6.260B

FY 2019 Enacted: $6.585B

Priorities:

- Continue operations of the national laboratories
- Continue exascale computing research for delivery in FY 2021
- Expand quantum computing and quantum information science efforts
- Provide sufficient funding to ensure robust cybersecurity program
- Focus on cutting edge, early stage research and development
- Maintain interagency and international partnerships

FY 2019 SC Budget (House-Senate Conference)

(Dollars in Thousands)

	FY 2017			FY 2018		FY 2019			
	President's Request	Enacted Approp.	Current Approp.	President's Request	Enacted Approp.	President's Request	House Mark	Senate Mark	Conference
ASCR	663,180	647,000	626,559	722,010	810,000	899,010	914,500	980,000	935,500
BES	1,936,730	1,871,500	1,812,113	1,554,500	2,090,000	1,850,000	2,129,233	2,193,400	2,166,000
BER	661,920	612,000	588,826	348,950	673,000	500,000	673,000	715,000	705,000
FES	398,178	380,000	368,119	309,940	532,111	340,000	590,000	425,000	564,000
HEP	817,997	825,000	802,849	672,700	908,000	770,000	1,004,510	1,010,000	980,000
NP	635,658	622,000	604,473	502,700	684,000	600,000	690,000	710,000	690,000
WDTS	20,925	19,500	19,500	14,000	19,500	19,000	19,500	24,500	22,500
SLI	130,000	130,000	130,000	76,200	257,292	126,852	290,147	302,100	232,890
S&S	103,000	103,000	103,000	103,000	103,000	106,110	106,110	106,000	106,110
PD	204,481	182,000	182,000	168,516	183,000	180,000	183,000	184,000	183,000
SBIR/STTR (SC)	...	...	154,561	...	...	...	...	...	...
Total Budget Authority and Obligations, Office of Science	5,572,069	5,392,000	5,392,000	4,472,516	6,259,903	5,390,972	6,600,000	6,650,000	6,585,000
SBIR/STTR (DOE)	...	...	90,813	...	...	...	...	...	...
Rescission of Prior Year Balances	...	-1,028	-1,028	...	...	...	...	...	...
Total, Office of Science	5,572,069	5,390,972	5,481,785	4,472,516	6,259,903	5,390,972	6,600,000	6,650,000	6,585,000

SC Research Programs

FY 2017 Enacted, FY 2018 Enacted, FY 2019 Enacted

Advanced Scientific Computing Research *(ASCR: FY 2017 $647M; FY 2018 $810M; FY 2019 $936M)*

- Advances applied mathematics, computer science, and computational research to discover, develop, and deploy computational and networking capabilities to analyze, model, simulate, and predict complex phenomena important to the U.S.
- Builds and operates some of the fastest computers in the world for open science. Leads the U.S. effort to develop the next generation of computing tools (exascale).

Basic Energy Sciences *(BES: FY 2017 $1,872M; FY 2018 $2,090M; FY 2019 $2,166M)*

- Advances fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels to provide foundations for new energy technologies. Supports a large portfolio of core research in chemical sciences, geosciences, biosciences, and materials sciences and engineering to advance DOE priorities.
- Constructs and supports scientific user facilities that enable atomic-level visualization and characterization of materials from many scientific fields, including chemistry, physics, geology, materials science, environmental science, and biology.

Biological and Environmental Research *(BER: FY 2017 $612M; FY 2018 $673M; FY 2019 $705M)*

- Advances fundamental research to achieve a predictive understanding of complex biological, earth and environmental systems for energy and infrastructure security, independence, and prosperity.
- Supports core research in genomic sciences of plants and microbes, research to understand atmospheric and earth system processes and to understand the dynamic physical, biogeochemical, microbial, and plant processes and interactions.

SC Research Programs

FY 2017 Enacted, FY 2018 Enacted, FY 2019 Enacted

Fusion Energy Sciences *(FES: FY 2017 $380M; FY 2018 $532M; FY 2019 $564M)*

- Advances the theoretical and experimental understanding of matter at high temperatures and density, including magnetic confinement science, fusion materials, and discovery plasma science.

High Energy Physics *(HEP: FY 2017 $825M; FY 2018 $908M; FY 2019 $980M)*

- Advances understanding of the basic constituents of matter, deeper symmetries in the laws of nature at high energies, and mysterious phenomena that are commonplace in the universe, such as dark energy and dark matter.

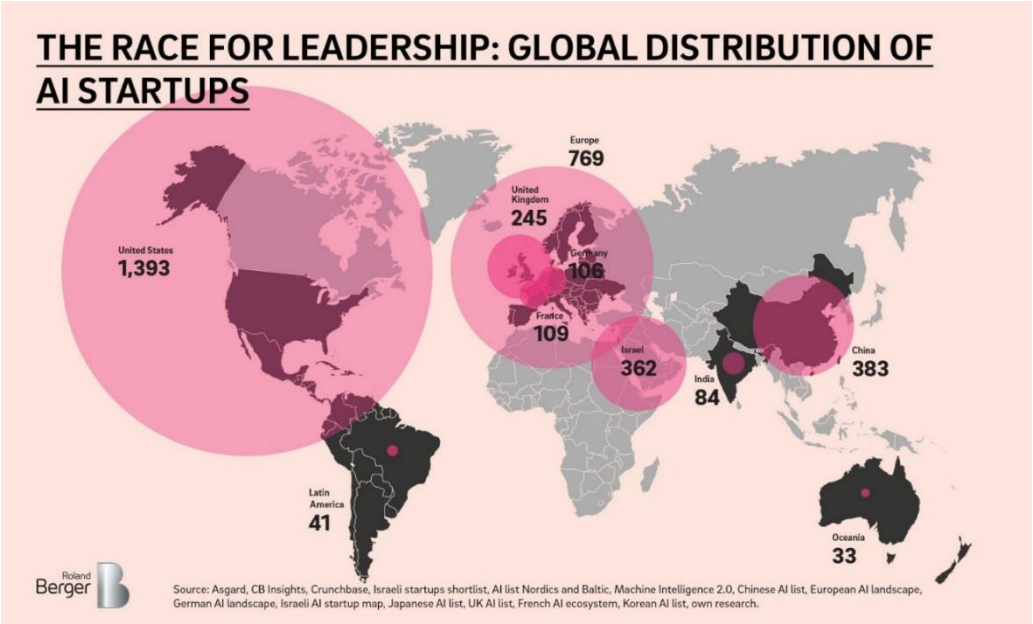
Nuclear Physics *(NP: FY 2017 $622M; FY 2018 $684M; FY 2019 $690M)*

- Advances experimental and theoretical research to discover, explore, and understand all forms of nuclear matter.
- Supports DOE's Isotopes Development and Production for Research and Applications subprogram for production of stable and radioactive research isotopes.

Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) *(SBIR 3.20%; STTR 0.45%)*

- SC manages the competitive SBIR/STTR Programs for DOE (except ARPA-E), competing the 3.65% of DOE's appropriated R&D to small businesses, in collaboration with the DOE science and technology offices.

Artificial Intelligence – Race for Global Leadership

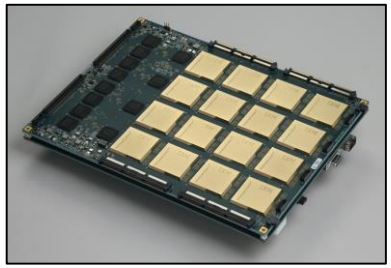


Foundational technology that is disrupting the current landscape and will lead to decades of innovation

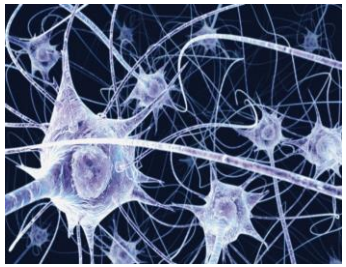
Artificial Intelligence

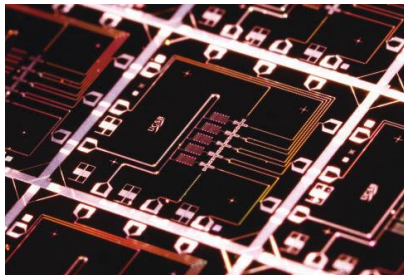
- Spans sensors, learning, deciding, autonomy and human interface, mission support
- Not High Performance Computing (HPC);
- AI platforms use less space and energy
- Lives in data
- Applied at source of data creation
- Transforming hardware landscape
- Surface questions and proposes models from data
- Beyond Von Neumann architectures and Moore's Law to the next-gen computing technologies

Novel Memory Architectures



Neuromorphic Systems





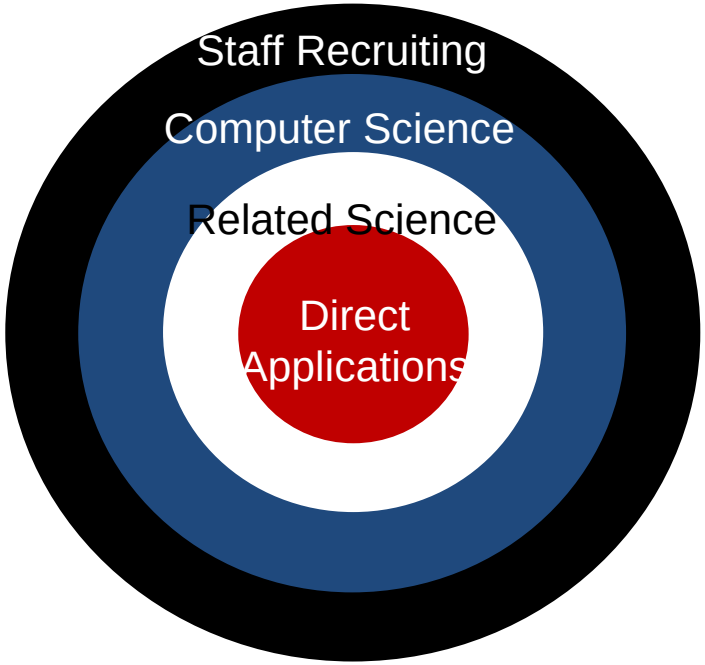
Quantum Information Systems

Computing landscape will continue to evolve
US must develop and capitalize on future technologies

Application of AI Research in DOE

- Artificial Intelligence concepts shift in scientific high-performance computing
- AI applicable to energy, science, national security realms
- AI concepts are an integral part of early Exascale systems

- Direct applications
  - Data driven modeling
  - Multi-scale modeling
  - Rethinking algorithms
  - Concept space exploration
  - Mesh management
- Science applications
  - Data analysis
  - Feature extraction
  - Uncertainty quantification
- Computer science applications
  - Problem partitioning
  - Job scheduling
  - Adaptive refinement
- Staff recruiting



U.S. Artificial Intelligence (AI) Priorities

- **Using AI for government services:**
  - Executive departments and agencies are to apply AI to improve government services
- **Removing barriers to AI innovation:**
  - Facilitate creation of new American industries by removing regulatory barriers to deployment of AI-powered technologies
- **Achieving strategic military advantage:**
  - Administration's National Security Strategy recognizes need to lead in AI
- **Supporting Research & Development (R&D):**
  - Prioritized funding for fundamental AI research and computing infrastructure, machine learning, and autonomous systems

EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON, D.C.

July 31, 2018

M-18-22

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: MICK MULVANEY
DIRECTOR, OFFICE OF MANAGEMENT AND BUDGET

MICHAEL KRATSIOS
DEPUTY ASSISTANT TO THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY

SUBJECT: FY 2020 Administration Research and Development Budget Priorities

The United States is a nation of thinkers, inventors, and entrepreneurs. Empowered by free-market capitalism and driven by bold ideas, Americans created an ecosystem of innovation that is the envy of the world, advancing science and technology and making the Nation prosperous and strong. America brought the miracle of electric light to people's homes, placed millennia of knowledge in people's pockets, and put men on the Moon and brought them safely back to Earth.

American Leadership in Artificial Intelligence, Quantum Information Sciences, and Strategic Computing

Continued leadership in AI, quantum information science (QIS), and strategic computing is critically important to our national security and economic competitiveness. Advances in these areas promise opportunities for major scientific breakthroughs and are quickly transforming American life and industry. Agencies should invest in fundamental and applied AI research, including machine learning, autonomous systems, and applications at the human-technology frontier. Agencies should prioritize QIS R&D, which will build the technical and scientific base necessary to explore the next generation of QIS theory, devices, and applications. Agencies should prioritize investment in research and infrastructure to maintain U.S. leadership in strategic computing, from edge devices to high-performance computing, that accelerates delivery of low-power, high performance devices; supports a national high-performance computing ecosystem; and explores novel pathways to advance computing in a post-Moore's Law era.

In Conclusion …

- **In the immediate future:**
  - Keep producing great science!
  - Continue the traditions of excellence in SC-supported research and operations of our scientific facilities

- **In the coming weeks and months:**
  - The FY 2019 budget was enacted and in place on October 1
  - We are executing the FY 2019 budget

Questions?