Science
(dollars in thousands)

FY 2018 Enacted	FY 2019 Enacted	FY 2020 Request
$6,259,903	$6,585,000	$5,545,972

Overview
The Office of Science's (SC) mission is to deliver 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 Nation's largest Federal sponsor of basic research in the physical sciences and the lead Federal agency supporting fundamental scientific research for our Nation's energy future.

SC accomplishes its mission and advances national goals by supporting:

- *The frontiers of science*—exploring nature's mysteries from the study of fundamental subatomic particles, atoms, and molecules that are the building blocks of the materials of our universe and everything in it to the DNA, proteins, and cells that are the building blocks of life. Each of the programs in SC supports research probing the most fundamental disciplinary questions.
- *The 21st Century tools of science*—providing the nation's researchers with 27 state-of-the-art national scientific user facilities - the most advanced tools of modern science - propelling the U.S. to the forefront of science, technology development, and deployment through innovation.
- *Science for energy and the environment*—paving the knowledge foundation to spur discoveries and innovations for advancing the Department's mission in energy and environment. SC supports a wide range of funding modalities from single principal investigators to large team-based activities to engage in fundamental research on energy production, conversion, storage, transmission, and use, and on our understanding of the earth systems.

SC is an established leader of the U.S. scientific discovery and innovation enterprise. Over the decades, SC investments and accomplishments in basic research and enabling research capabilities have provided the foundations for new technologies, businesses, and industries, making significant contributions to our nation's economy, national security, and quality of life. Select scientific accomplishments in FY 2018 enabled by the SC programs are described in the program budget narratives. Additional descriptions of recent science discoveries can be found at http://science.energy.gov/news/highlights.

Highlights and Major Changes in the FY 2020 Request
The FY 2020 Request for SC is $5,546 million, a decrease of 15.8 percent, below the FY 2019 Enacted level, to implement the Administration's objectives for advancing U.S. science and technology and making the Nation prosperous and strong[a]. The FY 2020 Request supports a balanced research portfolio of basic scientific research probing some of the most fundamental questions in areas such as: high energy, nuclear, and plasma physics; materials and chemistry; biological and environmental systems; applied mathematics; next generation high-performance computing and simulation capabilities; and basic research for advancement in new energy technologies. The Request includes investments in a coordinated, multidisciplinary research effort in quantum information sciences (QIS) in support of the National Quantum Initiative, data-driven science enabled by artificial intelligence (AI) and machine learning (ML), next-generation microelectronics, genomic sciences to inform biosecurity research, and critical scientific infrastructure needs at DOE laboratories. The Request supports SC's basic research portfolio, which includes extramural grants and contracts supporting over 22,000 researchers located at over 300 institutions and the 17 DOE national laboratories, spanning all fifty states and the District of Columbia. In FY 2020, SC's suite of 27 scientific user facilities will continue to provide unmatched tools and capabilities for over 32,000 users per year from universities, national laboratories, industry, and international partners. The Request will also support the construction of new user facilities and the R&D necessary for future facilities and facility upgrades to continue to provide world class research capabilities to U.S. researchers. SC allocates Working Capital Fund charges for common administrative services to the research programs and the Program Direction account.

[a] M-18-22, OMB/OSTP Memo: *FY 2020 Administration R&D Budget Priorities* (American Leadership in Artificial Intelligence, Quantum Information Sciences, and Strategic Computing, American Energy Dominance, Security of the American People, Managing and Modernizing R&D Infrastructure, and Training a Workforce for the 21st Century.)

Highlights of the FY 2020 Request by Program Office include:

- *Advanced Scientific Computing Research (ASCR)* supports research to discover, develop, and deploy computational and networking capabilities to analyze, model, simulate, and predict complex phenomena important to the DOE and the United States. The ASCR Request of $920.9 million, is a decrease of $14.6 million, or 1.6 percent, below the FY 2019 Enacted level. The Request supports the Department's Exascale Computing Initiative (ECI) and will enable delivery of at least one exascale-capable system in calendar year 2021—reasserting U.S. leadership in this critical area. Within ASCR, ECI consists of two components, Office of Science Exascale Computing Project (SC-ECP), which supports the research and development focused on addressing the challenges of exascale and the second component, preparations for the deployment of at least one exascale system at an ASCR Leadership Computing Facility (LCF) in calendar year 2021. To ensure continued progress during and after the ECI, this Request prioritizes basic research for ML/AI with a focus on foundational research and data intensive science and on future computing technologies. The Request maintains support for ASCR's Computational Partnerships with a focus on developing strategic partnerships in quantum computing. ASCR will partner with the Offices of Basic Energy Sciences and High Energy Physics to establish at least one multi-disciplinary QIS center to promote basic research and early stage development to accelerate the advancement of QIS through vertical integration between systems and theory and hardware and software. The Request also provides strong support for ASCR user facilities operations to ensure the availability of high performance computing and networking to the scientific community and upgrades to maintain U.S. leadership in these essential areas. Funding for the LCF's is increased to continue site preparations and non-recurring engineering activities to deploy an exascale system at the Argonne Leadership Computing Facility (ALCF) in calendar year 2021 and for a second architecturally distinct exascale system at the Oak Ridge Leadership Computing Facility (OLCF) to be deployed in the calendar year 2021–2022 timeframe. Both facilities will provide testbed resources to the SC-ECP to test and scale application codes and continuously test and deploy software technologies. The FY 2020 Request also supports the operations of the 200 petaflop (pf) Summit system at OLCF, and the 8.5 pf Theta system at the ALCF for existing users while the ALCF upgrade project continues. The National Energy Research Scientific Computing Center (NERSC) will operate the 30 pf Cori supercomputer, and funding will support the final site and early application preparations for NERSC-9. Increased funds will support continued operations of the Energy Sciences Network (ESnet) and the ESnet-6 upgrade to address the rapidly growing volume of scientific data transmission.

- *Basic Energy Sciences (BES)* supports 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. The BES Request of $1,858.3 million is a decrease of $307.7 million, or 14.2 percent, below the FY 2019 Enacted level. The FY 2020 Request focuses resources toward early-stage fundamental research, the operation and maintenance of a complementary suite of scientific user facilities, and the highest priority facility upgrades. The highest priorities in core research are QIS, next-generation microelectronics, and data analytics and machine learning for data-driven science. BES will partner with the ASCR and High Energy Physics programs to establish at least one multi-disciplinary QIS center to promote basic research and early stage development to accelerate the advancement of QIS through vertical integration between systems and theory and hardware and software. The Request increases funding for the Energy Frontier Research Centers (EFRCs) with a planned solicitation in FY 2020 to expand the EFRC portfolio in topical areas of the highest priority to the Department, including QIS and microelectronics, and recompeting funding for science relevant to the Department's environmental management mission. The Request continues support for computational materials and chemical sciences to deliver shared software infrastructure to the research communities as part of the ECI, and supports the Batteries and Energy Storage Energy Innovation Hub. The Fuels from Sunlight Energy Innovation Hub will complete its second five-year term with FY 2019 funding. FY 2020 funding is requested for continued support of early-stage fundamental research on solar fuels generation that builds on the Hub's unique capabilities and accomplishments to date. An open competition will solicit research to address emerging new directions as well as long-standing challenges in this transformational area of energy science. The Request also provides funds for the DOE Established Program to Stimulate Competitive Research (EPSCoR). BES maintains a balanced suite of complementary tools, including supporting Linac Coherent Light Source (LCLS) operations, which will resume in the second quarter of FY 2020 after completion of installation of LCLS-II accelerator components. The Request supports about 87 percent of optimal operations in FY 2020 at the four remaining x-ray facilities, both BES-supported neutron sources, and five nanoscale science research centers (NSRC). Funding for the Advanced Photon Source Upgrade project continues per the project plan. The Request includes funds for the Advanced Light Source Upgrade project, the Linac Coherent Light Source-II High Energy (LCLS-II-HE) project, and the Proton Power Upgrade and the Second Target Station projects at the

Spallation Neutron Source. The FY 2020 Request includes two new Major Item of Equipment projects: the NSLS-II Experimental Tools-II (NEXT-II) project to continue the phased build-out of beamlines at NSLS-II and the NSRC Recapitalization project.

- *Biological and Environmental Research (BER)* supports transformative science and scientific user facilities to achieve a predictive understanding of complex biological, earth, and environmental systems for energy and infrastructure security, independence, and prosperity. The BER Request of $494.4 million is a decrease of $210.6 million, or 29.9 percent, below the FY 2019 Enacted level. The FY 2020 Request implements Administration priorities for early-stage fundamental research focused on biological and earth and environmental systems that will contribute to a future of stable, reliable, and secure sources of American energy and advance transformative science for economic prosperity. The FY 2020 Request for Biological Systems Science supports core research areas of Genomic Sciences, including new efforts in secure biosystems design, particularly genome-scale engineering tools, ongoing activities in systems biology and environmental genomics, and fully supports the third year of the recompeted four DOE Bioenergy Research Centers (BRCs). The BRCs continue to perform new fundamental research underpinning the production of fuels and chemicals from sustainable biomass resources and the building blocks of new technological advances for translation of basic research results to industry. Extended secure biosystems design activities will test the fundamental engineering principles that control plant and microbial systems, with a specific goal of enhancing the stability, resilience, and controlled performance of engineered biological systems. Biomolecular Characterization and Imaging Science research will continue to support structural, spatial, and temporal understanding of functional biomolecules and processes occurring within living cells. New efforts in QIS imaging and sensing approaches will expand experimental observation capabilities to advance systems-level predictive understanding of biological processes. In the Earth and Environmental Systems Sciences subprogram, the Request focuses on continuing to prioritize development of the DOE high-resolution earth system model and for model diagnostics and intercomparisons and associated data management. The Request supports operations of BER's three scientific user facilities: the DOE Joint Genome Institute (JGI), the Environmental Molecular Sciences Laboratory, and the Atmospheric Radiation Measurement Research Facility (ARM). JGI operations are reduced to accommodate the FY 2020 move into the Integrative Genomics Building on the Lawrence Berkeley National Laboratory campus. The ARM user facility will continue to develop the aerial capability acquired in FY 2019.

- *Fusion Energy Sciences (FES)* supports research to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation needed to develop a fusion energy source. The FES FY 2020 Request of $402.8 million is a decrease of $161.3 million, or 28.6 percent, below the FY 2019 Enacted level. The FY 2020 Request prioritizes keeping SC fusion user facilities world-leading, investing in FES related high performance computing and preparing for exascale, exploring the potential of QIS and ML, supporting high-impact research in fusion materials, strengthening collaborations that enable access to international facilities with unique capabilities, learning how to predict and control transient events in fusion plasmas, continuing stewardship of discovery plasma science, and increasing partnership opportunities with the private sector. FES investments in DIII-D facility operations focus on utilizing the facility enhancements implemented during the FY 2018 – FY 2019 Long Torus Opening; the Request supports 13 weeks of research operations, which is 65 percent of optimal operations, along with machine improvements needed for new research capabilities. In FY 2020, the NSTX-U facility is down for recovery and repair; the Request for NSTX-U Operations will support high-priority activities to implement repairs and corrective actions required to achieve research operations, as well as to increase machine reliability. In addition, the Request includes funding for enhanced collaborative research at other facilities to support NSTX-U research program priorities. In FY 2020, the FES SciDAC portfolio, in partnership with ASCR, will continue to address challenges in burning plasma science, with emphasis on integration and whole-device modeling capability, as well as strengthening readiness for the Exascale era. In addition, research efforts focusing on emerging technologies with transformational potential, such as ML/AI and computing aspects of QIS, will be enhanced. The FY 2020 Request will continue support for leveraged research opportunities by U.S. scientists on international superconducting tokamaks, stellarators, and other facilities with unique capabilities, and core discovery plasma science experiments on intermediate-scale collaborative facilities. Funding is requested for the Materials-Plasma Exposure eXperiment MIE project, which is expected to be baselined in FY 2020 and will be a world-leading facility for steady-state, high-heat-flux testing of fusion materials. The Request supports the initiation of a line-item construction project for a significant upgrade to the Matter in Extreme Conditions instrument at the LCLS facility at SLAC National Accelerator Laboratory to support research in high energy density laboratory plasmas. The Request also supports research conducted on medium-scale laser facilities through the new LaserNetUS network,

and explores research opportunities of high energy density science for QIS. The FY 2020 Request includes funding for continued design and fabrication of the highest priority "in-kind" hardware systems for ITER.

- *High Energy Physics (HEP)* supports research to understand how the universe works at its most fundamental level by discovering the most elementary constituents of matter and energy, probing the interactions among them, and exploring the basic nature of space and time itself. The FY 2020 Request of $768.0 million is a decrease of $212 million, or 21.6 percent, below the FY 2019 Enacted level. The FY 2020 Request will focus support on the highest priority elements identified in the 2014 High Energy Physics Advisory Panel Particle Physics Project Prioritization Panel (P5) Report. Support for Research will prioritize efforts that address the science drivers of particle physics, as identified in the P5 report, and enable early and visible science results from HEP project investments. R&D that requires long-term investments, including Advanced Technology R&D, Accelerator Stewardship, and cross-cutting efforts in QIS and AI/ML to accelerate discovery in particle physics, will also be given higher priority in order to sustain world-leading efforts and support Office of Science priorities. HEP will partner with ASCR and BES to establish at least one multi-disciplinary QIS center to promote basic research and early stage development to accelerate the advancement of QIS through vertical integration between systems and theory and hardware and software. The P5 report identified the High-Luminosity Large Hadron Collider (HL-LHC) accelerator and A Toroidal LHC Apparatus (ATLAS) and Compact Muon Solenoid (CMS) Detector Upgrade Projects as the highest priority in the near-term, and Long-Baseline Neutrino Facility and Deep Underground Neutrino Experiment (LBNF/DUNE) as the highest-priority large project in its timeframe. To continue our strong international partnership with CERN, the FY 2020 Request will support these high-priority projects. The Request continues support for LBNF/DUNE, including upgrades to the Sanford Underground Research Facility (SURF) to meet DOE expectations of reliable, efficient, and safe operations during the construction of LBNF/DUNE and its subsequent data-taking phase. The Request supports R&D to reduce technical risk for the planned Proton Improvement Plan II (PIP-II) construction project. Eight HEP projects will be completely funded by FY 2020: the Dark Energy Spectrographic Instrument (DESI), Facility for Advanced Accelerator Experimental Tests II (FACET-II), LHC ATLAS Detector Upgrade, LHC CMS Detector Upgrade, Large Synoptic Survey Telescope camera (LSSTcam), Large Underground Xenon (LUX)-ZonEd Proportional scintillation in LIquid Noble gases (ZEPLIN) experiment (LZ), Muon to Electron Conversion Experiment (Mu2e), and the Super Cryogenic Dark Matter Search at Sudbury Neutrino Observatory Laboratory (SuperCDMS-SNOLAB). DESI, FACET-II, LZ, Mu2e, and SuperCDMS-SNOLAB projects received final project funds in FY 2019. The FY 2020 Request will support technology R&D and pre-conceptual design studies for the next generation Cosmic Microwave Background (CMB-S4) experiment, recommended by P5. The Request will also support the operation of the Fermi National Accelerator Laboratory Accelerator Complex at 88 percent of optimal, and will support the new Fermilab Kautz Road Sub-Station Radial Feed Electrical Upgrade General Plant Project, which will upgrade or replace existing electrical feeders to improve reliability, increase system capacity, and bring the service up to modern standards.

- *Nuclear Physics (NP)* supports experimental and theoretical research to discover, explore, and understand all forms of nuclear matter. The FY 2020 Request of $624.9 million is a decrease of $65.1 million, or 9.4 percent, below the FY 2019 Enacted level. The FY 2020 Request will support the highest priority research and scientific user facilities to maintain U.S. leadership in nuclear science. The FY 2020 Request supports operations of the Relativistic Heavy Ion Collider (RHIC) to confirm the origin of intriguing new phenomena observed in quark gluon plasma formation, and continues support for the Strongly Pioneering High Energy Nuclear Interaction eXperiment (sPHENIX) MIE, which will further explore the properties of the quark gluon plasma. Operations support for the recently updated 12 GeV Continuous Electron Beam Accelerator Facility (CEBAF) will enable the highly anticipated science program to make progress towards unraveling the mechanism of quark confinement. The Request supports a new General Purpose Plant project to build and install the critically needed End Station Refrigerator to mitigate end-of-life risk of current equipment and provide required additional capacity for future experiments. At Argonne National Lab, the Request also supports the operations of the Argonne Tandem Linac Accelerator System (ATLAS) to provide opportunities for research in nuclear structure and nuclear astrophysics. The Request will support the continued construction of the Facility for Rare Isotope Beams (FRIB) according to the performance baseline profile, and continues support for the Gamma-Ray Energy Tracking Array (GRETA) detector for FRIB. In FY 2020, three additional MIEs are initiated: the High Rigidity Spectrometer (HRS) for FRIB, which will maximize FRIB's ability to study heavy, neutron-rich nuclei thought to be central to the production of heavy elements in the cosmos, the Measurement of a Lepton-Lepton Electroweak Reaction (MOLLER) experiment, which will search for physics beyond our present understanding by measuring parity-violation in electron-electron scattering with the 12 GeV CEBAF machine; and the Ton-Scale Neutrino-less Double Beta Decay (NLDBD) Experiment, which will determine whether the neutrino is its own antiparticle. Funding is requested in FY 2020 for the start of R&D and

conceptual design for a proposed U.S.-based Electron Ion Collider. The FY 2020 Request increases support for the DOE Isotope Program to produce, and develop cutting-edge approaches for producing, critical isotopes in short supply. The Request also continues the Stable Isotope Production Facility (SIPF) MIE project and initiates an AIP project for the harvesting of isotopes at FRIB. The FY 2020 Request initiates a new construction project for the U.S. Stable Isotope Production and Research Center to produce critical enriched stable isotopes in short supply and mitigate U.S. dependence on foreign supply. The Request for Research supports university and laboratory researchers to nurture critical core competencies and enable the highest priority theoretical and experimental activities to target compelling scientific opportunities at the frontier of nuclear science, including investments in QIS efforts in collaboration with other SC programs, the development of quantum sensors based on atomic-nuclear interactions and quantum control techniques, and the production of stable isotopes for next generation quantum information systems.

Reorganization and Restructure Initiative

SC continues to review its functions and the organizational structure to maximize efficiencies across all programs in an attempt to reduce and streamline the Federal footprint. Through workforce analysis and restructuring, we will continue to review, analyze and prioritize mission requirements and identify those organizations and functions most in line with the Administration and Department program objectives and SC strategic goals. SC has begun the implementation of a restructuring of the Field and mission support components following approval by the Secretary of Energy in November 2018. This restructuring merges two geographical separate service centers (Chicago and Oak Ridge) into a functionally consolidated center and consolidates corporate functions to improve consistency in operations, and pilots the merging of two SC federal site offices at national laboratories in the same geographic area (Lawrence Berkeley National Laboratory Site Office and the SLAC Site Office), both located in the San Francisco Bay area. This reorganization maximizes efficiencies across all SC field components programs and will reduce and streamline the Federal footprint. Through workforce analysis and restructuring, SC reviewed, analyzed and prioritized mission requirements and identified those organizations and functions most in line with the Administration and Department program objectives and SC strategic goals. Using available human capital workforce reshaping tools, SC has focused on functional consolidation, elimination of positions, and hiring limitations to achieve necessary results.

Basic and Applied R&D Coordination

Coordination between the Department's basic research and applied technology programs is a high priority within DOE and is facilitated through joint planning meetings, technical community workshops, annual contractor/awardee meetings, joint research solicitations, focused DOE program office working groups in targeted research areas, and collaborative program management of DOE's Small Business Innovation Research and Small Business Technology Transfer programs. Co-funding of research activities and facilities at the DOE National Laboratories and partnership/collaboration-encouraging funding mechanisms facilitate research integration within the basic and applied research communities. SC's R&D coordination also occurs at the interagency level. Specific collaborative activities are highlighted in the "Basic and Applied R&D Coordination" sections of each individual SC program budget justification narrative.

High-Risk, High-Reward Research[a]

SC incorporates high-risk, high-reward, basic research elements in all of its research portfolios; each SC research program considers a significant proportion of its supported research as high-risk, high-reward. Because advancing the frontiers of science also depends on the continued availability of state-of-the-art scientific facilities, SC constructs and operates national scientific facilities and instruments that comprise the world's most sophisticated suite of research capabilities. SC's basic research is integrated within program portfolios, projects, and individual awards; as such, it is not possible to quantitatively separate the funding contributions of particular experiments or theoretical studies that are high-risk, high-reward from other mission-driven research in a manner that is credible and auditable. SC incorporates high-risk, high-reward basic research elements in its research portfolios to drive innovation and challenge current thinking, using a variety of mechanisms to develop topics: Federal advisory committees, triennial Committees of Visitors, program and topical workshops, interagency working groups, National Academies' studies, and special SC program solicitations. Many of these topics are captured in formal reports, e.g., *Basic Research Needs for Microelectronics*, joint BES, ASCR, and HEP workshop (2018); *Basic Research Needs for Scientific Machine Learning; Core Technologies for Artificial Intelligence*, ASCR workshop (2018)[b]; *Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global* Context, by the High Energy Physics

[a] In compliance with the reporting requirements in the America COMPETES Act of 2007 (P.L. 110-69, section 1008)

[b] https://science.energy.gov/ascr/community-resources/program-documents/

Advisory Panel (2014)[a]; *Quantum Computing Testbed for Science,* ASCR workshop report (2017)[b]; *Basic Energy Science Roundtable: Opportunities for Basic Research for Quantum Computing in Chemical and Materials Sciences*, Basic Energy Sciences workshop report (2017); *Basic Energy Science Roundtable: Opportunities for Basic Research for Next-Generation Quantum Systems*, Basic Energy Sciences workshop report (2017)[c]; *Challenges at the Frontiers of Matter and Energy: Transformative Opportunities for Discovery Science*, by BES Advisory Committee (2015)[d]; *Basic Research Needs Workshop on Quantum Materials for Energy Relevant Technology,* BES workshop report (2016)[e]; *Grand Challenges for Biological and Environmental Research: Progress and Future* Vision, by the BER Advisory Committee (2017)[f]; *Technologies for Characterizing Molecular and Cellular Systems*, BER workshop report (2016)[g]; *Plasma: at the Frontier of Scientific Discovery*, FES workshop report (2017)[h]; *Isotope Research and Production Opportunities and Priorities*, by the Nuclear Science Advisory Committee (NSAC) (2015)[i]; and *Nuclear Physics Long Range Plan*, by the NSAC (2015)[j]

Scientific Workforce

For more than 60 years SC and its predecessors have fostered the training of a highly skilled scientific workforce. In addition to the undergraduate and graduate research opportunities provided through SC's Office of Workforce Development for Teachers and Scientists, the six SC research program offices train undergraduates, graduate students, and postdoctoral researchers through sponsored research awards at universities and the DOE National Laboratories. The research program offices also support targeted undergraduate and graduate-level experimental training in areas associated with scientific user facilities and not readily available in university academic departments, such as particle accelerator and detector physics, neutron and x-ray scattering, nuclear chemistry, and computational sciences at the leadership computing level. To help attract critical talent, SC supports the Early Career Research Program, which funds individual research programs by outstanding Ph.D. scientists early in their careers in the disciplines supported by SC[k]. To retain highly skilled researchers by rewarding scientific excellence and leadership, SC initiated the Distinguished Scientist Fellows opportunity to recognize innovative and accomplished DOE laboratory staff and sponsoring their efforts to develop, sustain, and promote scientific and academic excellence in SC research through collaborations between institutions of higher education and national laboratories. SC coordinates with other DOE offices and other agencies on best practices for training programs and program evaluation through internal DOE working groups and active participation in the National Science and Technology Council's Committee on Science, Technology, Engineering, and Mathematics Education. SC also participates in the American Association for the Advancement of Science's Science & Technology Policy Fellowships program and the Presidential Management Fellows Program to bring highly qualified scientists and professionals to DOE headquarters for a maximum term of two years.

Cybersecurity

DOE is engaged in two categories of cyber-related activities: protecting the DOE enterprise from a range of cyber threats that can adversely impact mission capabilities and improving cybersecurity in the electric power subsector and the oil and natural gas subsector. SC supports the Cybersecurity Departmental Crosscut, which includes central coordination of the strategic and operational aspects of cybersecurity and facilitates cooperative efforts such as the Joint Cybersecurity Coordination Center for incident response, and the implementation of Department-wide Identity, Credentials, and Access Management.

[a] http://science.energy.gov/~/media/hep/hepap/pdf/May%202014/FINAL_P5_Report_Interactive_060214.pdf
[b] https://science.energy.gov/~/media/ascr/pdf/programdocuments/docs/2017/QTSWReport.pdf
[c] https://science.energy.gov/~/media/bes/pdf/reports/2018/Quantum_computing.pdf; https://science.energy.gov/~/media/bes/pdf/reports/2018/Quantum_systems.pdf
[d] http://science.energy.gov/~/media/bes/besac/pdf/Reports/CFME_rpt_print.pdf
[e] https://science.energy.gov/~/media/bes/pdf/reports/2016/BRNQM_rpt_Final_12-09-2016.pdf
[f] https://science.energy.gov/~/media/ber/berac/pdf/Reports/BERAC-2017-Grand-Challenges-Report.pdf
[g] http://science.energy.gov/~/media/ber/pdf/workshop%20reports/VirtualEcosystems.pdf
[h] https://science.energy.gov/~/media/fes/pdf/program-news/Frontiers_of_Plasma_Science_Final_Report.pdf
[i] https://science.energy.gov/~/media/ber/pdf/community-resources/Technologies_for_Characterizing_Molecular_and_Cellular_Systems.pdf
[j] https://science.energy.gov/np/nsac/reports/
[k] https://science.energy.gov/early-career/