DEPARTMENT OF ENERGY SCIENCE FOR THE FUTURE ACT OF 2022

Section-by-Section

Sec. 1. Short Title.

This sections provides the short title for the bill as "Department of Energy Science for the Future Act of 2022."

Sec. 2. Mission of the Office of Science.

This section amends the Department of Energy Organization Act (42 U.S.C. 7139) by authorizing the Director of the Office of Science to carry out the construction, operation, and maintenance of user facilities to support the mission of the Office of Science. This section also authorizes the Secretary of Energy to coordinate the activities of the Office of Science with other offices of the Department and other federal agencies—for the purpose of enabling development of mission-relevant technologies. This section also requires all Office of Science programs to complete a future planning roadmap consistent with this Act.

Sec. 3. Basic Energy Sciences Program.

Subsection (a) amends the Department of Energy Research and Innovation Act (42 U.S.C. 18641) by authorizing a research and development program in basic energy sciences, including materials sciences and engineering, chemical sciences, physical biosciences, geosciences, and other disciplines to provide the foundations for new energy technologies. This subsection authorizes sustainable chemistry research. It authorizes upgrades and related improvements to multiple user facilities, including: the Advanced Photon Source; the Spallation Neutron Source; the Advanced Light Source; the Linac Coherent Light Source II; the Cryomodule Repair and Maintenance Facility; the Nanoscale Science Research Center; and the National Synchrotron Light Source II. This subsection authorizes computational material and chemical sciences research and development, including up to six centers. It authorizes development of a materials research database. This subsection authorizes: $2,877,705,000 for fiscal year (FY) 2022; $2,978,896,600 for FY 2023; $3,169,489,612 for FY 2024; $3,311,698,885 for FY 2025; and $3,441,651,600 for FY 2026 for the Basic Energy Sciences Program.

Subsection (b) amends section 973 of the Energy Policy Act of 2005 (42 U.S.C. 16313) by authorizing $50,000,000 per year for FY 2022 through FY 2026 to support basic research in artificial photosynthesis and $50,000,000 per year for FY 2022 through FY 2026 to support basic research in biochemistry, replication of natural photosynthesis, and related processes. It removes the existing statutory prohibition on the use of funds for commercial application of energy technology.

Subsection (c) amends section 975 of the Energy Policy Act of 2005 (42 U.S.C. 16315) by authorizing basic research and development activities to ensure U.S. competitiveness in energy storage. This subsection authorizes $50,000,000 per year for FY 2022 through FY 2026 to support basic research in multivalent ion materials in electric energy storage systems, $50,000,000 per year for FY 2022 through FY 2026 to support electrochemistry modeling and

simulation, and $20,000,000 per year for FY 2022 through FY 2026 to support mesoscale electrochemistry. It removes the existing statutory prohibition on the use of funds for commercial application of energy technology.

Subsection (d) authorizes the Director of the Office of Science to support a program of basic research and development to bridge scientific barriers to expand knowledge relevant to nuclear matter for the benefit of commerce, medicine, and national security. This subsection authorizes $50,000,000 for each FY 2022 through FY 2026.

Subsection (e) establishes a "Carbon Materials Research Initiative" to expand fundamental knowledge of coal and carbon ore chemistry which includes a basic research program and the establishment of a research center in each of the two major coal-producing regions of the United States. This subsection authorizes $50,000,000 for each FY 2022 through FY 2026.

Subsection (f) establishes a "Carbon Oxide Sequestration Research and Geologic Computing Initiative" to expand fundamental knowledge, data collection, data analysis, and modelling of subsurface geology to advance understanding of carbon oxide sequestration in geologic formations. This section includes a basic research program and the establishment of at least two carbon oxide storage research and geologic computing centers. This subsection authorizes $50,000,000 for each FY 2022 through FY 2026.

Sec. 4. Biological and Environmental Research.

Subsection (a) amends section 306 of the Department of Energy Research and Innovation Act (42 U.S.C. 18644) by authorizing a research and development program in biological systems science and climate and environment science relevant to the development of new energy technologies for the energy, environment, and national security missions of the Department. The subsection authorizes biological systems activities in genomic science, including fundamental research on plants and microbes, and biomolecular characterization and imaging science.

Subsection (b) amends section 306(e)(8) of the Department of Energy Research and Innovation Act (42 U.S.C. 18644(e)(8)) by authorizing $50,000,000 for FY 2025 and $60,000,000 for FY 2026 for the Low-Dose Radiation Research Program.

Subsection (c) directs the Secretary to carry out a basic research program on the similarities and differences between the effects of exposure to low-dose radiation on Earth, in low Earth orbit, and in the space environment, in coordination with the Administrator of the National Aeronautics and Space Administration.

Subsection (d) amends section 306 of the Department of Energy Research and Innovation Act (42 U.S.C. 18644) by authorizing the Director of the Office of Science to carry out earth and environmental systems science research in consultation with the National Oceanic and Atmospheric Administration (NOAA). It also directs the development, construction, operation, and maintenance of user facilities to enhance the collection and analysis of observational data related to complex biological, climate, and environmental systems, including a microbial molecular phenotyping capability, and to carry out a research program, in consultation with NOAA and other federal agencies, to enhance the understanding of coastal ecosystems. The

subsection also directs the Secretary to establish an initiative focused on the development of engineered ecosystems within the Biological and Environmental Research program. The subsection authorizes: $880,360,000 for FY 2022; $946,385,200 for FY 2023; $1,016,332,164 for FY 2024; $1,090,475,415 for FY 2025; and $1,169,108,695 for FY 2026 for the Biological and Environmental Research Program.

Subsection (e) authorizes up to six bioenergy research centers to conduct fundamental research in plant and microbial systems biology, biological imaging and analysis, and genomics, and to accelerate advanced research and development of advanced biofuels, bioenergy or biobased materials, chemicals, and products that are produced from a variety of regionally diverse feedstocks, and to facilitate the translation of research results to industry.

Sec. 5. Advanced Scientific Computing Research Program.

Subsection (a) amends section 304 of the Department of Energy Research and Innovation Act (42 U.S.C. 18642) by authorizing a program to steward applied mathematics, computational science, and computer science research relevant to the mission of the Department. Within that program the subsection includes provisions for applied mathematics and software development for high-end computing systems and computer sciences research, an advanced computing program, guidance on mitigation of bias in high-performance computing capabilities, architectural research in heterogeneous computing systems, an energy efficient computing program, and upgrades to the energy science network user facility. Subsection (a) also authorizes a computational science graduate fellowship program. Subsection (a) authorizes: $1,126,350,000 for FY 2022; $1,222,674,500 for FY 2023; $1,324,320,715 for FY 2024; $1,431,660,115 for FY 2025; and $1,535,090,121 for FY 2026 for the Advanced Scientific Computing Research Program.

Subsection (b) authorizes a research, development, and demonstration program to accelerate innovation to support quantum network infrastructure and authorizes $100,000,000 per year for FY 2022 through FY 2026 for this program. It also directs the Secretary to establish a Quantum User Expansion for Science and Technology program (QUEST) to encourage and facilitate access to the United States quantum computing hardware and clouds for research purposes. The subsection authorizes: $30,000,000 for FY 2022; $50,000,000 for FY 2023; $70,000,000 for FY 2024; $90,000,000 for FY 2025; and $100,000,000 for FY 2026 for the QUEST program.

Sec. 6. Fusion Energy Research.

Subsection (a) amends section 307 of the Department of Energy Research and Innovation Act (42 U.S.C. 18645) by authorizing $50,000,000 per year for FY 2022 through FY 2026 for research and development of fusion materials. It extends the authorization for inertial fusion research and development, the innovation network for fusion energy, the milestone-based development program through FY 2026. It directs the construction of the Material Plasma Exposure Experiment including, $32,800,000 for FY 2022; $13,400,000 for FY 2023; $12,600,000 for FY 2024; and $400,000 for FY 2025 to carry out the project. The subsection also authorizes an upgrade to the Matter in Extreme Conditions endstation at the Linac Coherent Light Source, including $1,000,000,000 for FY 2026 for the endstation.

Subsection (b) amends section 972 of the Energy Policy Act of 2005 (42 U.S.C. 16312) by authorizing $281,000,000 for FY 2026 for construction of the ITER international fusion project.

Sec. 7. High Energy Physics Program.

Subsection (a) amends section 305 of the Department of Energy Research and Innovation Act (42 U.S.C. 18643) by authorizing a research program in elementary particle physics and associated advanced technology research and development to improve the understanding of the fundamental properties of the universe, including constituents of matter and energy and the nature of space and time.

Subsection (b) amends section 305(d) of the Department of Energy Research and Innovation Act (42 U.S.C. 18634(d)) by authorizing the Director of the Office of Science to ensure the participation of the United States in international efforts related to the Large Hadron Collider, encourage international participation in the Long-Baseline Neutrino Facility and Deep Underground Neutrino Experiment, and prioritize engagement in future international facilities.

Subsection (c) amends section 305(f) of the Department of Energy Research and Innovation Act (42 U.S.C. 18645(f)) by authorizing research to understand the nature of the universe and authorizes collaboration with other federal agencies and international partners.

Subsection (d) amends section 305 of the Department of Energy Research and Innovation Act (42 U.S.C. 18645) by authorizing the construction of major facilities and items of equipment, including: the Long-Baseline Neutrino Facility; the Proton Improvement Plan-II Accelerator Upgrade; and the Cosmic Microwave Background Stage 4 project. It also authorizes accelerator and detector upgrades and research and development, and a program to conduct scientific research in underground facilities. Subsection (d) authorizes: $1,355,690,000 for FY 2022; $1,517,628,300 for FY 2023; $1,652,112,281 for FY 2024; $1,711,460,141 for FY 2025; and $1,656,012,351 for FY 2026 for the High Energy Physics Program.

Sec. 8. Nuclear Physics Program.

Amends section 308 of the Department of Energy Research and Innovation Act (42 U.S.C. 18646) by authorizing a research program to discover and understand various forms of nuclear matter. It authorizes $2,000,000 for FY 2022 to complete construction of the Facility for Rare Isotope Beams. It authorizes construction of the Electron-Ion Collider, including: $101,000,000 for FY 2022; $155,000,000 for FY 2023; $250,000,000 for FY 2024; $300,000,000 for FY 2025; and $305,000,000 for FY 2026. The subsection authorizes: $780,000,000 for FY 2022; $879,390,000 for FY 2023; $1,025,097,300 for FY 2024; $1,129,354,111 for FY 2025; and $1,192,408,899 for FY 2026 for the Nuclear Physics Program.

Sec. 9. Science Laboratories Infrastructure Program.

Amends section 309 of the Department of Energy Research and Innovation Act (42 U.S.C. 18647) by authorizing the Director of the Office of Science to employ all available approaches and funding mechanisms to address science laboratory infrastructure needs. This section authorizes the Secretary to fund projects needed to address deferred maintenance, critical

infrastructure needs, and modernization of Office of Science National Laboratories. It directs the Secretary to report annually on the list of projects for which the Secretary will provide funding under this section, including a description of each project and the funding profile for the project. The section authorizes $600,000,000 per year for FY 2022 through FY 2026 for the Science Laboratory Infrastructure Program.

Sec. 10. Accelerator Research and Development.

Amends the Department of Energy Research and Innovation Act (42 U.S.C. 18601 et seq.) by authorizing a program to advance particle accelerator science and technology of relevance to the mission of the Department; foster partnerships to develop, demonstrate, and enable the commercial application of such technologies; support associated workforce development activities; and provide access to accelerator design and engineering resources. The section authorizes: $24,000,000 for FY 2022; $25,680,000 for FY 2023; $27,477,600 for FY 2024; $29,401,032 for FY 2025; and $31,459,104 for FY 2026.

Sec. 11. Isotope Research, Development, and Production.

Subsection (a) amends the Department of Energy Research and Innovation Act (42 U.S.C. 18601 et seq.) by authorizing a program to produce isotopes that are needed and of sufficient quality for research, medical, industrial, and related purposes. It also advances isotope production methods and techniques by maintaining and enhancing associated infrastructure and conducting research into new production and processing techniques. This subsection authorizes the Director of the Office of Science to carry out activities to reduce dependence on the foreign supply of critical radioactive and stable isotopes, ensure isotope production activities meet the needs of end-users, and do not interfere with private sector efforts to produce isotopes. It authorizes the establishment of an Isotope Program Advisory Committee and requires reports for meeting the nation's isotope needs. The subsection authorizes: $90,000,000 for FY 2022; $96,300,000 for FY 2023; $103,041,000 for FY 2024; $110,253,870 for FY 2025; and $117,971,641 for FY 2026.

Subsection (b) amends section 952(a) of the Energy Policy Act of 2005 (42 U.S.C. 16272(a)) by establishing an isotope demonstration program to support the development and commercial demonstration of critical radioactive and stable isotope production in existing commercial nuclear power plants.

Subsection (c) authorizes the constructions of a radioisotope processing facility to provide for the growing radiochemical processing capability needs associated with the production of critical radioactive isotopes. The subsection authorizes $375,000,000 for the period of FY 2022 through FY 2026.

Subsection (d) authorizes the establishment of a stable isotope production and research center to expand the ability of the United States to perform multiple stable isotope production campaigns at large-scale production, as authorized under section 311 of the Department of Energy Research and Innovation Act. The subsection authorizes $250,000,000 for the period of FY 2022 through FY 2026.

Sec. 12. Increased Collaboration with Teachers and Scientists.

Subsection (a) amends the Department of Energy Research and Innovation Act (42 U.S.C. 18601 et seq.) by authorizing the Director of the Office of Science to support the development of a scientific workforce. It authorizes programs that foster collaboration between teachers at elementary schools and secondary schools, students and faculty at institutions of higher education, early-career researchers, and the National Laboratories. This section authorizes the use of proven techniques to expand the number of individuals from underrepresented groups pursuing and attaining skills or undergraduate and graduate degrees relevant to the mission of the Office of Science.

Subsection (b) authorizes $40,000,000 per year for FY 2022 through FY 2026 to support the activities of this section.

Subsection (c) amends the Department of Energy Science Education Enhancement Act by authorizing the Secretary to expand opportunities to increase the number of highly skilled science, technology, engineering, and mathematics (STEM) professionals working in disciplines relevant to the mission of the Department, including by broadening the recruitment pool to increase participation of underrepresented groups. The Secretary is further directed to report to Congress on the Department's plan associated with this authorization. Of the funds authorized under this section, not less than $2,000,000 per year is authorized to carry out these activities.

Sec. 13. High intensity laser research initiative; Helium conservation program; Office of Science Emerging Biological Threat Preparedness Research Initiative; Midscale Instrumentation and Research Equipment Program; Authorization of Appropriations.

This section amends the Department of Energy Research and Innovation Act (42 U.S.C. 18601 et seq.) (as amended by section 12(a) of the bill) by adding the following sections:

Sec. 313 authorizes the Director of the Office of Science to establish a high intensity laser research initiative. The subsection authorizes $50,000,000 for FY 2022; $100,000,000 for FY 2023; $150,000,000 for FY 2024; $200,000,000 for FY 2025; and $250,000,000 for FY 2026.

Sec. 314 authorizes the Secretary to establish a program to reduce the consumption of helium for Department grant recipients and facilities and encourage helium recycling and reuse.

Sec. 315 authorizes the Secretary to establish a cross-cutting research initiative, to be known as the 'Emerging Biological Threat Preparedness Research Initiative', to aid efforts to prevent, prepare for, predict, and respond to emerging natural and anthropogenic biological threats to national security. It authorizes the Secretary to leverage the innovative analytical resources and tools, user facilities, and advanced computational and networking capabilities of the Department as necessary for the purposes of this initiative. This section authorizes $50,000,000 per year for FY 2022 and 2023 and such sums as are necessary for FY 2024 through FY 2026.

Sec. 316 authorizes the Director of the Office of Science to establish a midscale instrumentation and research equipment program to develop, acquire, and commercialize research instrumentation and equipment in the $1,000,000 to $20,000,000 range needed to meet the

Department's mission and to provide platform technologies for the broader scientific community. This section authorizes $150,000,000 per year for FY 2022 through 2026.

Sec. 317 authorizes $8,451,905,000 for FY 2022; $9,035,354,600 for FY 2023; $9,705,470,672 for FY 2024; $10,259,703,569 for FY 2025; and $12,049,702,411 for FY 2026 for the Office of Science.

Sec. 14. Established Program to Stimulate Competitive Research (EPSCoR).

This section amends section 2203(b)(3) of the Energy Policy Act of 1992 (42 U.S.C. 3503(b)(3)) to expand DOE's EPSCoR program and improve its integration with Office of Science programs. It expands activities to improve the research capacity and capabilities at universities in EPSCoR states, including with scholarships and fellowships, grants for early career faculty, and funding to institutions to support collaboration and expertise-building. The section authorizes: $75,000,000 for FY 2022; $75,000,000 for FY 2023; $100,000,000 for FY 2024; $100,000,000 for FY 2025; and $150,000,000 for FY 2026 to support the activities authorized under this section. Additionally, this section authorizes $50,000,000 per year for FY 2022 through FY 2026 for research instrumentation and equipment that range in cost from $500,000 to $20,000,000.

This section requires that not less than 10 percent of the university research and developments funds awarded by the Office of Science be awarded to institutions in EPSCoR states to further enhance their participation in and contributions to Office of Science programs. To further improve coordination, the Undersecretary for Science is directed to ensure robust participation of representatives from EPSCoR universities on Office of Science Advisory Committees. The Department is required to submit to the appropriate committees of Congress its plan for implementing the activities authorized in this section and to provide an annual evaluation report.

Sec. 15. Research Security.

This section directs the Secretary to develop and maintain tools and processes to manage and mitigate research security risks associated with any research, development, demonstration, or deployment activities authorized under this Act, such as a science and technology risk matrix, informed by threats identified by the Director of the Office of Intelligence and Counterintelligence, to facilitate determinations of the risk of loss of United States intellectual property or threat to the national security of the United States. It also imposes penalties on funding recipients which knowingly violate the protocols established to mitigate research security risks.