115TH CONGRESS
2d Session
HOUSE OF REPRESENTATIVES
REPORT
115–787

DEPARTMENT OF ENERGY SCIENCE AND INNOVATION ACT OF 2018

JUNE 27, 2018.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. SMITH of Texas, from the Committee on Science, Space, and Technology, submitted the following

R E P O R T

[To accompany H.R. 5905]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, Space, and Technology, to whom was referred the bill (H.R. 5905) to authorize basic research programs in the Department of Energy Office of Science for fiscal years 2018 and 2019, having considered the same, report favorably thereon with an amendment and recommend that the bill as amended do pass.

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The amendment is as follows:

Strike all after the enacting clause and insert the following:

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "Department of Energy Science and Innovation Act of 2018".

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

SEC. 2. DEFINITIONS.

In this Act:

(1) DEPARTMENT.—The term "Department" means the Department of Energy.

(2) DIRECTOR.—The term ¥ means the Director of the Office of Science of the Department.

(3) NATIONAL LABORATORY.—The term "National Laboratory" has the meaning given that term in section 2 of the Energy Policy Act of 2005 (42 U.S.C. 15801).

(4) SECRETARY.—The term "Secretary" means the Secretary of Energy.

SEC. 3. MISSION.

Section 209 of the Department of Energy Organization Act (42 U.S.C. 7139) is amended by adding at the end the following:

"(c) MISSION.—The mission of the Office of Science shall be the delivery of scientific discoveries, capabilities, and major scientific tools to transform the understanding of nature and to advance the energy, economic, and national security of the United States.".

SEC. 4. BASIC ENERGY SCIENCES.

(a) PROGRAM.—The Director shall carry out a program in basic energy sciences, including materials sciences and engineering, chemical sciences, physical biosciences, and geosciences, for the purpose of providing the scientific foundations for new energy technologies.

(b) MISSION.—The mission of the program described in subsection (a) shall be to support fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support Department missions in energy, environment, and national security.

(c) BASIC ENERGY SCIENCES USER FACILITIES.—

(1) IN GENERAL.—The Director shall carry out a program for the development, construction, operation, and maintenance of national user facilities.

(2) REQUIREMENTS.—To the maximum extent practicable, the national user facilities developed, constructed, operated, or maintained under paragraph (1) shall serve the needs of the Department, industry, the academic community, and other relevant entities to create and examine materials and chemical processes for the purpose of improving the competitiveness of the United States.

(3) INCLUDED FACILITIES.—The national user facilities developed, constructed, operated, or maintained under paragraph (1) shall include—

(A) x-ray light sources;

(B) neutron sources;

(C) nanoscale science research centers; and

(D) such other facilities as the Director considers appropriate, consistent with section 209 of the Department of Energy Organization Act (42 U.S.C. 7139).

(d) BASIC ENERGY SCIENCES RESEARCH INFRASTRUCTURE.—

(1) ADVANCED PHOTON SOURCE UPGRADE.—

(A) IN GENERAL.—The Secretary shall provide for the upgrade to the Advanced Photon Source described in the publication approved by the Basic Energy Sciences Advisory Committee on June 9, 2016, titled "Report on Facility Upgrades", including the development of a multi-bend achromat lattice to produce a high flux of coherent x-rays within the hard x-ray energy region and a suite of beamlines optimized for this source.

(B) DEFINITIONS.—In this paragraph:

(i) FLUX.—The term "flux" means the rate of flow of photons.

(ii) HARD X-RAY.—The term "hard x-ray" means a photon with energy greater than 20 kiloelectron volts.

(C) START OF OPERATIONS.—The Secretary shall, to the maximum extent practicable, ensure that the start of full operations of the upgrade under this paragraph occurs before December 31, 2025.

(D) FUNDING.—Out of funds authorized to be appropriated under section 11 for Basic Energy Sciences, there shall be made available to the Secretary to carry out the upgrade under this paragraph—

(i) $93,000,000 for fiscal year 2018; and

(ii) $130,000,000 for fiscal year 2019.

(2) SPALLATION NEUTRON SOURCE PROTON POWER UPGRADE.—

(A) IN GENERAL.—The Secretary shall provide for a proton power upgrade to the Spallation Neutron Source.

(B) DEFINITION OF PROTON POWER UPGRADE.—For the purposes of this paragraph, the term "proton power upgrade" means the Spallation Neutron Source power upgrade described in—

(i) the publication of the Office of Science of the Department of Energy titled "Facilities for the Future of Science: A Twenty-Year Outlook", published December 2003;

(ii) the publication of the Office of Science of the Department of Energy titled "Four Years Later: An Interim Report on Facilities for the Future of Science: A Twenty-Year Outlook", published August 2007; and

(iii) the publication approved by the Basic Energy Sciences Advisory Committee on June 9, 2016, titled "Report on Facility Upgrades".

(C) START OF OPERATIONS.—The Secretary shall, to the maximum extent practicable, ensure that the start of full operations of the upgrade under this paragraph occurs before December 31, 2025.

(D) FUNDING.—Out of funds authorized to be appropriated under section 11 for Basic Energy Sciences, there shall be made available to the Secretary to carry out the upgrade under this paragraph—

(i) $36,000,000 for fiscal year 2018; and

(ii) $60,800,000 for fiscal year 2019.

(3) SPALLATION NEUTRON SOURCE SECOND TARGET STATION.—

(A) IN GENERAL.—The Secretary shall provide for a second target station for the Spallation Neutron Source.

(B) DEFINITION OF SECOND TARGET STATION.—For the purposes of this paragraph, the term "second target station" means the Spallation Neutron Source second target station described in—

(i) the publication of the Office of Science of the Department of Energy titled "Facilities for the Future of Science: A Twenty-Year Outlook", published December 2003;

(ii) the publication of the Office of Science of the Department of Energy titled "Four Years Later: An Interim Report on Facilities for the Future of Science: A Twenty-Year Outlook", published August 2007; and

(iii) the publication approved by the Basic Energy Sciences Advisory Committee on June 9, 2016, titled "Report on Facility Upgrades".

(C) START OF OPERATIONS.—The Secretary shall, to the maximum extent practicable, ensure that the start of full operations of the second target station under this paragraph occurs before December 31, 2030, with the option for early operation in 2028.

(D) FUNDING.—Out of funds authorized to be appropriated under section 11 for Basic Energy Sciences, there shall be made available to the Secretary to carry out activities, including construction, under this paragraph—

(i) $5,000,000 for fiscal year 2018; and

(ii) $10,000,000 for fiscal year 2019.

(4) ADVANCED LIGHT SOURCE UPGRADE.—

(A) IN GENERAL.—The Secretary shall provide for the upgrade to the Advanced Light Source described in the publication approved by the Basic Energy Sciences Advisory Committee on June 9, 2016, titled "Report on Facility Upgrades", including the development of a multi-bend achromat lattice to produce a high flux of coherent x-rays within the soft x-ray energy region.

(B) DEFINITIONS.—In this paragraph:

(i) FLUX.—The term "flux" means the rate of flow of photons.

(ii) SOFT X-RAY.—The term "soft x-ray" means a photon with energy in the range from 50 to 2,000 electron volts.

(C) START OF OPERATIONS.—The Secretary shall, to the maximum extent practicable, ensure that the start of full operations of the upgrade under this paragraph occurs before December 31, 2026.

(D) FUNDING.—Out of funds authorized to be appropriated under section 11 for Basic Energy Sciences, there shall be made available to the Secretary to carry out the upgrade under this paragraph—

(i) $20,000,000 for fiscal year 2018; and

(ii) $50,000,000 for fiscal year 2019.

(5) LINAC COHERENT LIGHT SOURCE II HIGH ENERGY UPGRADE.—

(A) IN GENERAL.—The Secretary shall provide for the upgrade to the Linac Coherent Light Source II facility described in the publication approved by the Basic Energy Sciences Advisory Committee on June 9, 2016, titled "Report on Facility Upgrades", including the development of experimental capabilities for high energy x-rays to reveal fundamental scientific discoveries. The Secretary shall ensure the upgrade under this paragraph enables the production and use of high energy, ultra-short pulse x-rays delivered at a high repetition rate.

(B) DEFINITIONS.—In this paragraph:

(i) HIGH ENERGY X-RAY.—The term a "high energy x-ray" means a photon with an energy at or exceeding 12 kiloelectron volts.

(ii) HIGH REPETITION RATE.—The term "high repetition rate" means the delivery of x-ray pulses up to one million pulses per second.

(iii) ULTRA-SHORT PULSE X-RAYS.—The term "ultra-short pulse x-rays" means x-ray bursts capable of durations of less than one hundred femtoseconds.

(C) START OF OPERATIONS.—The Secretary shall, to the maximum extent practicable, ensure that the start of full operations of the upgrade under this paragraph occurs before December 31, 2025.

(D) FUNDING.—Out of funds authorized to be appropriated under section 11 for Basic Energy Sciences, there shall be made available to the Secretary to carry out the upgrade under this paragraph—

(i) $20,000,000 for fiscal year 2018; and

(ii) $55,000,000 for fiscal year 2019.

(e) ACCELERATOR RESEARCH AND DEVELOPMENT.—The Director shall carry out research and development on advanced accelerator and storage ring technologies relevant to the development of Basic Energy Sciences user facilities, in consultation with the Office of Science's High Energy Physics and Nuclear Physics programs.

(f) SOLAR FUELS RESEARCH INITIATIVE.—

(1) IN GENERAL.—Section 973 of the Energy Policy Act of 2005 (42 U.S.C. 16313) is amended to read as follows:

"SEC. 973. SOLAR FUELS RESEARCH INITIATIVE.

"(a) INITIATIVE.—

"(1) IN GENERAL.—The Secretary shall carry out a research initiative, to be known as the 'Solar Fuels Research Initiative' (referred to in this section as the 'Initiative') to expand theoretical and fundamental knowledge of photochemistry, electrochemistry, biochemistry, and materials science useful for the practical development of experimental systems to convert solar energy to chemical energy.

"(2) LEVERAGING.—In carrying out programs and activities under the Initiative, the Secretary shall leverage expertise and resources from—

"(A) the Basic Energy Sciences Program and the Biological and Environmental Research Program of the Office of Science; and

"(B) the Office of Energy Efficiency and Renewable Energy.

"(3) TEAMS.—

"(A) IN GENERAL.—In carrying out the Initiative, the Secretary shall organize activities among multidisciplinary teams to leverage, to the maximum extent practicable, expertise from the National Laboratories, institutions of higher education, and the private sector.

"(B) GOALS.—The multidisciplinary teams described in subparagraph (A) shall pursue aggressive, milestone-driven, basic research goals.

"(C) RESOURCES.—The Secretary shall provide sufficient resources to the multidisciplinary teams described in subparagraph (A) to achieve the goals described in subparagraph (B) over a period of time to be determined by the Secretary.

"(4) ADDITIONAL ACTIVITIES.—The Secretary may organize additional activities under this subsection through Energy Frontier Research Centers, Energy Innovation Hubs, or other organizational structures.

"(b) ARTIFICIAL PHOTOSYNTHESIS.—

"(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research needed to bridge scientific barriers to, and discover knowledge relevant to, artificial photosynthetic systems.

"(2) ACTIVITIES.—As part of the program described in paragraph (1)—

"(A) the Director of the Office of Basic Energy Sciences shall support basic research to pursue distinct lines of scientific inquiry, including—

"(i) photoinduced production of hydrogen and oxygen from water; and

"(ii) the sustainable photoinduced reduction of carbon dioxide to fuel products including hydrocarbons, alcohols, carbon monoxide, and natural gas; and

"(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

"(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

"(4) FUNDING.—

"(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences, the Secretary shall make available for carrying out activities under this subsection $50,000,000 for each of fiscal years 2018 through 2019.

"(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

"(c) BIOCHEMISTRY, REPLICATION OF NATURAL PHOTOSYNTHESIS, AND RELATED PROCESSES.—

"(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research needed to replicate natural photosynthetic processes by use of artificial photosynthetic components and materials.

"(2) ACTIVITIES.—As part of the program described in paragraph (1)—

"(A) the Director of the Office of Basic Energy Sciences shall support basic research to expand fundamental knowledge to replicate natural synthesis processes, including—

"(i) the photoinduced reduction of dinitrogen to ammonia;

"(ii) the absorption of carbon dioxide from ambient air;

"(iii) molecular-based charge separation and storage;

"(iv) photoinitiated electron transfer; and

"(v) catalysis in biological or biomimetic systems;

"(B) the Associate Director of Biological and Environmental Research shall support systems biology and genomics approaches to understand genetic and physiological pathways connected to photosynthetic mechanisms; and

"(C) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

"(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

"(4) FUNDING.—

"(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences and Biological and Environmental Research, the Secretary shall make available for carrying out activities under this subsection $50,000,000 for each of fiscal years 2018 through 2019.

"(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.".

(2) CONFORMING AMENDMENT.—The table of contents for the Energy Policy Act of 2005 is amended by striking the item relating to section 973 and inserting the following:

"Sec. 973. Solar fuels research initiative.".

(g) ELECTRICITY STORAGE RESEARCH INITIATIVE.—

(1) IN GENERAL.—Section 975 of the Energy Policy Act of 2005 (42 U.S.C. 16315) is amended to read as follows:

"SEC. 975. ELECTRICITY STORAGE RESEARCH INITIATIVE.

"(a) INITIATIVE.—

"(1) IN GENERAL.—The Secretary shall carry out a research initiative, to be known as the 'Electricity Storage Research Initiative' (referred to in this section as the 'Initiative')—

"(A) to expand theoretical and fundamental knowledge to control, store, and convert—

"(i) electrical energy to chemical energy; and

"(ii) chemical energy to electrical energy; and

"(B) to support scientific inquiry into the practical understanding of chemical and physical processes that occur within systems involving crystalline and amorphous solids, polymers, and organic and aqueous liquids.

"(2) LEVERAGING.—In carrying out programs and activities under the Initiative, the Secretary shall leverage expertise and resources from—

"(A) the Basic Energy Sciences Program, the Advanced Scientific Computing Research Program, and the Biological and Environmental Research Program of the Office of Science; and

"(B) the Office of Energy Efficiency and Renewable Energy.

"(3) TEAMS.—

"(A) IN GENERAL.—In carrying out the Initiative, the Secretary shall organize activities among multidisciplinary teams to leverage, to the maximum extent practicable, expertise from the National Laboratories, institutions of higher education, and the private sector.

"(B) GOALS.—The multidisciplinary teams described in subparagraph (A) shall pursue aggressive, milestone-driven, basic research goals.

"(C) RESOURCES.—The Secretary shall provide sufficient resources to the multidisciplinary teams described in subparagraph (A) to achieve the goals described in subparagraph (B) over a period of time to be determined by the Secretary.

"(4) ADDITIONAL ACTIVITIES.—The Secretary may organize additional activities under this subsection through Energy Frontier Research Centers, Energy Innovation Hubs, or other organizational structures.

"(b) MULTIVALENT SYSTEMS.—

"(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research needed to bridge scientific barriers to, and discover knowledge relevant to, multivalent ion materials in electric energy storage systems.

"(2) ACTIVITIES.—As part of the program described in paragraph (1)—

"(A) the Director of the Office of Basic Energy Sciences shall investigate electrochemical properties and the dynamics of materials, including charge transfer phenomena and mass transport in materials; and

"(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

"(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

"(4) FUNDING.—

"(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences and Biological and Environmental Research, the Secretary shall make available for carrying out activities under this subsection $50,000,000 for each of the fiscal years 2018 through 2019.

"(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

"(c) ELECTROCHEMISTRY MODELING AND SIMULATION.—

"(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research to model and simulate organic electrolytes, including the static and dynamic electrochemical behavior and phenomena of organic electrolytes at the molecular and atomic level in monovalent and multivalent systems.

"(2) ACTIVITIES.—As part of the program described in paragraph (1)—

"(A) the Director of the Office of Basic Energy Sciences, in coordination with the Associate Director of Advanced Scientific Computing Research, shall support the development of high performance computational tools through a joint development process to maximize the effectiveness of current and projected high performance computing systems; and

"(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

"(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

"(4) FUNDING.—

"(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences and Advanced Scientific Computing Research, the Secretary shall make available for carrying out activities under this subsection $30,000,000 for each of the fiscal years 2018 through 2019.

"(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

"(d) MESOSCALE ELECTROCHEMISTRY.—

"(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research needed to reveal electrochemistry in confined mesoscale spaces, including scientific discoveries relevant to—

"(A) bio-electrochemistry and electrochemical energy conversion and storage in confined spaces; and

"(B) the dynamics of the phenomena described in subparagraph (A).

"(2) ACTIVITIES.—As part of the program described in paragraph (1)—

"(A) the Director of the Office of Basic Energy Sciences and the Associate Director of Biological and Environmental Research shall investigate phenomena of mesoscale electrochemical confinement for the purpose of replicating and controlling new electrochemical behavior; and

"(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

"(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

"(4) FUNDING.—

"(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences and Biological and Environmental Research, the Secretary shall make available for carrying out activities under this subsection $20,000,000 for each of fiscal years 2018 through 2019.

"(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.".

(2) CONFORMING AMENDMENT.—The table of contents for the Energy Policy Act of 2005 is amended by striking the item relating to section 975 and inserting the following:

"Sec. 975. Electricity storage research initiative.".

(h) ENERGY FRONTIER RESEARCH CENTERS.—

(1) IN GENERAL.—The Director shall carry out a program to provide awards, on a competitive, merit-reviewed basis, to multi-institutional collaborations or other appropriate entities to conduct fundamental and use-inspired energy research to accelerate scientific breakthroughs.

(2) COLLABORATIONS.—A collaboration receiving an award under this subsection may include multiple types of institutions and private sector entities.

(3) SELECTION AND DURATION.—

(A) IN GENERAL.—A collaboration under this subsection shall be selected for a period of 4 years.

(B) EXISTING CENTERS.—An Energy Frontier Research Center in existence and supported by the Director on the date of enactment of this Act may continue to receive support for a period of 4 years beginning on the date of establishment of that center.

(C) REAPPLICATION.—After the end of the period described in subparagraph (A) or (B), as applicable, a recipient of an award may reapply for selection on a competitive, merit-reviewed basis.

(D) TERMINATION.—Consistent with the existing authorities of the Department, the Director may terminate an underperforming center for cause during the performance period.

(i) MATERIALS RESEARCH DATABASE.—

(1) IN GENERAL.—As part of the program in materials sciences and engineering, the Director shall support the development of a web-based platform to provide access to a database of computed information on known and predicted ma-

terials properties and computational tools to accelerate breakthroughs in materials discovery and design.

(2) In carrying out this section, the Director shall—

(A) conduct cooperative research with industry, academia, and other research institutions to facilitate the design of novel materials;

(B) leverage existing high performance computing systems to conduct high-throughput calculations, and develop computational and data mining algorithms for the prediction of material properties;

(C) advance understanding, prediction, and manipulation of materials;

(D) strengthen the foundation for new technologies and advanced manufacturing; and

(E) drive the development of advanced materials for applications that span the Department's missions in energy, environment, and national security.

(3) In carrying out this section, the Director shall leverage programs and activities across the Department.

SEC. 5. ADVANCED SCIENTIFIC COMPUTING RESEARCH.

(a) PROGRAM.—The Director shall carry out a research, development, and demonstration program to advance computational and networking capabilities to analyze, model, simulate, and predict complex phenomena relevant to the development of new energy technologies and the competitiveness of the United States.

(b) AMERICAN SUPER COMPUTING LEADERSHIP.—

(1) RENAMING OF ACT.—

(A) IN GENERAL.—Section 1 of the Department of Energy High-End Computing Revitalization Act of 2004 (15 U.S.C. 5501 note; Public Law 108–423) is amended by striking "Department of Energy High-End Computing Revitalization Act of 2004" and inserting "American Super Computing Leadership Act".

(B) CONFORMING AMENDMENT.—Section 976(a)(1) of the Energy Policy Act of 2005 (42 U.S.C. 16316(1)) is amended by striking "Department of Energy High-End Computing Revitalization Act of 2004" and inserting "American Super Computing Leadership Act".

(2) DEFINITIONS.—Section 2 of the American Super Computing Leadership Act (15 U.S.C. 5541), as renamed by paragraph (1), is amended—

(A) by redesignating paragraphs (2) through (5) as paragraphs (3) through (6), respectively;

(B) by striking paragraph (1) and inserting the following:

"(1) DEPARTMENT.—The term 'Department' means the Department of Energy.

"(2) EXASCALE COMPUTING.—The term 'exascale computing' means computing through the use of a computing machine that performs near or above 10 to the 18th power operations per second."; and

(C) in paragraph (6) (as redesignated by subparagraph (A)), by striking ", acting through the Director of the Office of Science of the Department of Energy".

(3) DEPARTMENT OF ENERGY HIGH-END COMPUTING RESEARCH AND DEVELOPMENT PROGRAM.—Section 3 of the American Super Computing Leadership Act (15 U.S.C. 5542), as renamed by paragraph (1), is amended—

(A) in subsection (a)(1), by striking "program" and inserting "coordinated program across the Department";

(B) in subsection (b)(2), by striking ", which may" and all that follows through "multithreading architectures"; and

(C) by striking subsection (d) and inserting the following:

"(d) EXASCALE COMPUTING PROGRAM.—

"(1) IN GENERAL.—The Secretary shall conduct a research program (referred to in this subsection as the 'Program') for exascale computing, including the development of two or more exascale computing machine architectures, to promote the missions of the Department.

"(2) EXECUTION.—

"(A) IN GENERAL.—In carrying out the Program, the Secretary shall—

"(i) establish a National Laboratory partnership for industry partners and institutions of higher education for codesign of exascale hardware, technology, software, and applications across all applicable organizations of the Department;

"(ii) acquire multiple exascale computing systems at the existing Departmental facilities that represent at least two distinct technology options developed under clause (i);

"(iii) develop such advancements in hardware and software technology as are required to fully realize the potential of an exascale pro-

duction system in addressing Department target applications and solving scientific problems involving predictive modeling and simulation, large scale data analytics and management, and artificial intelligence;

"(iv) explore the use of exascale computing technologies to advance a broad range of science and engineering; and

"(v) provide, as appropriate, on a competitive, merit-reviewed basis, access for researchers in industries in the United States, institutions of higher education, National Laboratories, and other Federal agencies to the exascale computing systems developed pursuant to clause (i).

"(B) SELECTION OF PARTNERS.—The Secretary shall select the partnerships with the computing facilities of the Department under subparagraph (A) through a competitive, peer-review process.

"(3) CODESIGN AND APPLICATION DEVELOPMENT.—

"(A) IN GENERAL.—The Secretary shall—

"(i) carry out the Program through an integration of applications, computer science, applied mathematics, and computer hardware architecture using the partnerships established pursuant to paragraph (2) to ensure that, to the maximum extent practicable, two or more exascale computing machine architectures are capable of solving Department target applications and broader scientific problems, including predictive modeling and simulation, large scale data analytics and management, and artificial intelligence; and

"(ii) conduct outreach programs to increase the readiness for the use of such platforms by domestic industries, including manufacturers.

"(B) REPORT.—(i) The Secretary shall submit to Congress a report describing how the integration under subparagraph (A) is furthering application science data and computational workloads across application interests, including national security, material science, physical science, cybersecurity, biological science, the Materials Genome and BRAIN Initiatives of the President, advanced manufacturing, and the national electric grid.

"(ii) The roles and responsibilities of National Laboratories and industry, including the definition of the roles and responsibilities within the Department to ensure an integrated program across the Department.

"(4) PROJECT REVIEW.—

"(A) IN GENERAL.—The exascale architectures developed pursuant to partnerships established pursuant to paragraph (2) shall be reviewed through a project review process.

"(B) REPORT.—Not later than 90 days after the date of enactment of this subsection, the Secretary shall submit to Congress a report on—

"(i) the results of the review conducted under subparagraph (A); and

"(ii) the coordination and management of the Program to ensure an integrated research program across the Department.

"(5) ANNUAL REPORTS.—At the time of the budget submission of the Department for each fiscal year, the Secretary, in consultation with the members of the partnerships established pursuant to paragraph (2), shall submit to Congress a report that describes funding for the Program as a whole by functional element of the Department and critical milestones.".

(c) HIGH-PERFORMANCE COMPUTING AND NETWORKING RESEARCH.—The Director shall support research in high-performance computing and networking relevant to energy applications, including modeling, simulation, machine learning, and advanced data analytics for basic and applied energy research programs carried out by the Secretary.

(d) APPLIED MATHEMATICS AND SOFTWARE DEVELOPMENT FOR HIGH-END COMPUTING SYSTEMS, COMPUTATIONAL, AND COMPUTER SCIENCES RESEARCH.—

(1) IN GENERAL.—The Director shall carry out activities to develop, test, and support—

(A) mathematics, models, statistics, and algorithms for complex systems and programming environments; and

(B) tools, languages, and operations for high-end computing systems (as defined in section 2 of the American Super Computing Leadership Act (15 U.S.C. 5541), as renamed by this section).

(2) PORTFOLIO BALANCE.—The Director shall maintain a balanced portfolio within the advanced scientific computing research and development program established under section 976 of the Energy Policy Act of 2005 (42 U.S.C. 16316) that supports robust investment in applied mathematical, computational, and computer sciences research while accommodating necessary investments in high-performance computing hardware and facilities.

(e) WORKFORCE DEVELOPMENT.—The Director of the Office of Advanced Scientific Computing Research shall support the development of a computational science workforce through a program that—

(1) facilitates collaboration between university students and researchers at the National Laboratories; and

(2) endeavors to advance science in areas relevant to the mission of the Department through the application of computational science.

SEC. 6. HIGH ENERGY PHYSICS.

(a) PROGRAM.—The Director shall carry out a research program on the fundamental constituents of matter and energy and the nature of space and time.

(b) MISSION.—The mission of the program described in subsection (a) shall be to support theoretical and experimental research in both elementary particle physics and fundamental accelerator science and technology to understand fundamental properties of the universe.

(c) SENSE OF CONGRESS.—It is the sense of the Congress that—

(1) the Director should incorporate the findings and recommendations of the Particle Physics Project Prioritization Panel's report entitled "Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context", into the Department's planning process as part of the program described in subsection (a);

(2) the Director should prioritize domestically hosted research projects that will maintain the United States position as a global leader in particle physics and attract the world's most talented physicists and foreign investment for international collaboration; and

(3) the nations that lead in particle physics by hosting international teams dedicated to a common scientific goal attract the world's best talent and inspire future generations of physicists and technologists.

(d) NEUTRINO RESEARCH.—As part of the program described in subsection (a), the Director shall carry out research activities on rare decay processes and the nature of the neutrino, which may include collaborations with the National Science Foundation or international collaborations.

(e) LONG-BASELINE NEUTRINO FACILITY FOR DEEP UNDERGROUND NEUTRINO EXPERIMENT.—

(1) IN GENERAL.—The Secretary shall provide for a Long-Baseline Neutrino Facility to facilitate the international Deep Underground Neutrino Experiment to enable a program in neutrino physics to measure the fundamental properties of neutrinos, explore physics beyond the Standard Model, and better clarify the nature of matter and antimatter.

(2) FACILITY CAPABILITIES.—The Secretary shall ensure that the facility described in paragraph (1) will provide, at a minimum, the following capabilities:

(A) A broad-band neutrino beam capable of 1.2 megawatts (MW) of beam power and upgradable to 2.4 MW of beam power.

(B) Four caverns excavated for a forty kiloton fiducial detector mass and supporting surface buildings and utilities.

(C) Neutrino detector facilities at both the Far Site in South Dakota and the Near Site in Illinois to categorize and study neutrinos on their 800-mile journey between the two sites.

(D) Cryogenic systems to support neutrino detectors.

(3) START OF OPERATIONS.—The Secretary shall, to the maximum extent practicable, ensure that the start of full operations of the facility under this subsection occurs before December 31, 2026.

(4) FUNDING.—Out of funds authorized to be appropriated under section 11 for High Energy Physics, there shall be made available to the Secretary to carry out activities, including construction of the facility, under this subsection—

(A) $95,000,000 for fiscal year 2018; and

(B) $175,000,000 for fiscal year 2019.

(5) DARK ENERGY AND DARK MATTER RESEARCH.—As part of the program described in paragraph (1), the Director shall carry out research activities on the nature of dark energy and dark matter, which may include collaborations with the National Aeronautics and Space Administration or the National Science Foundation, or international collaborations.

(6) INTERNATIONAL COLLABORATION.—The Director, as practicable and in coordination with other appropriate Federal agencies as necessary, shall ensure the access of United States researchers to the most advanced accelerator facilities and research capabilities in the world, including the Large Hadron Collider.

SEC. 7. BIOLOGICAL AND ENVIRONMENTAL RESEARCH.

(a) PROGRAM.—The Director shall carry out a program of basic research in the areas of biological systems science and environmental science relevant to the devel-

opment of new energy technologies and to support Department missions in energy, environment, and national security.

(b) BIOLOGICAL SYSTEMS.—The Director shall carry out research and development activities in fundamental, structural, computational, and systems biology to increase systems-level understanding of the complex biological systems, which may include activities—

(1) to accelerate breakthroughs and new knowledge that would enable the cost-effective, sustainable production of—

(A) biomass-based liquid transportation fuels;

(B) bioenergy; and

(C) biobased materials;

(2) to improve understanding of the global carbon cycle, including processes for removing carbon dioxide from the atmosphere, through photosynthesis and other biological processes, for sequestration and storage; and

(3) to understand the biological mechanisms used to transform, immobilize, or remove contaminants from subsurface environments.

(c) BIOENERGY RESEARCH CENTERS.—

(1) IN GENERAL.—In carrying out activities under subsection (a), the Director shall select and establish up to 4 bioenergy research centers to conduct basic and fundamental research in plant and microbial systems biology, bio imaging and analysis, and genomics to inform the production of fuels, chemicals from sustainable biomass resources, and to facilitate the translation of basic research results to industry.

(2) SELECTION.—The Director shall select centers under paragraph (1) on a competitive, merit-reviewed basis. The Director shall consider applications from National Laboratories, multi-institutional collaborations, and other appropriate entities.

(3) DURATION.—A center established under this subsection shall receive support for a period of not more than 5 years, subject to the availability of appropriations.

(4) EXISTING CENTERS.—The Director may select a center for participation under this subsection that is in existence, or undergoing a renewal process, on the date of enactment of this Act. Such center shall be eligible to receive support for the duration the 5-year period beginning on the date of establishment of such center.

(5) RENEWAL.—Upon the expiration of any period of support of a center under this subsection, the Director may renew support for the center, on a merit-reviewed basis, for a period of not more than 5 years.

(6) TERMINATION.—Consistent with the existing authorities of the Department, the Director may terminate an underperforming center for cause during the performance period.

(d) LOW DOSE RADIATION RESEARCH PROGRAM.—

(1) IN GENERAL.—Subtitle G of title IX of the Energy Policy Act of 2005 (42 U.S.C. 16311 et seq.) is amended by inserting after section 977 the following new section:

"SEC. 977A. LOW-DOSE RADIATION RESEARCH PROGRAM.

"(a) IN GENERAL.—The Secretary shall carry out a basic research program on low-dose radiation to—

"(1) enhance the scientific understanding of, and reduce uncertainties associated with, the effects of exposure to low-dose radiation; and

"(2) inform improved risk-assessment and risk-management methods with respect to such radiation.

"(b) PROGRAM COMPONENTS.—In carrying out the program required under subsection (a), the Secretary shall—

"(1) formulate scientific goals for low-dose radiation basic research in the United States;

"(2) identify ongoing scientific challenges for understanding the long-term effects of ionizing radiation on biological systems;

"(3) develop a long-term strategic and prioritized basic research agenda to address such scientific challenges in coordination with other research efforts;

"(4) leverage the collective body of knowledge from existing low-dose radiation research; and

"(5) engage with other Federal agencies, research communities, and potential users of information produced under this section, including institutions concerning radiation research, medical physics, radiology, health physics, and emergency response.

"(c) COORDINATION.—In carrying out the program, the Secretary, in coordination with the Physical Science Subcommittee of the National Science and Technology Council, shall—

"(1) support the directives under section 106 of the American Innovation and Competitiveness Act (42 U.S.C. 6601 note);

"(2) ensure that the Office of Science of the Department of Energy consults with the National Aeronautics and Space Administration, the National Institutes of Health, the Environmental Protection Agency, the Department of Defense, the Nuclear Regulatory Commission, and the Department of Homeland Security;

"(3) advise and assist the National Science and Technology Council on policies and initiatives in radiation biology, including enhancing scientific knowledge of the effects of low-dose radiation on biological systems to improve radiation risk-assessment and risk-management methods; and

"(4) identify opportunities to stimulate international cooperation relating to low-dose radiation and leverage research and knowledge from sources outside of the United States.

"(d) RESEARCH PLAN.—Not later than 180 days after the date of enactment of this Act, the Secretary shall transmit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a 4-year research plan that identifies and prioritizes basic research needs relating to low-dose radiation. In developing such plan, the Secretary shall incorporate the components described in subsection (b).

"(e) DEFINITION OF LOW-DOSE RADIATION.—In this section, the term 'low-dose radiation' means a radiation dose of less than 100 millisieverts.

"(f) RULE OF CONSTRUCTION.—Nothing in this section shall be construed to subject any research carried out by the Secretary for the program under this section to any limitations described in 977(e) of the Energy Policy Act of 2005 (42 U.S.C. 16317(e)).

"(g) FUNDING.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Biological and Environmental Research, the Secretary make available to carry out this section—

"(1) $20,000,000 for fiscal year 2018; and

"(2) $20,000,000 for fiscal year 2019.".

(2) CONFORMING AMENDMENT.—The table of contents for subtitle G of title IX of the Energy Policy Act of 2005 is amended by inserting after the item relating to section 977 the following:

"977A. Low-dose radiation research program.".

(e) MODELING RESEARCH.—As part of the activities described in subsection (a), the Director is authorized to carry out research to develop multiscale computational models that incorporate and examine interactions among human and earth systems.

(f) LIMITATION FOR RESEARCH FUNDS.—The Director shall not approve new climate science-related initiatives without making a determination that such work is well-coordinated with any relevant work carried out by other Federal agencies.

SEC. 8. FUSION ENERGY.

(a) PROGRAM.—The Director shall carry out a fusion energy sciences research program to expand the understanding of plasmas and matter at very high temperatures and densities and build the science and engineering foundation needed to develop a fusion energy source.

(b) INERTIAL FUSION ENERGY RESEARCH AND DEVELOPMENT PROGRAM.—The Secretary shall carry out a program of research and technology development in inertial fusion for energy applications, including ion beam, laser, and pulsed power fusion systems.

(c) TOKAMAK RESEARCH AND DEVELOPMENT.—

(1) IN GENERAL.—The Director shall support research and development activities and facility operations to optimize the tokamak approach to fusion energy.

(2) INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR CONSTRUCTION.—Section 972 of the Energy Policy Act of 2005 (42 U.S.C. 16312) is amended by adding at the end the following new paragraph:

"(7) ITER CONSTRUCTION.—

"(A) IN GENERAL.—There is authorized United States participation in the construction and operations of the ITER project, as agreed to under the April 25, 2007 'Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project.'.

"(B) FACILITY REQUIREMENTS.—The Secretary shall ensure that the mission-oriented user facility will enable the study of a burning plasma, and shall be built to have the following characteristics in its full configuration:

"(i) A tokamak device with a plasma radius of 6.2 meters and a magnetic field of 5.3 T.

"(ii) Capable of creating and sustaining a 15-million-Ampere plasma current for greater than 300 seconds.

"(C) AUTHORIZATION OF APPROPRIATIONS.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Fusion Energy Sciences, there is authorized for in-kind contributions under this paragraph—

"(i) $122,000,000 for fiscal year 2018; and

"(ii) $163,000,000 for fiscal year 2019.

"(D) AUTHORIZATION OF APPROPRIATIONS.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Fusion Energy Sciences, there is authorized for cash contributions under this paragraph—

"(i) $50,000,000 for fiscal year 2018; and

"(ii) $50,000,000 for fiscal year 2019.".

(d) ALTERNATIVE AND ENABLING CONCEPTS.—

(1) IN GENERAL.—As part of the program described in subsection (a), the Director shall support research and development activities and facility operations at United States universities, national laboratories, and private facilities for a portfolio of alternative and enabling fusion energy concepts that may provide solutions to significant challenges to the establishment of a commercial magnetic fusion power plant, prioritized based on the ability of the United States to play a leadership role in the international fusion research community. Fusion energy concepts and activities explored under this paragraph may include—

(A) high magnetic field approaches facilitated by high temperature superconductors;

(B) advanced stellarator concepts;

(C) non-tokamak confinement configurations operating at low magnetic fields;

(D) magnetized target fusion energy concepts;

(E) liquid metals to address issues associated with fusion plasma interactions with the inner wall of the encasing device;

(F) immersion blankets for heat management and fuel breeding;

(G) advanced scientific computing activities; and

(H) other promising fusion energy concepts identified by the Director.

(2) COORDINATION WITH ARPA–E.—The Under Secretary and the Director shall coordinate with the Director of the Advanced Research Projects Agency–Energy (in this paragraph referred to as "ARPA–E") to—

(A) assess the potential for any fusion energy project supported by ARPA–E to represent a promising approach to a commercially viable fusion power plant;

(B) determine whether the results of any fusion energy project supported by ARPA–E merit the support of follow-on research activities carried out by the Office of Science; and

(C) avoid unintentional duplication of activities.

(e) FAIRNESS IN COMPETITION FOR SOLICITATIONS FOR INTERNATIONAL PROJECT ACTIVITIES.—Section 33 of the Atomic Energy Act of 1954 (42 U.S.C. 2053) is amended by inserting before the first sentence the following: "In this section, with respect to international research projects, the term 'private facilities or laboratories' means facilities or laboratories located in the United States.".

(f) IDENTIFICATION OF PRIORITIES.—

(1) REPORT.—

(A) IN GENERAL.—Not later than 2 years after the date of enactment of this Act, the Secretary shall submit to Congress a report on the fusion energy research and development activities that the Department proposes to carry out over the 10-year period following the date of the report under not fewer than 3 realistic budget scenarios, including a scenario based on 3-percent annual growth in the non-ITER portion of the budget for fusion energy research and development activities.

(B) INCLUSIONS.—The report required under subparagraph (A) shall—

(i) identify specific areas of fusion energy research and enabling technology development, including activities to advance inertial and alternative fusion energy concepts, in which the United States can and should establish or solidify a lead in the global fusion energy development effort;

(ii) identify priorities for initiation of facility construction and facility decommissioning under each of the three budget scenarios described in subparagraph (A); and

(iii) assess the ability of the fusion workforce of the United States to carry out the activities identified under clauses (i) and (ii), including the adequacy of programs at institutions of higher education in the United States to train the leaders and workers of the next generation of fusion energy researchers.

(2) PROCESS.—In order to develop the report required under paragraph (1)(A), the Secretary shall leverage best practices and lessons learned from the process used to develop the most recent report of the Particle Physics Project Prioritization Panel of the High Energy Physics Advisory Panel.

(3) REQUIREMENT.—No member of the Fusion Energy Sciences Advisory Committee shall be excluded from participating in developing or voting on final approval of the report required under paragraph (1)(A).

SEC. 9. NUCLEAR PHYSICS.

(a) PROGRAM.—The Director shall carry out a program of experimental and theoretical research, and support associated facilities, to discover, explore, and understand all forms of nuclear matter.

(b) ISOTOPE DEVELOPMENT AND PRODUCTION FOR RESEARCH APPLICATIONS.—The Director—

(1) may carry out a program for the production of isotopes, including the development of techniques to produce isotopes, that the Secretary determines are needed for research, medical, industrial, or related purposes; and

(2) shall ensure that isotope production activities carried out under the program under this paragraph do not compete with private industry unless the Director determines that critical national interests require the involvement of the Federal Government.

(c) RENAMING OF THE RARE ISOTOPE ACCELERATOR.—Section 981 of the Energy Policy Act of 2005 (42 U.S.C. 16321) is amended—

(1) in the section heading, by striking "**RARE ISOTOPE ACCELERATOR**" and inserting "**FACILITY FOR RARE ISOTOPE BEAMS**"; and

(2) by striking "Rare Isotope Accelerator" each place it appears and inserting "Facility for Rare Isotope Beams".

(d) FACILITY FOR RARE ISOTOPE BEAMS.—

(1) IN GENERAL.—The Secretary shall provide for a Facility for Rare Isotope Beams to advance the understanding of rare nuclear isotopes and the evolution of the cosmos.

(2) FACILITY CAPABILITY.—In carrying out paragraph (1), the Secretary shall provide for, at a minimum, a rare isotope beam facility capable of 400 kW of beam power.

(3) START OF OPERATIONS.—The Secretary shall, to the maximum extent practicable, ensure that the start of full operations of the facility under this subsection occurs before June 30, 2022, with early operation in 2018.

(4) FUNDING.—Out of funds authorized to be appropriated under section 11 for Nuclear Physics, there shall be made available to the Secretary to carry out activities, including construction of the facility, under this subsection—

(A) $101,200,000 for fiscal year 2018; and

(B) $86,000,000 for fiscal year 2019.

SEC. 10. SCIENCE LABORATORIES INFRASTRUCTURE PROGRAM.

(a) IN GENERAL.—The Director shall carry out a program to improve the safety, efficiency, and mission readiness of infrastructure at Office of Science laboratories. The program shall include projects to—

(1) renovate or replace space that does not meet research needs;

(2) replace facilities that are no longer cost effective to renovate or operate;

(3) modernize utility systems to prevent failures and ensure efficiency;

(4) remove excess facilities to allow safe and efficient operations; and

(5) construct modern facilities to conduct advanced research in controlled environmental conditions.

(b) APPROACH.—In carrying out this section, the Director shall utilize all available approaches and mechanisms, including capital line items, minor construction projects, energy savings performance contracts, utility energy service contracts, alternative financing, and expense funding, as appropriate.

SEC. 11. AUTHORIZATION OF APPROPRIATIONS.

(a) FISCAL YEAR 2018.—There are authorized to be appropriated to the Secretary for the Office of Science for fiscal year 2018 $6,259,903,000, of which—

(1) $2,090,000,000 shall be for Basic Energy Science;

(2) $908,000,000 shall be for High Energy Physics;

(3) $673,000,000 shall be for Biological and Environmental Research;

(4) $684,000,000 shall be for Nuclear Physics;

(5) $810,000,000 shall be for Advanced Scientific Computing Research;
(6) $532,111,000 shall be for Fusion Energy Sciences;
(7) $257,292,000 shall be for Science Laboratories Infrastructure;
(8) $183,000,000 shall be for Science Program Direction;
(9) $103,000,000 shall be for Safeguards and Security; and
(10) $19,500,000 shall be for Workforce Development for Teachers and Scientists.

(b) FISCAL YEAR 2019.—There are authorized to be appropriated to the Secretary for the Office of Science for fiscal year 2019 $6,600,000,000, of which—
(1) $2,129,233,000 shall be for Basic Energy Science;
(2) $1,004,510,000 shall be for High Energy Physics;
(3) $673,000,000 shall be for Biological and Environmental Research;
(4) $690,000,000 shall be for Nuclear Physics;
(5) $899,010,000 shall be for Advanced Scientific Computing Research;
(6) $640,000,000 shall be for Fusion Energy Sciences;
(7) $257,292,000 shall be for Science Laboratories Infrastructure;
(8) $181,345,000 shall be for Science Program Direction;
(9) $106,110,000 shall be for Safeguards and Security; and
(10) $19,500,000 shall be for Workforce Development for Teachers and Scientists.

COMMITTEE STATEMENT AND VIEWS

PURPOSE AND SUMMARY

The purpose of H.R. 5905, the "Department of Energy Science and Innovation Act of 2018," is to provide for technological innovation through the prioritization of Federal investment in basic research and fundamental scientific discovery, and to make reforms to Federal science policy at the Department of Energy to ensure future United States economic competitiveness and security.

This bill authorizes the Department of Energy (DOE)'s Office of Science for fiscal years (FY) 2018 and 2019, including fundamental research in basic energy sciences (BES), advanced scientific computing research (ASCR), high energy physics (HEP), biological and environmental research (BER), fusion energy science (FES), and nuclear physics (NP). It also specifically authorizes basic research programs in solar fuels, electricity storage, exascale computing, bioenergy research, materials research, and low dose radiation.

This legislation also authorizes upgrades to and construction of seven major DOE user facilities and provides funds to secure U.S. participation in a critical international fusion research project.

BACKGROUND AND NEED FOR LEGISLATION

Federal policies that focus on scientific and technological advancement have been a recurring subject of congressional attention since the founding of the United States. Among the major post-World War II legislation in this area are the Atomic Energy Act of 1954 (P.L. 83–703), the Department of Energy Organization Act of 1977 (P.L. 95–91), the Energy Policy Act of 1992 (P.L. 102–486), the Energy Policy Act of 2005 (P.L. 109–58), and the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act (P.L. 110–69).

In 2010, Congress passed and the President signed into law, the America COMPETES Reauthorization Act of 2010 (P.L. 111–358). This authorization included limited provisions directing programs within the Department of Energy, including the DOE Office of Science, and expired at the end of 2014.

H.R. 5905 authorizes all Office of Science basic research programs, and if enacted, would be the first comprehensive DOE basic

research authorization in law. This legislation also authorizes specific basic research in exascale computing, chemistry and materials science relevant to advanced electricity storage systems, chemistry and materials science relevant to experimental solar fuels systems, and low dose radiation research.

The Office of Science within the Department of Energy (DOE) is the largest federal sponsor of basic research in the physical sciences. It conducts research in high performance computing, basic energy sciences, biological and environmental research, high energy physics, fusion energy, and nuclear physics.

DOE also operates world-class, open-access user facilities around the country at the DOE national laboratories. These facilities include the supercomputers, x-ray light sources, photon sources, and neutron sources necessary to conduct ground-breaking basic research, and host approximately 30,000 researchers annually from around the world.

The Committee recognizes that these best-in-the-world science facilities uniquely enable research conducted through the DOE Office of Science and other federal sponsors of basic research, and facilitate revolutionary discoveries about the atomic structure, properties, and dynamics of materials. Future transformative breakthroughs in innovative energy technologies will likely arise from a strong foundation in basic research, particularly in the study of and development of unique materials, for which the facilities authorized in this bill provide critical capabilities. For this reason, this legislation specifically authorizes funding to provide for upgrades and construction for these critical science research facilities.

Research infrastructure

This legislation relies on the assessments of the Department and the scientific community, primarily through the long-range planning function of the DOE Office of Science Basic Energy Sciences Advisory Committee (BESAC), the Nuclear Science Advisory Committee (NSAC), and the High Energy Physics Advisory Panel (HEPAP). These advisory committees, chartered under the Federal Advisory Committee Act (FACA) and comprised of representatives from universities, national laboratories, and industries involved in relevant areas of research, provide official technical advice to the Department and other federal agencies on the national program priorities for basic energy sciences, nuclear science research, and high-energy physics research.

Based on the recommendations provided in the most recent reports issued from each advisory committee, H.R. 5905 authorizes the completion of upgrades and construction of scientific user facilities necessary to undertake the next generation of transformative research in these areas. Under this legislation, the Secretary of Energy is authorized to provide for an upgrade to the Advanced Light Source (ALS) at Lawrence Berkeley National Laboratory (LBNL) and a high energy upgrade to the Linac Coherent Light Source II (LCLS–II) at Stanford Linear Accelerator Center National Laboratory (SLAC), an upgrade to the Advanced Photon Source (APS) at Argonne National Laboratory in IL, as well as a Proton Power Upgrade (PPU) and the construction of a Second Target Station (STS) for the Spallation Neutron Source (SNS) at Oak Ridge National

Laboratory (ORNL) under the Basic Energy Sciences (BES) program within the DOE Office of Science.

The Secretary is also authorized to complete the construction of Facility for Rare Isotope Beams (FRIB), located at Michigan State University, funded through the Office of Nuclear Physics (NP), and to construct the Long-Baseline Neutrino Facility (LBNF) underground sites at Fermi National Accelerator Laboratory (Fermilab) in Batavia, IL, and the Sanford Underground Research Facility (SURF) in Lead, SD, in order to complete the Deep Underground Neutrino Experiment (DUNE) funded by the High Energy Physics (HEP) program within the DOE Office of Science.

The ALS is a specialized particle accelerator that generates bright beams of x-ray light for scientific research. Electron bunches travel at nearly the speed of light in a circular path, emitting ultraviolet and x-ray light in the process. The light is directed through about 40 beamlines to numerous experimental end-stations, where scientists conduct research in a wide variety of fields, including materials science, biology, chemistry, physics, and the environmental sciences. The ALS–U will employ new technology to produce highly focused beams of soft x-ray light that are up to 1000 times brighter than current capability. Soft x-rays, like those produced at the ALS, are optimal for probing the electronic structure of chemicals and materials.

LCLS–II is the world's first hard x-ray free-electron laser. Scientists use its strobe-like pulses to take crisp pictures of atomic motions, watch chemical reactions unfold, probe the properties of materials and explore fundamental processes in living things. The LCLS–II high energy upgrade (LCLS–II–HE) will build on the success of LCLS–II to ensure that the U.S. maintains a world-leading capability for advanced research in chemistry, materials, biology and energy. LCLS–II–HE will provide a major jump in capability—moving from 120 pulses per second to 1 million pulses per second, and will enable researchers to perform experiments in a wide range of fields that are now impossible.

The APS is one of the most advanced synchrotron radiation research facilities in the world. The APS produces ultra-bright, high-energy, storage ring-generated x-ray beams which enable scientists to study the structure and behavior of physical and biological materials. This research enables innovation in many fields, including materials synthesis and pharmaceutical development. The APS–U will increase the brightness of the APS hard x-ray beams, which allows more x-rays to be focused onto a smaller area and provides more detailed data for researchers in less time. Hard x-rays, like those produced at the APS, are optimal for determining the atomic structure of materials and penetrating into condensed phase media.

The SNS is a one-of-a-kind neutron scattering research facility that provides the most intense pulsed neutron beams in the world for scientific research and industrial development. This source of brighter and more intense neutrons enables unprecedented research opportunities, allowing scientists to make sensitive measurements in complex sample environments, with higher resolution and speed than any existing neutron facility.

The SNS–PPU will update the SNS accelerator complex, doubling the power of its proton beam and greatly increasing the flux (the neutron density (n) multiplied by neutron velocity (v)) on

SNS's existing First Target Station neutron beamlines. This will correspondingly increase the capacity and capability of these neutron beamlines to power important experiments and analyses.

The SNS–PPU will also provide power for the SNS–STS. In order to maintain its leadership in the field of neutron science, the SNS requires a second target station to provide opportunity to a growing research community. The STS will double the number of beamlines at SNS, significantly expanding the number of instrument stations and opportunities for cutting-edge neutron scattering research at this facility. Combined, the PPU and the STS will allow SNS to reach its full potential and provide for world-leading neutron science here in the U.S.

The Department's longstanding support and prioritization of the ALS upgrade, the high energy upgrade to LCLS–II, the APS upgrade, and the two upgrades to the SNS is documented in a publication of the Office of Science titled, "Facilities for the Future of Science: A Twenty-Year Outlook," published November 2003, and its publication of "Four Years Later: An Interim Report on Facilities for the Future of Science: A Twenty-Year Outlook," published August 2007. In June 2016, the BESAC released a report titled, "Report on Facility Upgrades," which identified the ALS–U, the LCLS–II–HE, the APS–U, SNS–PPU, and SNS–STS as the five priority upgrade projects within BES. In this report, the BESAC determined that these facilities are absolutely central to U.S. contributions to world leading science.

DOE nuclear physics research programs support the experimental and theoretical research needed to discover, explore, and understand all forms of nuclear matter. Within the area of low energy nuclear physics research, FRIB will advance the understanding of rare nuclear isotopes and the evolution of the cosmos. FRIB, which is currently under construction, is a one-of-a-kind, linear accelerator user facility that will use fast, stopped, and reaccelerated rare isotope beams to allow researchers to study a variety of rare isotopes and their properties.

FRIB will expand the foundational understanding of nuclear structure, the atomic interactions of nuclear species, and the origin of elements, and will enable critical nuclear science research across a wide breadth of fields, ranging from medicine to astrophysics.

The Department's longstanding support of the construction of a rare isotope accelerator is documented in a publication of NSAC titled, "Opportunities in Nuclear Science, A Long-Range Plan for the Next Decade," published April 2002. In December 2007, NSAC recommended the construction of FRIB in its publication of "The Frontiers of Nuclear Science, A Long Range Plan," and in October 2015, NSAC listed the completion of FRIB construction as one of the committee's highest priorities in its publication titled, "Reaching for the Horizon: The 2015 Long Range Plan for Nuclear Science."

The HEP program is tasked with conducting the theoretical and experimental particle physics and accelerator science and technology in order to discover the most elementary constituents of matter and energy, the basic nature of space and time, and interactions between the two. The LBNF project is a critical component of these long-term research goals.

The LBNF is an internationally coordinated project, designed to build the world's highest intensity neutrino beam and a suite of

cryogenic near detectors at Fermilab. This facility will be used to run the Deep Underground Neutrino Experiment (DUNE), which will measure the neutrino beamline generated at LBNF on cutting-edge, far detectors located 800 miles away at the SURF in South Dakota.

Longstanding support for construction of this world-leading neutrino facility is documented in the HEPAP report titled, "US Particle Physics: Scientific Opportunities, A Strategic Plan for the Next Ten Years, Report of the Particle Physics Project Prioritization Panel," published May 2008, and in its publication titled, "Major High Energy Physics Facilities 2014–2024, Input to the prioritization of proposed scientific user facilities for the Office of Science," published March 2013. In May 2014, HEPAP named the execution of the LBNF at Fermilab as "the highest priority large project in its timeframe," in its publication titled, "Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context, Report of the Particle Physics Prioritization Panel."

Basic research priorities

H.R. 5905 also identifies and authorizes critical basic research initiatives throughout the Office of Science. This includes programs in electricity storage, solar fuels, materials science, high performance computing, low dose radiation research, and fusion energy.

Within the Basic Energy Sciences (BES) program, H.R. 5905 authorizes basic research in chemistry and materials science relevant to advanced electricity storage systems and experimental solar fuels systems. It directs DOE to organize its efforts to advance scientific knowledge relevant to advanced electricity storage concepts under the new Electricity Storage Basic Research Initiative, and to advance artificial photosynthesis, photosynthesis replication, and related processes to produce chemical energy, under the new Solar Fuels Basic Research Initiative.

Another key area of basic research authorized in this legislation is high performance computing, authorized within the Advanced Scientific Computing Research (ASCR) program. High performance computation maintains U.S. competitiveness in the global market for scientific research and development. The next generation of high performance computing facilities, also known as exascale computing systems, will require new developments in hardware and software. The capabilities provided by exascale systems will be significantly more advanced than current capabilities and serve as a mechanism to greatly enhance scientific research and will also support DOE's nuclear weapons stockpile stewardship mission.

Accordingly, this legislation provides the Department with statutory authority to build and operate first-of-a-kind exascale computing systems incorporating increased resiliency features and optimized power requirements.

This legislation also authorizes a specific program in low dose radiation research within the Biological and Environmental Research (BER) program.

There is wide consensus among the radiobiology community that more research is necessary for physicians and related experts to make better informed decisions regarding the health risks associated with low doses of ionizing radiation. This consensus is referenced in the June 2005 publication of The National Academies

Press titled, "Health Risks From Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2," and in the 2012 publication of the National Council on Radiation Protection and Measurements titled, "Report No. 171—Uncertainties in the Estimation of Radiation Risks and Probability of Disease Causation", and in a September 2017 publication of the Government Accountability Office (GAO) titled, "Low Dose Radiation: Interagency Collaboration on Planning Research Could Improve Information on Health Effects," which recommends that DOE lead the development of a mechanism for interagency collaboration on research of the health effects linked to low dose radiation exposures. Based on the recommendations provided in the GAO publication, as well as consistent feedback provided to this Committee by researchers and stakeholders in the radiation biology and medical communities, H.R. 5905 reinstates the Department's historical leadership in this field and authorizes DOE to re-start the low-dose radiation basic research program.

Within the Fusion Energy Sciences (FES) program, H.R. 5905 authorizes both tokamak fusion research and inertial fusion research. Specifically, this legislation asserts Congressional support for the International Thermonuclear Experimental Reactor (ITER) Project. Considered the leading research initiative in fusion science, the goal of ITER project is to design, build, and operate the world's first net-energy producing fusion device. The ITER project is a critical step on the path to achieving commercial fusion energy, a transformative clean energy technology for the next generation. Appropriately, this legislation prioritizes the Department's contribution to this critical field of basic research.

LEGISLATIVE HISTORY

During the 114th and 115th Congresses, the House Committee on Science, Space, and Technology held 16 hearings relevant to the activities authorized in this bill.

On January 7, 2015, H.R. 35, the Low-Dose Radiation Research Act of 2015, passed the House under suspension of the rules.

On January 28, 2015, the Subcommittee on Energy held a hearing entitled, "Super Computing and American Technology Leadership." The purpose of this hearing was to assess the Advanced Scientific Computing Research (ASCR) program within the U.S. Department of Energy's (DOE) Office of Science as a mechanism to support technological advancement in the United States. This hearing examined DOE high performance computing (HPC) facilities' unique ability to accelerate innovation and inform the Committee regarding the applications and benefits from sustained investment in the ASCR program. Witnesses included Mr. Norman Augustine, Board Member, Bipartisan Policy Center; Dr. Roscoe Giles, Chairman, DOE Advanced Scientific Computing Advisory Committee; Mr. David Turek, Vice President, Technical Computing, IBM; and Dr. James Crowley, Executive Director, Society for Industrial and Applied Mathematics.

On February 25, 2015, the Full Committee held a hearing entitled, "An Overview of the Budget Proposal for the Department of Energy for Fiscal Year 2016." The purpose of this hearing was to examine the Department of Energy's science and technology priorities and their impact on the allocation of funding within the Department's research, development, demonstration, and commer-

cialization activities. The witness was The Honorable Ernest Moniz, Secretary, U.S. Department of Energy.

On April 15, 2015, H.R. 1806 was introduced by Representative Lamar Smith, with Mr. Lucas, Mrs. Comstock, Mr. Weber of Texas, Mr. Moolenaar, Mr. Palazzo, Mr. Hultgren, Mr. Knight, Mr. Babin, and Mr. Loudermilk.

On May 1, 2015, the Subcommittee on Energy held a hearing titled "Innovations in Battery Storage for Renewable Energy," which explored the state of large-scale battery storage and key technology breakthroughs achieved through research and development at the national labs and the Department of Energy, and how innovative energy storage companies use basic science research to develop and move breakthrough battery storage technology to the energy market.

On May 20, 2015, H.R. 1806, the America COMPETES Reauthorization Act of 2015, passed the House.

On June 17, 2015, the Energy Subcommittee of the Committee on Science, Space, and Technology held a hearing titled "Department of Energy Oversight: Energy Innovation Hubs," which scrutinized the effectiveness of the DOE's model for energy innovation by leveraging expertise from the DOE laboratories, universities, and the private sector.

On November 18, 2015, the Energy Subcommittee held a hearing titled, "Recommendations of the Commission to Review the Effectiveness of the National Energy Laboratories." Witnesses were: Mr. TJ Glauthier, Co-Chair, Commission to Review the Effectiveness of the National Energy Laboratories; Dr. Jared L. Cohon, Co-Chair, Commission to Review the Effectiveness of the National Energy Laboratories; Dr. Peter, Littlewood, Director, Argonne National Laboratory.

On March 22, 2016, the Committee held a hearing titled, "An Overview of the Budget Proposal for the Department of Energy for Fiscal Year 2017." The witness was The Honorable Ernest Moniz, Secretary of Energy, U.S. Department of Energy.

On June 15, 2016, the Energy Subcommittee of the Committee on Science, Space, and Technology held a hearing titled, "Innovation in Solar Fuels, Electricity Storage, and Advanced Materials," which explored opportunities in basic and early stage research and development for experimental solar fuels systems.

On September 21, 2016, the Oversight Subcommittee and the Energy Subcommittee held a joint hearing titled, "Examining Misconduct and Intimidation of Scientists by Senior DOE Officials." Witnesses were: Dr. Sharlene Weatherwax, Associate Director, Biological and Environmental Research, U.S. Department of Energy; Dr. Noelle Metting, Radiation Biologist, U.S. Department of Energy.

On January 6, 2017, S. 3084, the American Innovation and Competitiveness Act, which includes authority for DOE to formulate scientific goals for future low-dose radiation research and to ensure coordination between Federal agencies for research in radiation biology, was signed into law (P.L. 114–329).

On January 24, 2017, H.R. 589, the Department of Energy Research and Innovation Act, which includes policy directives for the DOE Office of Science, passed the House without amendment.

On June 28, 2017, the Energy Subcommittee and the Research and Technology Subcommittee held a hearing titled, "Material Science: Building the Future." Witnesses were: Dr. Matthew Tirrell, Deputy Laboratory Director for Science and Chief Research Officer, Argonne National Laboratory; Dr. Laurie Locascio, Acting Associate Director for Laboratory Programs and Director, Material Measurement Laboratory, National Institute of Standards and Technology; Dr. Adam Schwartz, Director, Ames Laboratory; Dr. Fred Higgs, John and Ann Doerr Professor of Mechanical Engineering, Rice University.

On July 19, 2017, the Committee held a hearing titled, "Energy Innovation: Letting Technology Lead." Witnesses were: Dr. Jacob DeWitte, President and CEO, Oklo; Dr. Gaurav N. Sant, Associate Professor and Henry Samueli Fellow, Department of Civil and Environmental Engineering, Henry Samueli School of Engineering and Applied Science, University of California, Los Angeles; Dr. Venky Narayanamurti, Benjamin Peirce Research Professor of Technology and Public Policy, John A. Paulson School of Engineering and Applied Science, Harvard University; Mr. Kiran Kumaraswamy, Market Development Director, AES Energy Storage.

On November 1, 2017, the Energy Subcommittee held a hearing titled, "The Future of Low Dose Radiation Research." Witnesses were: Mr. John Neumann, Director of Science and Technology Issues, Government Accountability Office; Dr. Gayle Woloschak, Professor of Radiation Oncology and Radiology, Northwestern University; Dr. James Brink, Professor of Radiology, Harvard Medical School, Radiologist-in-Chief, Massachusetts General Hospital.

On November 13, 2017, Energy Subcommittee Vice Chair Stephen Knight introduced H.R. 4376, the Department of Energy Research Infrastructure Act of 2018, and Rep. Randy Hultgren introduced H.R. 4377, the Accelerating American Innovation in Science Act of 2018, which were referred solely to the Committee.

On November 15, 2017, the Committee on Science, Space, and Technology approved and ordered reported H.R. 4376 and H.R. 4377 by voice vote.

On December 3, 2017, Rep. Roger Marshall introduced H.R. 4675, the Low Dose Radiation Research Act of 2018 which was referred solely to the Committee.

On January 30, 2018, the Committee held a hearing titled, "Department of Energy: Management and Priorities." Witnesses were the Honorable Paul Dabbar, Under Secretary for Science, U.S. Department of Energy, and the Honorable Mark Menezes, Under Secretary of Energy, U.S. Department of Energy.

On February 13, 2018, H.R. 4376, H.R. 4377, and H.R. 4675 passed the House under suspension of the rules.

On March 6, 2018, the Energy Subcommittee held a hearing titled, "The Future of U.S. Fusion Energy Research." Witnesses were Dr. Bernard Bigot, Director General of the ITER Organization, Dr. James Van Dam, Acting Associate Director of Fusion Energy Sciences, Department of Energy Office of Science, Dr. Mickey Wade, the Director of Advanced Fusion Systems, Magnetic Fusion Energy Division at General Atomics, and Dr. Mark Herrmann, the Director of the National Ignition Facility at Lawrence Livermore National Laboratory.

On March 13, 2018, the Committee held a hearing titled, "National Laboratories: World-Leading Innovation in Science." Witnesses were Dr. Mark Peters, the Director of Idaho National Laboratory, Dr. Susan Seestrom, the Advanced Science and Technology Associate Laboratory Director and Chief Research Officer at Sandia National Laboratory, Dr. Mary E. Maxon, the Associate Laboratory Director for Biosciences at Lawrence Berkeley National Laboratory, Dr. Chi-Chang Kao, the Director of Stanford Linear Accelerator Center, National Accelerator Laboratory, and Dr. Paul Kearns, the Director of Argonne National Laboratory.

On May 9, 2018, the Committee held a hearing titled, "An Overview of the Budget Proposal for the Department of Energy for Fiscal Year 2019." The witness was The Honorable Rick Perry, Secretary, U.S. Department of Energy.

COMMITTEE VIEWS

Basic Energy Sciences

The Committee recognizes the importance of the Basic Energy Sciences (BES) mission to support basic research in materials science, chemical science, and physical bioscience and geoscience to provide the scientific foundations for future energy technologies.

H.R. 5905 reauthorizes the Energy Frontier Research Centers (EFRCs), which will continue to support Office of Science's basic research mission by convening talented groups of researchers to confront fundamental challenges for potentially transformative energy technologies. The Committee acknowledges the contributions of the following reports: the BESAC "Grand Challenges" report, the BESAC "From Quanta to the Continuum: Opportunities for Mesoscale Science" report, and the "Basic Energy Sciences Basic Research Needs" workshop report.

The Committee finds that the Department should prioritize key areas of basic research, including research in fundamental science that could support the development of new technologies in electricity storage and solar fuels. The Committee encourages DOE to consider new mechanisms to efficiently make accessible the milestone driven research that will result from initiatives in these areas in order to most effectively engage with the research community.

The Committee also recognizes the importance of the BES contribution to the high performance computing research through its Computational Materials Sciences activities. The Committee encourages the DOE to coordinate research efforts between BES and the Exascale Computing Initiative, in order to accelerate the development of advanced computing architectures in the United States. The Committee supports the integration of BES materials science disciplines with advanced computing initiatives, including research that incorporates machine learning to expedite the processing and application of experimental materials data.

The Committee urges the BES program to aggressively pursue a strategy to maintain and expand upon its world-class, open-access user facilities, including x-ray light sources, neutron sources, and nanoscale science research centers. The Committee recognizes that these facilities uniquely enable research to provide useful informa-

tion and revolutionary discovery about the atomic structure and dynamics in materials.

H.R. 5905 prioritizes BES funding and supports the upgrade to the ALS, the LCLS–II–HE, the APS upgrade, the SNS–PPU, and the SNS–STS.

Advanced Light Source upgrade

H.R. 5905 authorizes the upgrade to the ALS described in the publication approved by the BESAC on June 9, 2016, titled, "Report on Facility Upgrades." This includes the development of a multi-bend achromat lattice to produce a high flux of coherent x-rays within the soft x-ray energy region and a suite of beamlines optimized for this source. The Committee concurs with the assessment of the Department and the most recent BESAC report that the completion of this upgrade is essential to maintaining world-leading science here in the United States.

The ALS upgrade authorized in this legislation will utilize new advances in accelerator technologies to produce soft x-ray beams that are several orders of magnitude brighter than the current ALS beamlines. In order to ensure the on-schedule, on-budget construction of this project, the Committee includes sufficient annual authorizations for FY 2018 and 2019 in this legislation and recommends future sufficient annual funding requiring the Department to complete the ALS upgrade by the close of 2026.

Linac Coherent Light Source High Energy upgrade

H.R. 5905 authorizes the LCLS–II–HE upgrade described in the June 9, 2016, BESAC "Report on Facility Upgrades," including the development of experimental capabilities for high energy x-rays to reveal fundamental scientific discoveries. The Committee concurs with the assessment of the Department and this most recent BESAC report that the completion of this upgrade is essential to maintaining world-leading science here in the United States.

The LCLS–II–HE upgrade authorized in this legislation will provide researchers with the imaging capability necessary to advance discoveries in chemistry, materials science, biology, and energy. In order to ensure the on-schedule, on-budget construction of this project, the Committee includes sufficient annual authorizations for FY 2018 and 2019 in this legislation and recommends future sufficient annual funding requiring the Department to complete the LCLS–II–HE upgrade by the close of 2025.

Advanced Photon Source upgrade

H.R. 5905 authorizes an upgrade to the APS as described in the publication approved by the BESAC on June 9, 2016, titled, "Report on Facility Upgrades." This includes the development of a multi-bend achromat lattice to produce a high flux of coherent x-rays within the hard x-ray energy region and a suite of beamlines optimized for this source. The Committee concurs with the assessment of the Department and the most recent BESAC report that the completion of this upgrade is essential to maintaining world-leading science here in the United States.

The APS upgrade authorized in this legislation will harness new advances in storage ring technologies to increase the brightness of the APS beamline. These improved capabilities will yield a vast in-

crease in imaging output, allowing researchers to observe materials under real conditions at extremely small scales. In order to ensure the on-schedule, on-budget construction of this project, the Committee includes sufficient annual authorizations for FY 2018 and 2019 in this legislation and recommends future sufficient annual funding requiring the Department to complete the APS upgrade by the close of 2025.

Spallation Neutron Source Proton Power upgrade and Second Target Station

H.R. 5905 authorizes two upgrades to the SNS as described in the publication approved by the BESAC on June 9, 2016, titled, "Report on Facility Upgrades." The Committee concurs with the assessment of the Department and the most recent BESAC report that the completion of these upgrades are essential to maintaining world-leading science here in the United States.

Currently, the SNS is the most powerful pulsed neutron user facility in the world. However, the Committee finds that without the upgrades authorized in this legislation, this leading facility will be surpassed by the European Spallation Source, which is currently under construction in Sweden and is expected to provide approximately an order of magnitude higher neutron flux than the SNS by 2024. Upon completion, the SNS–PPU and SNS–STS will ensure that the SNS remains the leading site for research in soft matter, biology, and polymer science that is facilitated by neutron experiments.

The June 2016 BESAC report also concluded that ORNL must resolve "significant scientific/engineering challenges" in order to ensure that the planned upgrades would effectively increase the repetition rate and average brightness at the SNS, and that more engagement with the neutron science user community was required to ensure the development of a compelling and robust set of "first experiments" for the upgraded SNS before initiating construction. However, following discussions with Department officials and ORNL leadership, the Committee finds that ORNL has provided the necessary responses to the Department in order to proceed with the construction of this project.

In order to ensure the on-schedule, on-budget construction of these projects, the Committee includes sufficient annual authorizations for FY 2018 and 2019 in this legislation and recommends future sufficient annual funding requiring the Department to complete the SNS–PPU by the close of 2025 and the SNS–STS by the close of 2030.

Advanced Scientific Computing Research

The Committee recognizes that high performance computing (HPC) modeling supports nearly every area of technological advancement and encourages the Department to develop next generation computing facilities through its ASCR program within the Office of Science. High performance computation keeps the United States competitive in the global market for scientific research and development and, therefore, is another priority funding area in H.R. 5905.

H.R. 5905 authorizes Department of Energy programs to operate first-of-a-kind computing systems incorporating increased resiliency

features and optimized power requirements. H.R. 5905 specifically authorizes an Exascale Computing Program that promotes the missions of the Department and requires the delivery of two or more exascale computing systems. The Committee finds that the Department should continue efforts in computer science and supporting research fields, and accordingly authorizes continued research in computer science, applied mathematics, and computer hardware architecture, in order to maintain a balanced portfolio that supports research outside of exascale delivery and facilitates workforce development.

High Energy Physics

The Committee supports the Particle Physics Projects Prioritization Panel's report entitled "Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context." The Committee encourages the High Energy Physics (HEP) program within the Office of Science to work towards regaining the United States' global leadership position in neutrino science and anticipates the completion of the Long Baseline Neutrino Facility (LBNF). The Committee also recognizes the importance of continued support for smaller-scale projects, including the Dark Energy Spectroscopic Instrument (DESI) and upgrades such as the Proton Improvement Plan II (PIP–II).

Long-Baseline Neutrino Facility

H.R. 5905 authorizes the construction of the Long-Baseline Neutrino Facility (LBNF) at Fermi National Accelerator Laboratory (Fermilab) to facilitate the international DUNE and enable a program in neutrino physics to measure the fundamental properties of neutrinos, explore physics beyond the Standard Model, and better clarify the nature of matter and anti-matter. The Committee concurs with the assessment of the Department and the most recent HEPAP report that the completion of this project is the highest priority large project within HEP and is essential to maintaining world-leading science here in the United States.

The construction of the LBNF and subsequent experiments will increase the fundamental knowledge of neutrinos and their properties—providing valuable insight into cosmic phenomena and theoretical particle physics. With initial construction of LBNF just beginning in 2017, the Committee includes sufficient annual authorizations for FY 2018 and 2019 in this legislation and believes that an authorization of specific annual funding for all remaining construction and necessary instrumentation is required to ensure this vital project is completed on time and on budget by the close of 2026.

Upon completion, LBNF will be the first internationally-funded science facility hosted in the United States. The Committee supports the Department's continuing efforts to solicit international contributions for the construction of the project, and recognizes the importance of funds already committed to the project, including the September 2017 commitment of $88 million from the United Kingdom, and the April 2018 LBNF collaboration agreement between the U.S. and India.

Biological and Environmental Research

The Committee recognizes the importance of the BER program's mission to support basic research and scientific user facilities to increase the knowledge base for complex biological and environmental systems. The Committee is concerned, however, about the trend within BER towards increased emphasis on climate modeling seemingly at the expense of physical science programs, including genomic and radiological sciences.

H.R. 5905 rebalances these priorities by requiring increased accountability and transparency for BER's climate modeling budget. It authorizes the existing Bioenergy Research Centers (BRCs) to conduct basic research in microbial systems biology and genomics to inform the production of fuels, chemicals, and biomass resource, and authorizes a comprehensive research program on the health effects of exposure to low dose radiation.

Low-Dose Radiation Research Program

The Committee recognizes the Department's unique capability to conduct research at the intersection of biological systems and radiological sciences. H.R. 5905 authorizes a basic research program on low dose radiation within BER. This legislation directs the Secretary of Energy to identify ongoing scientific challenges in low dose radiation research and to develop a long-term basic research plan that addresses these challenges.

Fusion Energy Sciences

The Committee supports the FES mission to expand the fundamental understanding of the behavior of plasmas and matter at very high temperatures. Additionally, the Committee recognizes the monumental challenges and questions of physics associated with controlling plasmas, generating and manipulating very strong electromagnetic fields, and developing materials that can withstand extreme conditions.

The Committee supports continuing the U.S. commitment to the ITER project. In order to maintain U.S. energy independence and its global standing as the leader in science, the Committee recommends full funding for U.S. contributions to the ITER project. H.R. 5905 authorizes critical investments to meet the U.S. commitment to the ITER project, for both in-kind and cash contributions, for FY 2018 and 2019.

Nuclear Physics

The Committee acknowledges the uniqueness of the Nuclear Physics (NP) program's support for fundamental nuclear science, including the Nuclear Theory subprogram which increases the knowledge base that will ultimately identify new frontiers for future experiments. H.R. 5905 supports the operation of user facilities such as the Argonne Tandem Linac Accelerator System (ATLAS), including the Californium Rare Ion Breeder Upgrade (CARIBU) and the construction of the Facility for Rare Isotope Beams (FRIB), a new user facility to support research on aspects of the nuclear structure and nuclear astrophysics.

The Committee encourages NP to continue its research efforts to explore novel concepts and rare decay processes relevant for the

production of critical isotopes that support medical applications among other things.

Facility for Rare Isotope Beams

H.R. 5905 authorizes completion of the FRIB to advance the understanding of rare nuclear isotopes and the evolution of the cosmos. This facility could also potentially be used to produce medical isotopes for diagnostic and therapeutic needs. While construction of the FRIB began in fiscal year 2014 and is already over 70 percent complete, the Committee includes sufficient annual authorizations for FY 2018 and 2019 in this legislation and believes that an authorization of specific annual funding for the remaining construction and necessary instrumentation is required to ensure this vital project is completed on time and on budget by June 2022.

The Committee also acknowledges the essential support for fundamental nuclear science from DOE NP, including the Nuclear Theory subprogram which increases the knowledge base that will ultimately identify new frontiers for future experiments in nuclear science. The Committee also encourages NP to continue its research efforts to explore novel concepts and rare decay processes relevant for the production of critical isotopes that support medical applications.

SECTION-BY-SECTION

Sec. 1. Short title; Table of contents

Section 1 provides a short title: "Department of Energy Science and Innovation Act."

Sec. 2. Definitions

Section 2 provides relevant definitions.

Sec. 3. Mission

Section 3 amends the Mission of the Department of Energy Office of Science.

Sec. 4. Basic energy sciences

Section 4 authorizes a program in basic energy sciences, including materials sciences and engineering, chemical sciences, physical biosciences, and geosciences in order to understand, predict, and control matter and energy at the electronic, atomic, and molecular levels. Within this program, Section 4 authorizes upgrades and construction of basic energy sciences infrastructure, including the Advanced Photon Source upgrade, Spallation Neutron Source proton power upgrade, Spallation Neutron Source second target station, Advanced Light Source upgrade, and Linac Coherent Light Source II high energy upgrade.

This section also specifically authorizes research programs in Solar Fuels Research Initiative, Electricity Storage Research Initiative, the Materials Research Database, and the Energy Frontier Research Centers.

Sec. 5. Advanced scientific computing research

Section 5 authorizes a program to develop an exascale computing capability through the support of one or more National Laboratory-

industry-university partnerships to conduct integrated research, development, and engineering of multiple exascale architectures. This section instructs the Director to support research in high-performance computing and networking relevant to energy applications, including modeling, simulation, machine learning, and advanced data analytics for basic and applied energy research programs carried out by the Department. This section also authorizes research and development activities in applied mathematics and high-end computing software development, including mathematics, models, and algorithms for complex systems as well as programming environments, tools, languages, and operating systems for high-end computing systems.

Sec. 6. High energy physics

Section 6 establishes a program to research the fundamental constituents of matter, energy, and the nature of space and time to support both elementary particle physics and fundamental accelerator science and technology. It establishes a sense of Congress that the Director incorporate the most recent report of the Particle Physics Project Prioritization Panel into the planning process of the Department. Additionally, as part of this program, the Director is instructed to ensure the access of U.S. researchers to the most advanced accelerator facilities and research capabilities in the world, including the Large Hadron Collider, and to support research into the nature of the neutrino, dark energy, and dark matter.

Within this program, Section 6 authorizes the construction of the Long-Baseline Neutrino Facility (LBNF) over nine years. This facility will be used to run the Deep Underground Neutrino Experiment (DUNE), which will enable fundamental research of neutrinos and their properties.

Sec. 7. Biological and environmental research

Section 7 authorizes biological systems science research activities to increase understanding of complex biological systems to accelerate breakthroughs in the sustainable production of biomass-based liquid transportation fuels, bioenergy, and biobased materials. This section authorizes the selection and establishment of four Bioenergy Research Centers to conduct basic and fundamental research in these areas.

This section specifically authorizes a basic research program on low-dose radiation within the Office of Science at the Department of Energy (DOE) over four years. It directs DOE to develop a long term basic research plan for low dose radiation research using existing scientific knowledge and engagement with the international research community, ensuring consultation between the DOE Office of Science and NASA, NIH, EPA, DoD, NRC, and DHS.

Sec. 8. Fusion energy

Section 8 directs the Director to carry out a fusion energy sciences research program to expand the fundamental understanding of plasmas and matter at very high temperatures and densities and to build the scientific foundation necessary to enable fusion power. This section also authorizes the research and development activities and facility operations to optimize the tokamak

approach to fusion energy, including funding for U.S. cash and in-kind contributions to the ITER project.

Sec. 9. Nuclear physics

Section 9 directs the Director to carry out a program to discover, explore, and understand all forms of nuclear matter, including a program for the production of isotopes that the Secretary determines are needed for research purposes.

This section specifically authorizes the construction of the Facility for Rare Isotope Beams (FRIB) over five years, in order to enable the study of a variety of rare isotopes and their properties, in order to expand our understanding of nuclear structure, the atomic interactions of nuclear species, and the origin of elements.

Sec. 10. Science laboratories and infrastructure program

Section 10 requires the Director to carry out a program to improve safety, efficiency, and mission readiness of infrastructure at Office of Science laboratories.

Sec. 11. Authorization of appropriations

Section 11 authorizes appropriations for fiscal year 2018 and 2019 for the Office of Science, which includes Basic Energy Sciences, Advanced Scientific Computing Research, High Energy Physics, Biological and Environmental Research, Fusion Energy Sciences, and Nuclear Physics.

EXPLANATION OF AMENDMENTS

A manager's amendment offered by Representative Randy Weber was adopted by the Committee. The amendment made minor and technical changes.

COMMITTEE CONSIDERATION

On May 23, 2018, the Committee met in open session and ordered reported favorably the bill, H.R. 5905, by voice vote, a quorum being present.

APPLICATION OF LAW TO THE LEGISLATIVE BRANCH

Section 102(b)(3) of Public Law 104–1 requires a description of the application of this bill to the legislative branch where the bill relates to the terms and conditions of employment or access to public services and accommodations. This bill authorizes the Department of Energy (DOE)'s Office of Science for fiscal years (FY) 2018 and 2019. It provides policy direction and authorizes funding for Office of Science basic research programs and authorizes research infrastructure upgrades and construction of major user facilities at the DOE national labs. As such, this bill does not relate to employment or access to public services and accommodations.

STATEMENT OF OVERSIGHT FINDINGS AND RECOMMENDATIONS OF THE COMMITTEE

In compliance with clause 3(c)(1) of rule XIII and clause (2)(b)(1) of rule X of the Rules of the House of Representatives, the Commit-

tee's oversight findings and recommendations are reflected in the descriptive portions of this report.

Statement of General Performance Goals and Objectives

H.R. 5905 authorizes the Department of Energy (DOE)'s Office of Science for fiscal years (FY) 2018 and 2019. It provides policy direction and authorizes funding for Office of Science basic research programs and authorizes research infrastructure upgrades and construction of major user facilities at the DOE national labs.

Duplication of Federal Programs

No provision of H.R. 5905 establishes or reauthorizes a program of the Federal Government known to be duplicative of another Federal program, a program that was included in any report from the Government Accountability Office to Congress pursuant to section 21 of Public Law 111–139, or a program related to a program identified in the most recent Catalog of Federal Domestic Assistance.

Disclosure of Directed Rule Makings

The Committee estimates that enacting H.R. 5905 does not direct the completion of any specific rule makings within the meaning of 5 U.S.C. 551.

Federal Advisory Committee Act

The Committee finds that the legislation does not establish or authorize the establishment of an advisory committee within the definition of 5 U.S.C. App., Section 5(b).

Unfunded Mandate Statement

Section 423 of the Congressional Budget and Impoundment Control Act (as amended by Section 101(a)(2) of the Unfunded Mandate Reform Act, P.L. 104–4) requires a statement as to whether the provisions of the reported include unfunded mandates. In compliance with this requirement the Committee has received a letter from the Congressional Budget Office included herein.

Earmark Identification

H.R. 5905 does not include any congressional earmarks, limited tax benefits, or limited tariff benefits as defined in clause 9 of rule XXI.

Committee Estimate

Clause 3(d)(2) of rule XIII of the Rules of the House of Representatives requires an estimate and a comparison by the Committee of the costs that would be incurred in carrying out H.R. 5905. However, clause 3(d)(3)(B) of that rule provides that this requirement does not apply when the Committee has included in its report a timely submitted cost estimate of the bill prepared by the Director of the Congressional Budget Office under section 402 of the Congressional Budget Act.

BUDGET AUTHORITY AND CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

With respect to the requirements of clause 3(c)(2) of rule XIII of the Rules of the House of Representatives and section 308(a) of the Congressional Budget Act of 1974 and with respect to requirements of clause (3)(c)(3) of rule XIII of the Rules of the House of Representatives and section 402 of the Congressional Budget Act of 1974, the Committee has received the following cost estimate for H.R. 5905 from the Director of Congressional Budget Office:

U.S. CONGRESS,
CONGRESSIONAL BUDGET OFFICE,
Washington, DC, June 25, 2018.

Hon. LAMAR SMITH,
Chairman, Committee on Science, Space, and Technology,
House of Representatives, Washington, DC.

DEAR MR. CHAIRMAN: The Congressional Budget Office has prepared the enclosed cost estimate for H.R. 5905, the Department of Energy Science and Innovation Act of 2018.

If you wish further details on this estimate, we will be pleased to provide them. The CBO staff contact is Janani Shankaran.

Sincerely,

KEITH HALL,
Director.

Enclosure.

H.R. 5905—Department of Energy Science and Innovation Act of 2018

Summary: H.R. 5905 would authorize appropriations for the Department of Energy's (DOE's) Office of Science and would codify existing activities under that office. CBO estimates that implementing the bill would cost $6.6 billion over the 2019–2023 period, assuming appropriation of the authorized amounts.

Enacting H.R. 5905 could affect direct spending; therefore, pay-as-you-go procedures apply. The bill would direct DOE to use all available approaches and mechanisms including "alternative financing" to upgrade infrastructure at its national laboratories. CBO considers the costs of alternative financing (that is, financing provided by nonfederal entities and not provided in annual appropriations acts) as direct spending. However, in CBO's view the legislation does not clearly expand DOE's existing alternative financing authority. Enacting the bill would not affect revenues.

CBO estimates that enacting H.R. 5905 would not increase net direct spending or on-budget deficits in any of the four consecutive 10-year periods beginning in 2029.

H.R. 5905 contains no intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act (UMRA).

Estimated cost to the Federal Government: The estimated budgetary effect of H.R. 5905 is shown in the following table. The costs of the legislation fall within budget function 250 (general science, space, and technology).

	By fiscal year, in millions of dollars—						
	2018	2019	2020	2021	2022	2023	2019–2023
INCREASES IN SPENDING SUBJECT TO APPROPRIATION							
Authorization Level	6,260	6,600	0	0	0	0	6,600
Estimated Outlays	0	3,630	1,980	990	0	0	6,600

H.R. 5905 would authorize the appropriation of about $6.3 billion in 2018 for activities in the Department of Energy's Office of Science. CBO does not estimate any outlays for that authorization because appropriations for 2018 have already been provided.

Basis of estimate: For this estimate, CBO assumes that H.R. 5905 will be enacted near the end of 2018 and that the authorized amounts will be appropriated.

H.R. 5905 would authorize the appropriation of $6.6 billion in 2019 for DOE's Office of Science, which supports basic research in the physical sciences and operates a system of national science user facilities. In 2018, DOE received an appropriation of $6.3 billion for those programs. Under current law, no specific sums are authorized to be appropriated to DOE for those purposes after 2018. Based on historical spending patterns, CBO estimates that implementing H.R. 5905 would cost $6.6 billion over the 2019–2023 period.

Pay-As-You-Go considerations: Section 10 would direct DOE to use all available approaches and mechanisms, including alternative financing, to upgrade infrastructure at the national laboratories. The bill does not define alternative financing; however, CBO expects that such arrangements could include use of funds provided through third-party financing (funds raised by a nonfederal entity). DOE and other federal agencies have existing authority to use certain types of third-party financing mechanisms including energy savings performance contracts, utility energy service contracts, and enhanced-use leases. CBO treats the costs of such transactions as direct spending and believes that the full cost of such long-term commitments that obligate the government to make payments in future years should be recorded in the budget upfront.[1]

Under a strict interpretation of the provision in section 10, DOE would continue to use existing authorities that it considers to be alternative financing (which would result in no additional direct spending). However, DOE could interpret section 10 as providing new or expanded authority that would allow the agency to expand its use of third-party financing mechanisms to build and improve facilities at its national laboratories. The 17 national laboratories comprise a large portion of DOE's real property portfolio. In 2015, the agency reported a backlog of $5.4 billion in maintenance and improvements across its facilities.[2] Using new alternative financing mechanisms to finance a portion of that backlog of projects would increase direct spending, however, in CBO's view the legislation does not clearly expand DOE's existing authorities.

Increase in long-term direct spending and deficits: CBO estimates that enacting H.R. 5905 would not increase net direct spending or on-budget deficits in any of the four consecutive 10-year periods beginning in 2029.

[1] For more information on the budgetary treatment of third-party financing, see Congressional Budget Office, Third-Party Financing of Federal Projects (June 2005), www.cbo.gov/publication/16554.

[2] U.S. Department of Energy, *Annual Report on the State of the DOE National Laboratories* (January 2017), p.86, www.energy.gov/downloads/annual-report-state-doe-national-laboratories.

Mandates: H.R. 5905 contains no intergovernmental or private-sector mandates as defined in UMRA.

Estimate prepared by: Federal costs: Janani Shankaran; Mandates: Jon Sperl.

Estimate reviewed by: Kim P. Cawley, Chief, Natural and Physical Resources Cost Estimates Unit; H. Samuel Papenfuss, Deputy Assistant Director for Budget Analysis.

CHANGES IN EXISTING LAW MADE BY THE BILL, AS REPORTED

In compliance with clause 3(e) of rule XIII of the Rules of the House of Representatives, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in italic, and existing law in which no change is proposed is shown in roman):

DEPARTMENT OF ENERGY ORGANIZATION ACT

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TITLE II—ESTABLISHMENT OF THE DEPARTMENT

* * * * * * *

OFFICE OF SCIENCE

SEC. 209. (a) There shall be within the Department an Office of Science to be headed by a Director, who shall be appointed by the President, by and with the advice and consent of the Senate, and who shall be compensated at the rate provided for level IV of the Executive Schedule under section 5315 of title 5, United States Code.

(b) It shall be the duty and responsibility of the Director—

(1) to advise the Secretary with respect to the physical research program transferred to the Department from the Energy Research and Development Administration;

(2) to monitor the Department's energy research and development programs in order to advise the Secretary with respect to any undesirable duplication or gaps in such programs;

(3) to advise the Secretary with respect to the well-being and management of the multipurpose laboratories under the jurisdiction of the Department, excluding laboratories that constitute part of the nuclear weapons complex;

(4) to advise the Secretary with respect to education and training activities required for effective short- and long-term basic and applied research activities of the Department;

(5) to advise the Secretary with respect to grants and other forms of financial assistance required for effective short- and long-term basic and applied research activities of the Department; and

(6) to carry out such additional duties assigned to the Office by the Secretary.

(c) MISSION.—The mission of the Office of Science shall be the delivery of scientific discoveries, capabilities, and major scientific tools

to transform the understanding of nature and to advance the energy, economic, and national security of the United States.

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ENERGY POLICY ACT OF 2005

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "Energy Policy Act of 2005".

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

TITLE IX—RESEARCH AND DEVELOPMENT

* * * * * * *

Subtitle G—Science

* * * * * * *

SEC. 972. FUSION ENERGY SCIENCES PROGRAM.

(a) DECLARATION OF POLICY.—It shall be the policy of the United States to conduct research, development, demonstration, and commercial applications to provide for the scientific, engineering, and commercial infrastructure necessary to ensure that the United States is competitive with other countries in providing fusion energy for its own needs and the needs of other countries, including by demonstrating electric power or hydrogen production for the United States energy grid using fusion energy at the earliest date.

(b) PLANNING.—

(1) IN GENERAL.—Not later than 180 days after the date of enactment of this Act, the Secretary shall submit to Congress a plan (with proposed cost estimates, budgets, and lists of potential international partners) for the implementation of the policy described in subsection (a) in a manner that ensures that—

(A) existing fusion research facilities are more fully used;

(B) fusion science, technology, theory, advanced computation, modeling, and simulation are strengthened;

(C) new magnetic and inertial fusion research and development facilities are selected based on scientific innovation and cost effectiveness, and the potential of the facilities to advance the goal of practical fusion energy at the earliest date practicable;

(D) facilities that are selected are funded at a cost-effective rate;

(E) communication of scientific results and methods between the fusion energy science community and the broader scientific and technology communities is improved;

(F) inertial confinement fusion facilities are used to the extent practicable for the purpose of inertial fusion energy research and development;

(G) attractive alternative inertial and magnetic fusion energy approaches are more fully explored; and

(H) to the extent practicable, the recommendations of the Fusion Energy Sciences Advisory Committee in the report on workforce planning, dated March 2004, are carried out, including periodic reassessment of program needs.

(2) COSTS AND SCHEDULES.—The plan shall also address the status of and, to the extent practicable, costs and schedules for—

(A) the design and implementation of international or national facilities for the testing of fusion materials; and

(B) the design and implementation of international or national facilities for the testing and development of key fusion technologies.

(c) UNITED STATES PARTICIPATION IN ITER.—

(1) DEFINITIONS.—In this subsection:

(A) CONSTRUCTION.—

(i) IN GENERAL.—The term "construction" means—

(I) the physical construction of the ITER facility; and

(II) the physical construction, purchase, or manufacture of equipment or components that are specifically designed for the ITER facility.

(ii) EXCLUSIONS.—The term "construction" does not include the design of the facility, equipment, or components.

(B) ITER.—The term "ITER" means the international burning plasma fusion research project in which the President announced United States participation on January 30, 2003, or any similar international project.

(2) PARTICIPATION.—The United States may participate in the ITER only in accordance with this subsection.

(3) AGREEMENT.—

(A) IN GENERAL.—The Secretary may negotiate an agreement for United States participation in the ITER.

(B) CONTENTS.—Any agreement for United States participation in the ITER shall, at a minimum—

(i) clearly define the United States financial contribution to construction and operating costs, as well as any other costs associated with a project;

(ii) ensure that the share of high-technology components of the ITER manufactured in the United States is at least proportionate to the United States financial contribution to the ITER;

(iii) ensure that the United States will not be financially responsible for cost overruns in components manufactured in other ITER participating countries;

(iv) guarantee the United States full access to all data generated by the ITER;

(v) enable United States researchers to propose and carry out an equitable share of the experiments at the ITER;

(vi) provide the United States with a role in all collective decisionmaking related to the ITER; and

(vii) describe the process for discontinuing or decommissioning the ITER and any United States role in that process.

(4) PLAN.—

(A) DEVELOPMENT.—The Secretary, in consultation with the Fusion Energy Sciences Advisory Committee, shall develop a plan for the participation of United States scientists in the ITER that shall include—

(i) the United States research agenda for the ITER;

(ii) methods to evaluate whether the ITER is promoting progress toward making fusion a reliable and affordable source of power; and

(iii) a description of how work at the ITER will relate to other elements of the United States fusion program.

(B) REVIEW.—The Secretary shall request a review of the plan by the National Academy of Sciences.

(5) LIMITATION.—No Federal funds shall be expended for the construction of the ITER until the Secretary has submitted to Congress—

(A) the agreement negotiated in accordance with paragraph (3) and 120 days have elapsed since that submission;

(B) a report describing the management structure of the ITER and providing a fixed dollar estimate of the cost of United States participation in the construction of the ITER, and 120 days have elapsed since that submission;

(C) a report describing how United States participation in the ITER will be funded without reducing funding for other programs in the Office of Science (including other fusion programs), and 60 days have elapsed since that submission; and

(D) the plan required by paragraph (4) (but not the National Academy of Sciences review of that plan), and 60 days have elapsed since that submission.

(6) ALTERNATIVE TO ITER.—

(A) IN GENERAL.—If at any time during the negotiations on the ITER, the Secretary determines that construction and operation of the ITER is unlikely or infeasible, the Secretary shall submit to Congress, along with the budget request of the President submitted to Congress for the following fiscal year, a plan for implementing a domestic burning plasma experiment such as the Fusion Ignition Research Experiment, including costs and schedules for the plan.

(B) ADMINISTRATION.—The Secretary shall—

(i) refine the plan in full consultation with the Fusion Energy Sciences Advisory Committee; and

(ii) transmit the plan to the National Academy of Sciences for review.

(7) ITER CONSTRUCTION.—

(A) IN GENERAL.—There is authorized United States participation in the construction and operations of the ITER project, as agreed to under the April 25, 2007 "Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project.".

(B) FACILITY REQUIREMENTS.—The Secretary shall ensure that the mission-oriented user facility will enable the study of a burning plasma, and shall be built to have the following characteristics in its full configuration:

(i) A tokamak device with a plasma radius of 6.2 meters and a magnetic field of 5.3 T.

(ii) Capable of creating and sustaining a 15-million-Ampere plasma current for greater than 300 seconds.

(C) AUTHORIZATION OF APPROPRIATIONS.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Fusion Energy Sciences, there is authorized for in-kind contributions under this paragraph—

(i) $122,000,000 for fiscal year 2018; and

(ii) $163,000,000 for fiscal year 2019.

(D) AUTHORIZATION OF APPROPRIATIONS.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Fusion Energy Sciences, there is authorized for cash contributions under this paragraph—

(i) $50,000,000 for fiscal year 2018; and

(ii) $50,000,000 for fiscal year 2019.

[SEC. 973. CATALYSIS RESEARCH PROGRAM.

[(a) ESTABLISHMENT.—The Secretary, acting through the Office of Science, shall support a program of research and development in catalysis science consistent with the statutory authorities of the Department related to research and development.

[(b) COMPONENTS.—The program shall include efforts to—

[(1) enable catalyst design using combinations of experimental and mechanistic methodologies coupled with computational modeling of catalytic reactions at the molecular level;

[(2) develop techniques for high throughput synthesis, assay, and characterization at nanometer and subnanometer scales in-situ under actual operating conditions;

[(3) synthesize catalysts with specific site architectures;

[(4) conduct research on the use of precious metals for catalysis; and

[(5) translate molecular understanding to the design of catalytic compounds.

[(c) DUTIES OF THE OFFICE OF SCIENCE.—In carrying out the program, the Director of the Office of Science shall—

[(1) support both individual investigators and multidisciplinary teams of investigators to pioneer new approaches in catalytic design;

[(2) develop, plan, construct, acquire, share, or operate special equipment or facilities for the use of investigators in collaboration with national user facilities, such as nanoscience and engineering centers;

[(3) support technology transfer activities to benefit industry and other users of catalysis science and engineering; and

[(4) coordinate research and development activities with industry and other Federal agencies.

[(d) ASSESSMENT.—Not later than 3 years after the date of enactment of this Act, the Secretary shall enter into an arrangement with the National Academy of Sciences to—

[(1) review the catalysis program to measure—

[(A) gains made in the fundamental science of catalysis; and

[(B) progress towards developing new fuels for energy production and material fabrication processes; and

[(2) submit to Congress a report describing the results of the review.]

SEC. 973. SOLAR FUELS RESEARCH INITIATIVE.

(a) INITIATIVE.—

(1) IN GENERAL.—The Secretary shall carry out a research initiative, to be known as the "Solar Fuels Research Initiative" (referred to in this section as the "Initiative") to expand theoretical and fundamental knowledge of photochemistry, electrochemistry, biochemistry, and materials science useful for the practical development of experimental systems to convert solar energy to chemical energy.

(2) LEVERAGING.—In carrying out programs and activities under the Initiative, the Secretary shall leverage expertise and resources from—

(A) the Basic Energy Sciences Program and the Biological and Environmental Research Program of the Office of Science; and

(B) the Office of Energy Efficiency and Renewable Energy.

(3) TEAMS.—

(A) IN GENERAL.—In carrying out the Initiative, the Secretary shall organize activities among multidisciplinary teams to leverage, to the maximum extent practicable, ex-

pertise from the National Laboratories, institutions of higher education, and the private sector.

(B) GOALS.—The multidisciplinary teams described in subparagraph (A) shall pursue aggressive, milestone-driven, basic research goals.

(C) RESOURCES.—The Secretary shall provide sufficient resources to the multidisciplinary teams described in subparagraph (A) to achieve the goals described in subparagraph (B) over a period of time to be determined by the Secretary.

(4) ADDITIONAL ACTIVITIES.—The Secretary may organize additional activities under this subsection through Energy Frontier Research Centers, Energy Innovation Hubs, or other organizational structures.

(b) ARTIFICIAL PHOTOSYNTHESIS.—

(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research needed to bridge scientific barriers to, and discover knowledge relevant to, artificial photosynthetic systems.

(2) ACTIVITIES.—As part of the program described in paragraph (1)—

(A) the Director of the Office of Basic Energy Sciences shall support basic research to pursue distinct lines of scientific inquiry, including—

(i) photoinduced production of hydrogen and oxygen from water; and

(ii) the sustainable photoinduced reduction of carbon dioxide to fuel products including hydrocarbons, alcohols, carbon monoxide, and natural gas; and

(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

(4) FUNDING.—

(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences, the Secretary shall make available for carrying out activities under this subsection $50,000,000 for each of fiscal years 2018 through 2019.

(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

(c) BIOCHEMISTRY, REPLICATION OF NATURAL PHOTOSYNTHESIS, AND RELATED PROCESSES.—

(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research needed to replicate natural photosynthetic processes by use of artificial photosynthetic components and materials.

(2) ACTIVITIES.—As part of the program described in paragraph (1)—

(A) the Director of the Office of Basic Energy Sciences shall support basic research to expand fundamental knowledge to replicate natural synthesis processes, including—

(i) the photoinduced reduction of dinitrogen to ammonia;

(ii) the absorption of carbon dioxide from ambient air;

(iii) molecular-based charge separation and storage;

(iv) photoinitiated electron transfer; and

(v) catalysis in biological or biomimetic systems;

(B) the Associate Director of Biological and Environmental Research shall support systems biology and genomics approaches to understand genetic and physiological pathways connected to photosynthetic mechanisms; and

(C) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

(4) FUNDING.—

(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences and Biological and Environmental Research, the Secretary shall make available for carrying out activities under this subsection $50,000,000 for each of fiscal years 2018 through 2019.

(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

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[SEC. 975. SOLID STATE LIGHTING.

[The Secretary shall conduct a program of fundamental research on solid state lighting in support of the Next Generation Lighting Initiative carried out under section 912.**]**

SEC. 975. ELECTRICITY STORAGE RESEARCH INITIATIVE.

(a) INITIATIVE.—

(1) IN GENERAL.—The Secretary shall carry out a research initiative, to be known as the "Electricity Storage Research Initiative" (referred to in this section as the "Initiative")—

(A) to expand theoretical and fundamental knowledge to control, store, and convert—

(i) electrical energy to chemical energy; and

(ii) chemical energy to electrical energy; and

(B) to support scientific inquiry into the practical understanding of chemical and physical processes that occur within systems involving crystalline and amorphous solids, polymers, and organic and aqueous liquids.

(2) LEVERAGING.—In carrying out programs and activities under the Initiative, the Secretary shall leverage expertise and resources from—

(A) the Basic Energy Sciences Program, the Advanced Scientific Computing Research Program, and the Biological and Environmental Research Program of the Office of Science; and

(B) the Office of Energy Efficiency and Renewable Energy.

(3) TEAMS.—

(A) IN GENERAL.—In carrying out the Initiative, the Secretary shall organize activities among multidisciplinary teams to leverage, to the maximum extent practicable, expertise from the National Laboratories, institutions of higher education, and the private sector.

(B) GOALS.—The multidisciplinary teams described in subparagraph (A) shall pursue aggressive, milestone-driven, basic research goals.

(C) RESOURCES.—The Secretary shall provide sufficient resources to the multidisciplinary teams described in subparagraph (A) to achieve the goals described in subparagraph (B) over a period of time to be determined by the Secretary.

(4) ADDITIONAL ACTIVITIES.—The Secretary may organize additional activities under this subsection through Energy Frontier Research Centers, Energy Innovation Hubs, or other organizational structures.

(b) MULTIVALENT SYSTEMS.—

(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research needed to bridge scientific barriers to, and discover knowledge relevant to, multivalent ion materials in electric energy storage systems.

(2) ACTIVITIES.—As part of the program described in paragraph (1)—

(A) the Director of the Office of Basic Energy Sciences shall investigate electrochemical properties and the dynamics of materials, including charge transfer phenomena and mass transport in materials; and

(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

(4) FUNDING.—

(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences and Biological and Environmental Research, the Secretary shall make available for carrying out activities under this subsection $50,000,000 for each of the fiscal years 2018 through 2019.

(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

(c) ELECTROCHEMISTRY MODELING AND SIMULATION.—

(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research to model and simulate organic electrolytes, including the static and dynamic electrochemical behavior and phenomena of organic electrolytes at the molecular and atomic level in monovalent and multivalent systems.

(2) ACTIVITIES.—As part of the program described in paragraph (1)—

(A) the Director of the Office of Basic Energy Sciences, in coordination with the Associate Director of Advanced Scientific Computing Research, shall support the development of high performance computational tools through a joint development process to maximize the effectiveness of current and projected high performance computing systems; and

(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

(4) FUNDING.—

(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences and Advanced Scientific Computing Research, the Secretary shall make available for carrying out activities under this subsection $30,000,000 for each of the fiscal years 2018 through 2019.

(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

(d) MESOSCALE ELECTROCHEMISTRY.—

(1) IN GENERAL.—The Secretary shall carry out under the Initiative a program to support research needed to reveal electrochemistry in confined mesoscale spaces, including scientific discoveries relevant to—

(A) bio-electrochemistry and electrochemical energy conversion and storage in confined spaces; and

(B) the dynamics of the phenomena described in subparagraph (A).

(2) ACTIVITIES.—As part of the program described in paragraph (1)—

(A) the Director of the Office of Basic Energy Sciences and the Associate Director of Biological and Environmental Research shall investigate phenomena of mesoscale electrochemical confinement for the purpose of replicating and controlling new electrochemical behavior; and

(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

(3) STANDARD OF REVIEW.—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

(4) FUNDING.—

(A) IN GENERAL.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Basic Energy Sciences and Biological and Environmental Research, the Secretary shall make available for carrying out activities under this subsection $20,000,000 for each of fiscal years 2018 through 2019.

(B) PROHIBITION.—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

SEC. 976. ADVANCED SCIENTIFIC COMPUTING FOR ENERGY MISSIONS.

(a) PROGRAM.—

(1) IN GENERAL.—The Secretary shall conduct an advanced scientific computing research and development program that includes activities related to applied mathematics and activities authorized by the ⟦Department of Energy High-End Computing Revitalization Act of 2004⟧ *American Super Computing Leadership Act* (15 U.S.C. 5541 et seq.).

(2) GOAL.—The Secretary shall carry out the program with the goal of supporting departmental missions, and providing the high-performance computational, networking, advanced visualization technologies, and workforce resources, that are required for world leadership in science.

(b) HIGH-PERFORMANCE COMPUTING.—Section 203 of the High-Performance Computing Act of 1991 (15 U.S.C. 5523) is amended to read as follows:

* * * * * * *".

SEC. 977A. LOW-DOSE RADIATION RESEARCH PROGRAM.

(a) IN GENERAL.—The Secretary shall carry out a basic research program on low-dose radiation to—

(1) enhance the scientific understanding of, and reduce uncertainties associated with, the effects of exposure to low-dose radiation; and

(2) inform improved risk-assessment and risk-management methods with respect to such radiation.

(b) PROGRAM COMPONENTS.—In carrying out the program required under subsection (a), the Secretary shall—

(1) formulate scientific goals for low-dose radiation basic research in the United States;

(2) identify ongoing scientific challenges for understanding the long-term effects of ionizing radiation on biological systems;

(3) develop a long-term strategic and prioritized basic research agenda to address such scientific challenges in coordination with other research efforts;

(4) leverage the collective body of knowledge from existing low-dose radiation research; and

(5) engage with other Federal agencies, research communities, and potential users of information produced under this section, including institutions concerning radiation research, medical physics, radiology, health physics, and emergency response.

(c) COORDINATION.—In carrying out the program, the Secretary, in coordination with the Physical Science Subcommittee of the National Science and Technology Council, shall—

(1) support the directives under section 106 of the American Innovation and Competitiveness Act (42 U.S.C. 6601 note);

(2) ensure that the Office of Science of the Department of Energy consults with the National Aeronautics and Space Administration, the National Institutes of Health, the Environmental Protection Agency, the Department of Defense, the Nuclear Regulatory Commission, and the Department of Homeland Security;

(3) advise and assist the National Science and Technology Council on policies and initiatives in radiation biology, including enhancing scientific knowledge of the effects of low-dose radiation on biological systems to improve radiation risk-assessment and risk-management methods; and

(4) identify opportunities to stimulate international cooperation relating to low-dose radiation and leverage research and knowledge from sources outside of the United States.

(d) RESEARCH PLAN.—Not later than 180 days after the date of enactment of this Act, the Secretary shall transmit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a 4-year research plan that identifies and prioritizes basic research needs relating to low-dose radiation. In developing such plan, the Secretary shall incorporate the components described in subsection (b).

(e) DEFINITION OF LOW-DOSE RADIATION.—In this section, the term "low-dose radiation" means a radiation dose of less than 100 millisieverts.

(f) RULE OF CONSTRUCTION.—Nothing in this section shall be construed to subject any research carried out by the Secretary for the program under this section to any limitations described in 977(e) of the Energy Policy Act of 2005 (42 U.S.C. 16317(e)).

(g) FUNDING.—From within funds authorized to be appropriated under section 11 of the Department of Energy Science and Innovation Act of 2018, for Biological and Environmental Research, the Secretary make available to carry out this section—

(1) $20,000,000 for fiscal year 2018; and

(2) $20,000,000 for fiscal year 2019.

* * * * * * *

SEC. 981. [RARE ISOTOPE ACCELERATOR] *FACILITY FOR RARE ISOTOPE BEAMS.*

(a) ESTABLISHMENT.—The Secretary shall construct and operate a [Rare Isotope Accelerator] *Facility for Rare Isotope Beams*. The Secretary shall commence construction no later than September 30, 2008.

(b) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the Secretary such sums as may be necessary to carry out this section. The Secretary shall not spend more than $1,100,000,000 in Federal funds for all activities associated with the [Rare Isotope Accelerator] *Facility for Rare Isotope Beams*, prior to operation of the Accelerator.

* * * * * * *

AMERICAN SUPER COMPUTING LEADERSHIP ACT

SECTION 1. SHORT TITLE.

This Act may be cited as the "[Department of Energy High-End Computing Revitalization Act of 2004] *American Super Computing Leadership Act*".

SEC. 2. DEFINITIONS.

In this Act:

[(1) CENTER.—The term"Center" means a High-End Software Development Center established under section 5542(d) of this title.]

(1) DEPARTMENT.—The term "Department" means the Department of Energy.

(2) EXASCALE COMPUTING.—The term "exascale computing" means computing through the use of a computing machine that performs near or above 10 to the 18th power operations per second.

[(2)] *(3)* HIGH-END COMPUTING SYSTEM.—The term "high-end computing system" means a computing system with performance that substantially exceeds that of systems that are commonly available for advanced scientific and engineering applications

[(3)] *(4)* LEADERSHIP SYSTEM.—The term "Leadership System" means a high-end computing system that is among the most advanced in the world in terms of performance in solving scientific and engineering problems.

[(4)] *(5)* INSTITUTION OF HIGHER EDUCATION.—The term "institution of higher education" has the meaning given the term in section 1001(a) of title 20.

[(5)] *(6)* SECRETARY.—The term "Secretary" means the Secretary of Energy[, acting through the Director of the Office of Science of the Department of Energy].

SEC. 3. DEPARTMENT OF ENERGY HIGH-END COMPUTING RESEARCH AND DEVELOPMENT PROGRAM.

(a) IN GENERAL.—The Secretary shall—

(1) carry out a [program] *coordinated program across the Department* of research and development (including development of software and hardware) to advance high-end computing systems; and

(2) develop and deploy high-end computing systems for advanced scientific and engineering applications.

(b) PROGRAM.—The program shall—

(1) support both individual investigators and multidisciplinary teams of investigators;

(2) conduct research in multiple architectures[, which may include vector, reconfigurable logic, streaming, processor-in-memory, and multithreading architectures];

(3) conduct research on software for high-end computing systems, including research on algorithms, programming environments, tools, languages, and operating systems for high-end computing systems, in collaboration with architecture development efforts;

(4) provide for sustained access by the research community in the United States to high-end computing systems and to

Leadership Systems, including provision of technical support for users of such systems;

(5) support technology transfer to the private sector and others in accordance with applicable law; and

(6) densure that the high-end computing activities of the Department of Energy are coordinated with relevant activities in industry and with other Federal agencies, including the National Science Foundation, the Defense Advanced Research Projects Agency, the National Nuclear Security Administration, the National Security Agency, the National Institutes of Health, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the National Institutes of Standards and Technology, and the Environmental Protection Agency.

(c) LEADERSHIP SYSTEMS FACILITIES.—

(1) IN GENERAL.—carry out a program of research and development (including development of software and hardware) to advance high-end computing systems; and

(A) conduct advanced scientific and engineering research and development using Leadership Systems; and

(B) develop potential advancements in high-end computing system hardware and software.

(2) ADMINISTRATION.—In carrying out this subsection, the Secretary shall provide to Leadership Systems, on a competitive, merit-reviewed basis, access to researchers in United States industry, institutions of higher education, national laboratories, and other Federal agencies.

[(d) HIGH-END SOFTWARE DEVELOPMENT CENTER.—

[(1) IN GENERAL.—As part of the program carried out under this subchapter, the Secretary shall establish at least 1 High-End Software Development Center.

[(2) DUTIES.—A Center shall concentrate efforts to develop, test, maintain, and support optimal algorithms, programming environments, tools, languages, and operating systems for high-end computing systems.

[(3) PROPOSALS.—In soliciting proposals for the Center, the Secretary shall encourage staffing arrangements that include both permanent staff and a rotating staff of researchers from other institutions and industry to assist in coordination of research efforts and promote technology transfer to the private sector.

[(4) USE OF EXPERTISE.—The Secretary shall use the expertise of a Center to assess research and development in high-end computing system architecture.

[(5) SELECTION.—The selection of a Center shall be determined by a competitive proposal process administered by the Secretary.**]**

(d) EXASCALE COMPUTING PROGRAM.—

(1) IN GENERAL.—The Secretary shall conduct a research program (referred to in this subsection as the "Program") for exascale computing, including the development of two or more exascale computing machine architectures, to promote the missions of the Department.

(2) EXECUTION.—

(A) IN GENERAL.—In carrying out the Program, the Secretary shall—

(i) establish a National Laboratory partnership for industry partners and institutions of higher education for codesign of exascale hardware, technology, software, and applications across all applicable organizations of the Department;

(ii) acquire multiple exascale computing systems at the existing Departmental facilities that represent at least two distinct technology options developed under clause (i);

(iii) develop such advancements in hardware and software technology as are required to fully realize the potential of an exascale production system in addressing Department target applications and solving scientific problems involving predictive modeling and simulation, large scale data analytics and management, and artificial intelligence;

(iv) explore the use of exascale computing technologies to advance a broad range of science and engineering; and

(v) provide, as appropriate, on a competitive, merit-reviewed basis, access for researchers in industries in the United States, institutions of higher education, National Laboratories, and other Federal agencies to the exascale computing systems developed pursuant to clause (i).

(B) SELECTION OF PARTNERS.—The Secretary shall select the partnerships with the computing facilities of the Department under subparagraph (A) through a competitive, peer-review process.

(3) CODESIGN AND APPLICATION DEVELOPMENT.—

(A) IN GENERAL.—The Secretary shall—

(i) carry out the Program through an integration of applications, computer science, applied mathematics, and computer hardware architecture using the partnerships established pursuant to paragraph (2) to ensure that, to the maximum extent practicable, two or more exascale computing machine architectures are capable of solving Department target applications and broader scientific problems, including predictive modeling and simulation, large scale data analytics and management, and artificial intelligence; and

(ii) conduct outreach programs to increase the readiness for the use of such platforms by domestic industries, including manufacturers.

(B) REPORT.—(i) The Secretary shall submit to Congress a report describing how the integration under subparagraph (A) is furthering application science data and computational workloads across application interests, including national security, material science, physical science, cybersecurity, biological science, the Materials Genome and BRAIN Initiatives of the President, advanced manufacturing, and the national electric grid.

(ii) The roles and responsibilities of National Laboratories and industry, including the definition of the roles and responsibilities within the Department to ensure an integrated program across the Department.

(4) PROJECT REVIEW.—

(A) IN GENERAL.—The exascale architectures developed pursuant to partnerships established pursuant to paragraph (2) shall be reviewed through a project review process.

(B) REPORT.—Not later than 90 days after the date of enactment of this subsection, the Secretary shall submit to Congress a report on—

(i) the results of the review conducted under subparagraph (A); and

(ii) the coordination and management of the Program to ensure an integrated research program across the Department.

(5) ANNUAL REPORTS.—At the time of the budget submission of the Department for each fiscal year, the Secretary, in consultation with the members of the partnerships established pursuant to paragraph (2), shall submit to Congress a report that describes funding for the Program as a whole by functional element of the Department and critical milestones.

ATOMIC ENERGY ACT OF 1954

TITLE I—ATOMIC ENERGY

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CHAPTER 4. RESEARCH

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SEC. 33. RESEARCH FOR OTHERS.—*In this section, with respect to international research projects, the term "private facilities or laboratories" means facilities or laboratories located in the United States.* Where the Commission finds private facilities or laboratories are inadequate to the purpose, it is authorized to conduct for other persons, through its own facilities, such of those activities and studies of the types specified in section 31 as it deems appropriate to the development of atomic energy. To the extent the Commission determines that private facilities or laboratories are inadequate to the purpose, and that the Commission's facilities, or scientific or technical resources have the potential of lending significant assistance to other persons in the fields of protection of public health and safety, the Commission may also assist other persons in these fields by conducting for such persons, through the Commission's own facilities, research and development or training activities and studies. The Commission is authorized to determine and make such

charges as in its discretion may be desirable for the conduct of the activities and studies referred to in this section.

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