

Suspend the Rules and Pass the Bill, H.R. 3593, With an Amendment

(The amendment strikes all after the enacting clause and inserts a new text)

117TH CONGRESS
1ST SESSION

H. R. 3593

To provide guidance for and investment in the research and development activities of the Department of Energy Office of Science, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

MAY 28, 2021

Ms. JOHNSON of Texas (for herself, Mr. LUCAS, Mr. BOWMAN, and Mr. WEBER of Texas) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

A BILL

To provide guidance for and investment in the research and development activities of the Department of Energy Office of Science, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the “Department of Energy
5 Science for the Future Act”.

1 **SEC. 2. MISSION OF THE OFFICE OF SCIENCE.**

2 Section 209 of the Department of Energy Organiza-
3 tion Act (42 U.S.C. 7139) is amended by adding at the
4 end the following:

5 “(d) **USER FACILITIES.**—The Director shall carry
6 out the construction, operation, and maintenance of user
7 facilities to support the mission described in subsection
8 (c). As practicable, these facilities shall serve the needs
9 of the Department, industry, the academic community,
10 and other relevant entities for the purposes of advancing
11 the missions of the Department, improving the competi-
12 tiveness of the United States, protecting public health and
13 safety, and addressing other national priorities including
14 emergencies.

15 “(e) **COORDINATION.**—

16 “(1) **IN GENERAL.**—The Secretary—

17 “(A) shall ensure the coordination of the
18 Office of Science with the other activities of the
19 Department;

20 “(B) shall support joint activities among
21 the programs of the Department;

22 “(C) shall coordinate with other relevant
23 Federal agencies in supporting advancements in
24 related research areas as appropriate; and

1 “(D) may form partnerships to enhance
2 the utilization of and ensure access to user fa-
3 cilities by other Federal agencies.

4 “(2) OFFICE OF SCIENCE.—The Director—

5 “(A) shall ensure the coordination of pro-
6 grams and activities carried out by the Office of
7 Science; and

8 “(B) shall direct all programs which have
9 not recently completed a future planning road-
10 map consistent with the funding of such pro-
11 grams authorized under the Department of En-
12 ergy Science for the Future Act to complete
13 such a roadmap.”.

14 **SEC. 3. BASIC ENERGY SCIENCES PROGRAM.**

15 (a) DEPARTMENT OF ENERGY RESEARCH AND INNO-
16 VATION ACT.—Section 303 of the Department of Energy
17 Research and Innovation Act (42 U.S.C. 18641) is amend-
18 ed—

19 (1) by redesignating subsections (a) through (e)
20 as subsections (c) through (g), respectively; and

21 (2) by inserting before subsection (c), as so re-
22 designated, the following:

23 “(a) PROGRAM.—As part of the activities authorized
24 under section 209 of the Department of Energy Organiza-
25 tion Act (42 U.S.C. 7139), the Director shall carry out

1 a research and development program in basic energy
2 sciences, including materials sciences and engineering,
3 chemical sciences, physical biosciences, geosciences, and
4 other disciplines, to understand, model, and control matter
5 and energy at the electronic, atomic, and molecular levels
6 in order to provide the foundations for new energy tech-
7 nologies, address scientific grand challenges, and support
8 the energy, environment, and national security missions
9 of the Department.

10 “(b) SUSTAINABLE CHEMISTRY.—In carrying out
11 chemistry-related research and development activities
12 under this section, the Director shall prioritize research
13 and development of sustainable chemistry to support
14 clean, safe, and economic alternatives and methodologies
15 to traditional chemical products and processes.”;

16 (3) in subsection (d), as so redesignated—

17 (A) in paragraph (3)—

18 (i) subparagraph (C), by striking
19 “and” at the end;

20 (ii) by redesignating subparagraph
21 (D) as subparagraph (E); and

22 (iii) by inserting after subparagraph
23 (C) the following:

24 “(D) autonomous chemistry and materials
25 synthesis and characterization facilities that le-

1 verage advances in artificial intelligence; and”;
2 and

3 (B) by adding at the end the following:

4 “(4) ADVANCED PHOTON SOURCE UPGRADE.—

5 “(A) DEFINITIONS.—In this paragraph:

6 “(i) FLUX.—The term ‘flux’ means
7 the rate of flow of photons.

8 “(ii) HARD X-RAY.—The term ‘hard
9 x-ray’ means a photon with energy greater
10 than 20 kiloelectron volts.

11 “(B) IN GENERAL.—The Secretary shall
12 provide for the upgrade to the Advanced Pho-
13 ton Source described in the publication ap-
14 proved by the Basic Energy Sciences Advisory
15 Committee on June 9, 2016, titled ‘Report on
16 Facility Upgrades’, including the development
17 of a multi-bend achromat lattice to produce a
18 high flux of coherent x-rays within the hard x-
19 ray energy region and a suite of beamlines opti-
20 mized for this source.

21 “(C) START OF OPERATIONS.—The Sec-
22 retary shall, subject to the availability of appro-
23 priations, ensure that the start of full oper-
24 ations of the upgrade under this paragraph oc-
25 curs before March 31, 2026.

1 “(D) FUNDING.—Out of funds authorized
2 to be appropriated under subsection (j), there
3 shall be made available to the Secretary to
4 carry out the upgrade under this paragraph
5 \$101,000,000 for fiscal year 2022 and
6 \$56,000,000 for fiscal year 2023.

7 “(5) SPALLATION NEUTRON SOURCE PROTON
8 POWER UPGRADE.—

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

12 “(B) PROTON POWER UPGRADE DE-
13 FINED.—For the purposes of this paragraph,
14 the term ‘proton power upgrade’ means the
15 Spallation Neutron Source power upgrade de-
16 scribed in—

17 “(i) the publication titled ‘Facilities
18 for the Future of Science: A Twenty-Year
19 Outlook’, published by the Office of
20 Science of the Department of Energy in
21 December, 2003;

22 “(ii) the publication titled ‘Four Years
23 Later: An Interim Report on Facilities for
24 the Future of Science: A Twenty-Year
25 Outlook’, published by the Office of

1 Science of the Department of Energy in
2 August, 2007; and

3 “(iii) the publication approved by the
4 Basic Energy Sciences Advisory Committee
5 on June 9, 2016, titled ‘Report on Facility
6 Upgrades’.

7 “(C) START OF OPERATIONS.—The Sec-
8 retary shall, subject to the availability of appro-
9 priations, ensure that the start of full oper-
10 ations of the upgrade under this paragraph oc-
11 curs before July 30, 2028, with the option for
12 early operation in 2025.

13 “(D) FUNDING.—Out of funds authorized
14 to be appropriated under subsection (j), there
15 shall be made available to the Secretary to
16 carry out the upgrade under this paragraph
17 \$49,800,000 for fiscal year 2022.

18 “(6) SPALLATION NEUTRON SOURCE SECOND
19 TARGET STATION.—

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

23 “(B) SECOND TARGET STATION DE-
24 FINED.—For the purposes of this paragraph,
25 the term ‘second target station’ means the

1 Spallation Neutron Source second target station
2 described in—

3 “(i) the publication titled, ‘Facilities
4 for the Future of Science: A Twenty-Year
5 Outlook’, published by the Office of
6 Science of the Department of Energy in
7 December, 2003;

8 “(ii) the publication titled, ‘Four
9 Years Later: An Interim Report on Facili-
10 ties for the Future of Science: A Twenty-
11 Year Outlook’, published by the Office of
12 Science of the Department of Energy in
13 August, 2007; and

14 “(iii) the publication approved by the
15 Basic Energy Sciences Advisory Committee
16 on June 9, 2016, titled ‘Report on Facility
17 Upgrades’.

18 “(C) START OF OPERATIONS.—The Sec-
19 retary shall, subject to the availability of appro-
20 priations, ensure that the start of full oper-
21 ations of the second target station under this
22 paragraph occurs before December 31, 2033,
23 with the option for early operation in 2029.

24 “(D) FUNDING.—Out of funds authorized
25 to be appropriated under subsection (j), there

1 shall be made available to the Secretary to
2 carry out the activities under this paragraph,
3 including construction—

4 “(i) \$70,000,000 for fiscal year 2022;

5 “(ii) \$127,000,000 for fiscal year
6 2023;

7 “(iii) \$204,000,000 for fiscal year
8 2024;

9 “(iv) \$279,000,000 for fiscal year
10 2025; and

11 “(v) \$300,000,000 for fiscal year
12 2026.

13 “(7) ADVANCED LIGHT SOURCE UPGRADE.—

14 “(A) DEFINITIONS.—In this paragraph:

15 “(i) FLUX.—The term ‘flux’ means
16 the rate of flow of photons.

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

20 “(B) IN GENERAL.—The Secretary shall
21 provide for the upgrade to the Advanced Light
22 Source described in the publication approved by
23 the Basic Energy Sciences Advisory Committee
24 on June 9, 2016, titled ‘Report on Facility Up-
25 grades’, including the development of a

1 multibend achromat lattice to produce a high
2 flux of coherent x-rays within the soft x-ray en-
3 ergy region.

4 “(C) START OF OPERATIONS.—The Sec-
5 retary shall, subject to the availability of appro-
6 priations, ensure that the start of full oper-
7 ations of the upgrade under this paragraph oc-
8 curs before September 30, 2029.

9 “(D) FUNDING.—Out of funds authorized
10 to be appropriated under subsection (j), there
11 shall be made available to the Secretary to
12 carry out the upgrade under this paragraph—

13 “(i) \$75,100,000 for fiscal year 2022;

14 “(ii) \$135,000,000 for fiscal year
15 2023;

16 “(iii) \$102,500,000 for fiscal year
17 2024;

18 “(iv) \$25,000,000 for fiscal year
19 2025; and

20 “(v) \$25,000,000 for fiscal year 2026.

21 “(8) LINAC COHERENT LIGHT SOURCE II HIGH
22 ENERGY UPGRADE.—

23 “(A) DEFINITIONS.—In this paragraph:

24 “(i) HIGH ENERGY X-RAY.—The term
25 ‘high energy x-ray’ means a photon with

1 an energy in the 5 to 13 kiloelectron volt
2 range.

3 “(ii) HIGH REPETITION RATE.—The
4 term ‘high repetition rate’ means the deliv-
5 ery of x-ray pulses up to 1 million pulses
6 per second.

7 “(iii) ULTRA-SHORT PULSE X-RAYS.—
8 The term ‘ultra-short pulse x-rays’ means
9 x-ray bursts capable of durations of less
10 than 100 femtoseconds.

11 “(B) IN GENERAL.—The Secretary shall—

12 “(i) provide for the upgrade to the
13 Linac Coherent Light Source II facility de-
14 scribed in the publication approved by the
15 Basic Energy Sciences Advisory Committee
16 on June 9, 2016, titled ‘Report on Facility
17 Upgrades’, including the development of
18 experimental capabilities for high energy x-
19 rays to reveal fundamental scientific dis-
20 coveries; and

21 “(ii) ensure such upgrade enables the
22 production and use of high energy, ultra-
23 short pulse x-rays delivered at a high rep-
24 etition rate.

1 “(C) START OF OPERATIONS.—The Sec-
2 retary shall, subject to the availability of appro-
3 priations, ensure that the start of full oper-
4 ations of the upgrade under this paragraph oc-
5 curs before December 31, 2026.

6 “(D) FUNDING.—Out of funds authorized
7 to be appropriated under subsection (j), there
8 shall be made available to the Secretary to
9 carry out the upgrade under this paragraph—

10 “(i) \$106,925,000 for fiscal year
11 2022;

12 “(ii) \$125,925,000 for fiscal year
13 2023;

14 “(iii) \$115,000,000 for fiscal year
15 2024;

16 “(iv) \$89,000,000 for fiscal year
17 2025; and

18 “(v) \$49,344,000 for fiscal year 2026.

19 “(9) CRYOMODULE REPAIR AND MAINTENANCE
20 FACILITY.—

21 “(A) IN GENERAL.—The Secretary shall
22 provide for the construction of a cryomodule re-
23 pair and maintenance facility to service the
24 Linac Coherent Light Source II and upgrades
25 to the facility. The Secretary shall consult with

1 the private sector, universities, National Lab-
2 oratories, and relevant Federal agencies to en-
3 sure that this facility has the capability to
4 maintain, repair, and test superconducting ra-
5 diofrequency accelerator components.

6 “(B) FUNDING.—Out of funds authorized
7 to be appropriated under subsection (j), there
8 shall be made available to the Secretary to
9 carry out the activities under this paragraph—

10 “(i) \$19,000,000 for fiscal year 2022;

11 “(ii) \$25,000,000 for fiscal year 2023;

12 “(iii) \$25,000,000 for fiscal year
13 2024; and

14 “(iv) \$17,000,000 for fiscal year
15 2025.

16 “(10) NANOSCALE SCIENCE RESEARCH CENTER
17 RECAPITALIZATION PROJECT.—

18 “(A) IN GENERAL.—The Secretary shall
19 provide for the recapitalization of the Nanoscale
20 Science Research Centers, to include the up-
21 grade of equipment at each Center supported
22 by the Office of Science on the date of enact-
23 ment of the Department of Energy Science for
24 the Future Act, to accelerate advances in the
25 various fields of science including nanoscience,

1 materials, chemistry, biology, and quantum in-
2 formation science.

3 “(B) FUNDING.—Out of funds authorized
4 to be appropriated under subsection (j), there
5 shall be made available to the Secretary to
6 carry out the recapitalization under this para-
7 graph—

8 “(i) \$20,000,000 for fiscal year 2022;

9 “(ii) \$30,000,000 for fiscal year 2023;

10 “(iii) \$20,000,000 for fiscal year
11 2024; and

12 “(iv) \$20,000,000 for fiscal year
13 2025.”; and

14 (4) by adding at the end the following:

15 “(h) COMPUTATIONAL MATERIALS AND CHEMICAL
16 SCIENCES.—

17 “(1) IN GENERAL.—The Director shall support
18 a program of research and development for the ap-
19 plication of advanced computing practices to
20 foundational and emerging research problems in
21 chemistry and materials science. Research activities
22 shall include—

23 “(A) chemical catalysis research and devel-
24 opment;

1 “(B) the use of large data sets to model
2 materials phenomena, including through ad-
3 vanced characterization of materials, materials
4 synthesis, processing, and innovative use of ex-
5 perimental and theoretical data;

6 “(C) co-design of chemical system and
7 chemistry modeling software with advanced
8 computing systems and hardware technologies;
9 and

10 “(D) modeling of chemical processes, as-
11 semblies, and reactions such as molecular dy-
12 namics and quantum chemistry, including
13 through novel computing methods.

14 “(2) COMPUTATIONAL MATERIALS AND CHEM-
15 ICAL SCIENCES CENTERS.—

16 “(A) IN GENERAL.—In carrying out the
17 activities authorized under paragraph (1), the
18 Director shall select and establish up to six
19 computational materials and chemical sciences
20 centers to—

21 “(i) develop open-source, robust, and
22 validated computational codes and user-
23 friendly software, coupled with innovative
24 use of experimental and theoretical data,
25 to enable the design, discovery, and devel-

1 opment of new materials and chemical sys-
2 tems; and

3 “(ii) focus on overcoming challenges
4 and maximizing the benefits of exascale
5 and other high performance computing
6 underpinned by accelerated node tech-
7 nologies.

8 “(B) SELECTION.—The Director shall se-
9 lect centers under subparagraph (A) on a com-
10 petitive, merit-reviewed basis. The Director
11 shall consider applications from the National
12 Laboratories, institutes of higher education,
13 multi-institutional collaborations, and other ap-
14 propriate entities.

15 “(C) DURATION.—

16 “(i) A center selected under subpara-
17 graph (A) shall receive support for a pe-
18 riod of not more than 5 years beginning on
19 the date of establishment of that center,
20 subject to the availability of appropria-
21 tions.

22 “(ii) A center already in existence on
23 the date of enactment of the Department
24 of Energy Science for the Future Act may
25 continue to receive support for a period of

1 not more than 5 years beginning on the
2 date of establishment of that center.

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

8 “(E) TERMINATION.—Consistent with the
9 existing authorities of the Department, the Di-
10 rector may terminate an underperforming cen-
11 ter for cause during the performance period.

12 “(i) MATERIALS RESEARCH DATABASE.—

13 “(1) IN GENERAL.—The Director shall support
14 the development of a web-based platform to develop
15 and provide access to a database of computed infor-
16 mation on known and predicted materials properties
17 and computational tools to accelerate breakthroughs
18 in materials discovery and design.

19 “(2) PROGRAM.—In carrying out this sub-
20 section, the Director shall—

21 “(A) conduct cooperative research with in-
22 dustry, academia, and other research institu-
23 tions to advance understanding, prediction, and
24 manipulation of materials and facilitate the de-
25 sign of novel materials;

1 “(B) develop and maintain data infrastruc-
2 ture at user facilities that generate data to col-
3 lect, analyze, label, and otherwise prepare the
4 data for inclusion in the database;

5 “(C) leverage existing high performance
6 computing systems to conduct high throughput
7 calculations, and develop computational and
8 data mining algorithms for the prediction of
9 material properties;

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

12 “(E) drive the development of advanced
13 materials for applications that span the Depart-
14 ment’s missions in energy, environment, and
15 national security.

16 “(3) COORDINATION.—In carrying out this sub-
17 section, the Director shall leverage programs and ac-
18 tivities across the Department, including computa-
19 tional materials and chemical sciences centers estab-
20 lished under subsection (h).

21 “(4) FUNDING.—Out of funds authorized to be
22 appropriated under subsection (j), there shall be
23 made available to the Secretary to carry out activi-
24 ties under this subsection \$10,000,000 for each of
25 the fiscal years 2022 through 2026.

1 “(j) AUTHORIZATION OF APPROPRIATIONS.—There
2 are authorized to be appropriated to the Secretary to carry
3 out the activities described in this section—

4 “(1) \$2,727,705,000 for fiscal year 2022;

5 “(2) \$2,828,896,600 for fiscal year 2023;

6 “(3) \$3,019,489,612 for fiscal year 2024;

7 “(4) \$3,161,698,885 for fiscal year 2025; and

8 “(5) \$3,291,651,600 for fiscal year 2026.”.

9 (b) ARTIFICIAL PHOTOSYNTHESIS.—Section 973 of
10 the Energy Policy Act of 2005 (42 U.S.C. 16313) is
11 amended—

12 (1) in subsection (b), by striking paragraph (4)
13 and inserting:

14 “(4) FUNDING.—From within funds authorized
15 to be appropriated for Basic Energy Sciences, the
16 Secretary shall make available for carrying out ac-
17 tivities under this subsection \$50,000,000 for each
18 of fiscal years 2022 through 2026.”; and

19 (2) in subsection (c), by striking paragraph (4)
20 and inserting:

21 “(4) FUNDING.—From within funds authorized
22 to be appropriated in section 316 of the Department
23 of Energy Research and Innovation Act, the Sec-
24 retary shall make available for carrying out activities

1 under this subsection \$50,000,000 for each of fiscal
2 years 2022 through 2026.”.

3 (c) ELECTRICITY STORAGE RESEARCH INITIATIVE.—
4 Section 975 of the Energy Policy Act of 2005 (42
5 U.S.C.16315) is amended—

6 (1) in subsection (b), by striking paragraph (4)
7 and inserting:

8 “(4) FUNDING.—From within funds authorized
9 to be appropriated for Basic Energy Sciences, the
10 Secretary shall make available for carrying out ac-
11 tivities under this subsection \$50,000,000 for each
12 of fiscal years 2022 through 2026.”;

13 (2) in subsection (c), by striking paragraph (4)
14 and inserting:

15 “(4) FUNDING.—From within funds authorized
16 to be appropriated in section 316 of the Department
17 of Energy Research and Innovation Act, the Sec-
18 retary shall make available for carrying out activities
19 under this subsection \$50,000,000 for each of fiscal
20 years 2022 through 2026.”; and

21 (3) in subsection (d), by striking paragraph (4)
22 and inserting:

23 “(4) FUNDING.—From within funds authorized
24 to be appropriated in section 316 of the Department
25 of Energy Research and Innovation Act, the Sec-

1 retary shall make available for carrying out activities
2 under this subsection \$20,000,000 for each of fiscal
3 years 2022 through 2026.”.

4 **SEC. 4. BIOLOGICAL AND ENVIRONMENTAL RESEARCH.**

5 (a) PROGRAM; BIOLOGICAL SYSTEMS; BIOMOLEC-
6 ULAR CHARACTERIZATION AND IMAGING SCIENCE.—Sec-
7 tion 306 of the Department of Energy Research and Inno-
8 vation Act (42 U.S.C. 18644) is amended—

9 (1) by striking subsection (a) and inserting the
10 following:

11 “(a) PROGRAM.—As part of the duties of the Director
12 authorized under section 209 of the Department of En-
13 ergy Organization Act (42 U.S.C. 7139), and coordinated
14 with the activities authorized under sections 303 and 304
15 of this Act, the Director shall carry out a program of re-
16 search and development in the areas of biological systems
17 science and climate and environmental science, including
18 subsurface science, relevant to the development of new en-
19 ergy technologies and to support the energy, environ-
20 mental, and national security missions of the Department.

21 “(b) BIOLOGICAL SYSTEMS.—The Director shall
22 carry out research and development activities in genomic
23 science including fundamental research on plants and mi-
24 crobes to increase systems-level understanding of the com-
25 plex biological systems, which may include activities to—

1 “(1) accelerate breakthroughs and new knowl-
2 edge that would enable the cost-effective, sustainable
3 production of—

4 “(A) biomass-based liquid transportation
5 fuels;

6 “(B) bioenergy; and

7 “(C) biobased materials from renewable
8 biomass;

9 “(2) improve fundamental understanding of
10 plant and microbial processes impacting the global
11 carbon cycle, including processes for removing car-
12 bon dioxide from the atmosphere, through photosyn-
13 thesis and other biological processes, for sequestra-
14 tion and storage;

15 “(3) understand the microbiome mechanisms
16 used to transform, immobilize, or remove contami-
17 nants from subsurface environments;

18 “(4) develop the computational approaches and
19 integrated platforms for open access collaborative
20 science;

21 “(5) leverage tools and approaches across the
22 Office of Science to expand research to include novel
23 processes, methods, and science to develop bio-based
24 chemicals, polymers, inorganic materials, including
25 research to—

1 “(A) advance biosystems design research
2 to advance the understanding of how CRISPR
3 tools and other gene editing tools and tech-
4 nologies work in nature, in the laboratory, and
5 in practice;

6 “(B) deepen genome-enabled knowledge of
7 root architecture and growth in crops, including
8 trees; and

9 “(C) develop biosystems design methods
10 and tools to increase the efficiency of photosyn-
11 thesis in plants; and

12 “(6) develop other relevant methods and proc-
13 esses as determined by the Director.

14 “(c) BIOMOLECULAR CHARACTERIZATION AND IMAG-
15 ING SCIENCE.—The Director shall carry out research and
16 development activities in biomolecular characterization
17 and imaging science, including development of integrative
18 imaging and analysis platforms and biosensors to under-
19 stand the expression, structure, and function of genome
20 information encoded within cells and for real-time meas-
21 urements in ecosystems and field sites of relevance to the
22 mission of the Department of Energy.”; and

23 (2) by redesignating subsections (b) through (d)
24 as subsections (d) through (f), respectively.

1 (b) BIOENERGY RESEARCH CENTERS.—Section
2 977(f) of the Energy Policy Act of 2005 (42 U.S.C.
3 16317(f)) is amended to read as follows:

4 “(f) BIOENERGY RESEARCH CENTERS.—

5 “(1) IN GENERAL.—In carrying out the pro-
6 gram under section 306(a) of the Department of
7 Energy Research and Innovation Act (42 U.S.C.
8 18644(a)), the Director shall support up to six bio-
9 energy research centers to conduct fundamental re-
10 search in plant and microbial systems biology, bio-
11 logical imaging and analysis, and genomics, and to
12 accelerate advanced research and development of
13 biomass-based liquid transportation fuels, bioenergy,
14 or biobased materials, chemicals, and products that
15 are produced from a variety of regionally diverse
16 feedstocks, and to facilitate the translation of re-
17 search results to industry. The activities of the cen-
18 ters authorized under this subsection may include—

19 “(A) accelerating the domestication of bio-
20 energy-relevant plants, microbes, and associated
21 microbial communities to enable high-impact,
22 value-added coproduct development at multiple
23 points in the bioenergy supply chain;

24 “(B) developing the science and techno-
25 logical advances to ensure process sustainability

1 is considered in the creation of biofuels and bio-
2 products from lignocellulose; and

3 “(C) using the latest tools in genomics,
4 molecular biology, catalysis science, chemical
5 engineering, systems biology, and computational
6 and robotics technologies to sustainably produce
7 and transform biomass into biofuels and bio-
8 products.

9 “(2) SELECTION AND DURATION.—

10 “(A) IN GENERAL.—A center established
11 under paragraph (1) shall be selected on a com-
12 petitive, merit-reviewed basis for a period of not
13 more than 5 years, subject to the availability of
14 appropriations, beginning on the date of estab-
15 lishment of that center.

16 “(B) APPLICATIONS.—The Director shall
17 consider applications from National Labora-
18 tories, multi-institutional collaborations, and
19 other appropriate entities.

20 “(C) EXISTING CENTERS.—A center al-
21 ready in existence on the date of enactment of
22 the Department of Energy Science for the Fu-
23 ture Act may continue to receive support for a
24 period of not more than 5 years beginning on
25 the date of establishment of that center.

1 “(3) RENEWAL.—After the end of either period
2 described in paragraph (2), the Director may renew
3 support for the center for a period of not more than
4 5 years on a merit-reviewed basis. For a center in
5 operation for 10 years after its previous selection on
6 a competitive, merit-reviewed basis, the Director
7 may renew support for the center on a competitive,
8 merit-reviewed basis for a period of not more than
9 5 years, and may subsequently provide an additional
10 renewal on a merit-reviewed basis for a period of not
11 more than 5 years.

12 “(4) TERMINATION.—Consistent with the exist-
13 ing authorities of the Department, the Director may
14 terminate an underperforming center for cause dur-
15 ing the performance period.

16 “(5) ACTIVITIES.—Centers shall undertake re-
17 search activities to accelerate the production of
18 biofuels and bioproducts from advanced biomass re-
19 sources by identifying the most suitable species of
20 plants for use as energy crops; and improving meth-
21 ods of breeding, propagation, planting, producing,
22 harvesting, storage and processing. Activities may
23 include the following:

24 “(A) Research activities to increase sus-
25 tainability, including—

1 “(i) advancing knowledge of how bio-
2 energy crop interactions with biotic and
3 abiotic environmental factors influence
4 crop growth, yield, and quality;

5 “(ii) identifying the most impactful
6 research areas that address the economics
7 of biofuels and bioproducts production; and

8 “(iii) utilizing multiscale modeling to
9 advance predictive understanding of biofuel
10 cropping ecosystems.

11 “(B) Research activities to further feed-
12 stock development, including lignocellulosic,
13 algal, gaseous wastes including carbon oxides
14 and methane, and direct air capture of single
15 carbon gases via plants and microbes, includ-
16 ing—

17 “(i) developing genetic and genomic
18 tools, high-throughput analytical tools, and
19 biosystems design approaches to enhance
20 bioenergy feedstocks and their associated
21 microbiomes;

22 “(ii) conducting field testing of new
23 potential bioenergy feedstock crops under
24 environmentally benign and geographically

1 diverse conditions to assess viability and
2 robustness; and

3 “(iii) developing quantitative models
4 informed by experimentation to predict
5 how bioenergy feedstocks perform under
6 diverse conditions.

7 “(C) Research activities to improve
8 lignocellulosic deconstruction and separation
9 methods, including—

10 “(i) developing feedstock-agnostic
11 deconstruction processes capable of effi-
12 ciently fractionating biomass into targeted
13 output streams;

14 “(ii) gaining a detailed understanding
15 of plant cell wall biosynthesis, composition,
16 structure, and properties during
17 deconstruction; and

18 “(iii) improving enzymes and ap-
19 proaches for biomass breakdown and cel-
20 lulose, hemicellulose, and lignin processing.

21 “(D) Research activities to improve the
22 feedstock conversion process for advanced
23 biofuels and bioproducts, including—

24 “(i) developing high-throughput meth-
25 ods to screen or select high-performance

1 microbial strains and communities to im-
2 prove product formation rates, yields, and
3 selectivity;

4 “(ii) establishing a broad set of plat-
5 form microorganisms and microbial com-
6 munities suitable for metabolic engineering
7 to produce biofuels and bioproducts, as
8 well as high-throughput methods for exper-
9 imental validation of gene function;

10 “(iii) developing techniques to en-
11 hance microbial robustness for tolerating
12 toxins to improve biofuel and bioproduct
13 yields and to gain a better understanding
14 of the cellular and molecular bases of toler-
15 ance for major chemical classes of inhibi-
16 tors found in these processes;

17 “(iv) advancing technologies for the
18 use of batch, continuous, as well as con-
19 solidated bioprocessing;

20 “(v) identifying, creating, and opti-
21 mizing microbial and chemical pathways to
22 produce promising, atom-economical inter-
23 mediates and final bioproducts from bio-
24 mass with considerations given to environ-
25 mentally benign processes;

1 “(vi) developing high-throughput,
2 real-time, in situ analytical techniques to
3 understand and characterize the pre- and
4 post-bioproduct separation streams in de-
5 tail;

6 “(vii) creating methodologies for effi-
7 ciently identifying viable target molecules,
8 identifying high-value bioproducts in exist-
9 ing biomass streams, and utilizing current
10 byproduct streams;

11 “(viii) identifying and improving plant
12 feedstocks with enhanced extractable levels
13 of desired bioproducts or bioproduct pre-
14 cursors, including lignin streams; and

15 “(ix) developing integrated biological
16 and chemical catalytic approaches to
17 valorize and produce a diverse portfolio of
18 advanced fuels and bioproducts.

19 “(6) INDUSTRY PARTNERSHIPS.—Centers shall
20 establish industry partnerships to translate research
21 results to commercial applications.

22 “(7) COORDINATION.—In coordination with the
23 Bioenergy Technologies Office of the Department,
24 the Director shall support interdisciplinary research
25 activities to improve the capacity, efficiency, resil-

1 ience, security, reliability, and affordability, of the
2 production and use of biofuels and bioproducts, as
3 well as activities to enable positive impacts and avoid
4 the potential negative impacts that the production
5 and use of biofuels and bioproducts may have on
6 ecosystems, people, and historically marginalized
7 communities.”.

8 (c) LOW-DOSE RADIATION RESEARCH PROGRAM.—
9 Section 306(e)(8) of the Department of Energy Research
10 and Innovation Act (42 U.S.C. 18644(e)(8)), as redesi-
11 gnated under subsection (a), is amended—

12 (1) in subparagraph (C), by striking “and”;

13 (2) in subparagraph (D), by striking the period
14 at the end and inserting a semicolon; and

15 (3) by adding at the end the following:

16 “(E) \$40,000,000 for fiscal year 2025; and

17 “(F) \$50,000,000 for fiscal year 2026.”.

18 (d) LOW-DOSE RADIATION AND SPACE RADIATION
19 RESEARCH PROGRAM.—Section 306(f) of the Department
20 of Energy Research and Innovation Act (42 U.S.C.
21 18644(d)), as redesignated under subsection (a), is
22 amended to read as follows:

23 “(f) LOW-DOSE RADIATION AND SPACE RADIATION
24 RESEARCH PROGRAM.—

1 “(1) IN GENERAL.—The Secretary of Energy,
2 in consultation with the Administrator of the Na-
3 tional Aeronautics and Space Administration, shall
4 carry out a basic research program on the similar-
5 ities and differences between the effects of exposure
6 to low-dose radiation on Earth, in low Earth orbit,
7 and in the space environment.

8 “(2) PURPOSE.—The purpose of this program
9 is to accelerate breakthroughs in low-dose and low
10 dose-rate radiation research and development as de-
11 scribed in subsection (e) and to inform the advance-
12 ment of new tools, technologies, and advanced mate-
13 rials needed to facilitate long-duration space explo-
14 ration.”.

15 (e) CLIMATE, ENVIRONMENTAL SCIENCE, AND
16 OTHER ACTIVITIES.—Section 306 of the Department of
17 Energy Research and Innovation Act (42 U.S.C. 18644)
18 is further amended by adding at the end the following:

19 “(g) EARTH AND ENVIRONMENTAL SYSTEMS
20 SCIENCES ACTIVITIES.—

21 “(1) IN GENERAL.—As part of the activities au-
22 thorized under subsection (a), and in coordination
23 with activities carried out under subsection (b), the
24 Director shall carry out earth and environmental
25 systems science research, in consultation with the

1 National Oceanic and Atmospheric Administration
2 and other relevant agencies, which may include ac-
3 tivities to—

4 “(A) understand, observe, and model the
5 response of Earth’s atmosphere and biosphere
6 to increased concentrations of greenhouse gas
7 emissions and any associated changes in cli-
8 mate, including frequency and intensity of ex-
9 treme weather events;

10 “(B) understand the coupled physical,
11 chemical, and biological processes to transform,
12 immobilize, remove, or move carbon, nitrogen,
13 and other energy production-derived contami-
14 nants such as radionuclides and heavy metals,
15 and understand the process of sequestration
16 and transformation of these, carbon dioxide,
17 and other relevant molecules in subsurface envi-
18 ronments;

19 “(C) understand, observe, and model the
20 cycling of water, carbon, and nutrients in ter-
21 restrial systems and at scales relevant to re-
22 sources management;

23 “(D) understand the biological, biogeo-
24 chemical, and physical processes across the
25 multiple scales that control the flux of environ-

1 mentally relevant compounds between the ter-
2 restrial surface and the atmosphere; and

3 “(E) inform potential natural mitigation
4 and adaptation options for increased concentra-
5 tions of greenhouse gas emissions and any asso-
6 ciated changes in climate.

7 “(2) PRIORITIZATION.—In carrying out the
8 program authorized under paragraph (1), the Direc-
9 tor shall prioritize—

10 “(A) the development of software and algo-
11 rithms to enable the productive application of
12 environmental systems and extreme weather in
13 climate and Earth system prediction models in
14 high-performance computing systems; and

15 “(B) capabilities that support the Depart-
16 ment’s mission needs for energy and infrastruc-
17 ture security, resilience, and reliability.

18 “(3) ENVIRONMENTAL SYSTEMS SCIENCE RE-
19 SEARCH.—

20 “(A) IN GENERAL.—As part of the activi-
21 ties described in paragraph (1), the Director
22 shall carry out research to advance an inte-
23 grated, robust, and scale-aware predictive un-
24 derstanding of environmental systems, including
25 the role of hydrobiogeochemistry, from the sub-

1 surface to the top of the vegetative canopy that
2 considers effects of seasonal to interannual vari-
3 ability and change.

4 “(B) CLEAN WATER AND WATERSHED RE-
5 SEARCH.—As part of the activities described in
6 subparagraph (A), the Director shall—

7 “(i) support interdisciplinary research
8 to significantly advance our understanding
9 of water availability, quality, and the im-
10 pact of human activity and a changing cli-
11 mate on urban and rural watershed sys-
12 tems, including in freshwater environ-
13 ments;

14 “(ii) consult with the Interagency Re-
15 search, Development, and Demonstration
16 Coordination Committee on the Nexus of
17 Energy and Water for Sustainability estab-
18 lished under section 1010 of the Energy
19 Act of 2020 (division Z of the Consolidated
20 Appropriations Act, 2021 (Public Law
21 116–260)) on energy-water nexus research
22 activities; and

23 “(iii) engage with representatives of
24 research and academic institutions, non-
25 profit organizations, State, local, and tribal

1 governments, and industry, who have ex-
2 pertise in technologies, technological inno-
3 vations, or practices relating to the energy-
4 water nexus, as applicable.

5 “(C) COORDINATION.—

6 “(i) DIRECTOR.—The Director shall
7 carry out activities under this paragraph in
8 accordance with priorities established by
9 the Secretary to support and accelerate the
10 decontamination of relevant facilities man-
11 aged by the Department.

12 “(ii) SECRETARY.—The Secretary
13 shall ensure the coordination of activities
14 of the Department, including activities
15 under this paragraph, to support and ac-
16 celerate the decontamination of relevant fa-
17 cilities managed by the Department.

18 “(4) CLIMATE AND EARTH MODELING.—As
19 part of the activities described in paragraph (1), the
20 Director, in collaboration with the Advanced Sci-
21 entific Computing Research program described in
22 section 304 and other programs carried out by the
23 Department, as applicable, and in consultation with
24 the National Oceanic and Atmospheric Administra-
25 tion and other relevant agencies, shall carry out re-

1 search to develop, evaluate, and use high-resolution
2 regional climate, global climate, Earth system, and
3 other relevant models to inform decisions on reduc-
4 ing greenhouse gas emissions and the resulting im-
5 pacts of a changing global climate. Such modeling
6 shall include—

7 “(A) integrated capabilities for modeling
8 multisectoral interactions, including socio-
9 economic factors as appropriate, which may in-
10 clude the impacts of climate policies on social
11 and regional equity and well-being, and the
12 interdependencies and risks at the energy-
13 water-land nexus;

14 “(B) greenhouse gas emissions, air quality,
15 energy supply and demand, and other critical
16 elements; and

17 “(C) interaction among human and Earth
18 systems informed by interdisciplinary research,
19 including the economic and social sciences.

20 “(5) MID-SCALE FUNDING MECHANISM.—

21 “(A) IN GENERAL.—Any of the activities
22 authorized in this subsection may be carried out
23 by competitively selected mid-scale, multi-insti-
24 tutional research centers in lieu of individual re-

1 search grants, or large-scale experiments or
2 user facilities.

3 “(B) CONSIDERATION.—The Biological
4 and Environmental Research Advisory Com-
5 mittee shall provide recommendations to the Di-
6 rector on projects most suitable for the research
7 centers described in subparagraph (A).

8 “(h) BIOLOGICAL AND ENVIRONMENTAL RESEARCH
9 USER FACILITIES.—

10 “(1) IN GENERAL.—The Director shall carry
11 out a program for the development, construction, op-
12 eration, and maintenance of user facilities to en-
13 hance the collection and analysis of observational
14 data related to complex biological, climate, and envi-
15 ronmental systems.

16 “(2) FACILITY REQUIREMENTS.—To the max-
17 imum extent practicable, the user facilities devel-
18 oped, constructed, operated, or maintained under
19 paragraph (1) shall include—

20 “(A) distributed field research and obser-
21 vation platforms for understanding earth sys-
22 tem processes;

23 “(B) analytical techniques, instruments,
24 and modeling resources for understanding the

1 physical, chemical, and cellular processes of bio-
2 logical and environmental systems;

3 “(C) integrated high-throughput sequenc-
4 ing, advanced bioanalytic techniques, DNA de-
5 sign and synthesis, metabolomics, and computa-
6 tional analysis; and

7 “(D) such other facilities as the Director
8 considers appropriate, consistent with section
9 209 of the Department of Energy Organization
10 Act (42 U.S.C. 7139).

11 “(3) EXISTING FACILITIES.—In carrying out
12 the program established in paragraph (1), the Direc-
13 tor is encouraged to evaluate the capabilities of ex-
14 isting user facilities and, to the maximum extent
15 practicable, invest in modernization of those capa-
16 bilities to address emerging research priorities.

17 “(4) USER FACILITIES INTEGRATION AND COL-
18 LABORATION PROGRAM.—

19 “(A) IN GENERAL.—The Director shall
20 support a program of collaboration between
21 user facilities as defined under this subsection
22 to encourage and enable researchers to more
23 readily integrate the tools, expertise, resources,
24 and capabilities of multiple Office of Science
25 user facilities (as described in section 209(d) of

1 the Department of Energy Organization Act
2 (42 U.S.C. 7139)) to further research and ad-
3 vance emerging technologies.

4 “(B) ACTIVITIES.—The program shall ad-
5 vance the integration of automation, robotics,
6 computational biology, bioinformatics, bio-
7 sensing, cellular platforms and other relevant
8 emerging technologies as determined by the Di-
9 rector to enhance productivity and scientific im-
10 pact of user facilities.

11 “(5) EARTH AND ENVIRONMENTAL SYSTEMS
12 SCIENCES USER FACILITIES.—

13 “(A) IN GENERAL.—In carrying out the
14 activities authorized under paragraph (1), the
15 Director shall establish and operate user facili-
16 ties to advance the collection, validation, and
17 analysis of atmospheric data, including activi-
18 ties to advance knowledge and improve model
19 representations and measure the impact of at-
20 mospheric gases, aerosols, and clouds on earth
21 and environmental systems.

22 “(B) SELECTION.—The Director shall se-
23 lect user facilities under paragraph (1) on a
24 competitive, merit-reviewed basis. The Director
25 shall consider applications from the National

1 Laboratories, institutes of higher education,
2 multi-institutional collaborations, and other ap-
3 propriate entities.

4 “(C) EXISTING FACILITIES.—To the max-
5 imum extent practicable, the Director shall uti-
6 lize existing facilities to carry out this sub-
7 section.

8 “(6) COORDINATION.—In carrying out the pro-
9 gram authorized in paragraph (1), the Director shall
10 ensure that the Office of Science—

11 “(A) consults and coordinates with the Na-
12 tional Oceanic Atmospheric Administration, the
13 Environmental Protection Agency, the National
14 Aeronautics and Space Administration, the De-
15 partment of Agriculture, the Department of the
16 Interior, and any other relevant Federal agency
17 on the collection, validation, and analysis of at-
18 mospheric data; and

19 “(B) coordinates with relevant stake-
20 holders, including institutes of higher education,
21 nonprofit research institutions, industry, State,
22 local, and tribal governments, and other appro-
23 priate entities to ensure access to the best avail-
24 able relevant atmospheric and historical weath-
25 er data.

1 “(i) COASTAL ZONE RESEARCH INITIATIVE.—

2 “(1) IN GENERAL.—The Director shall carry
3 out a research program, in consultation with the Na-
4 tional Oceanic and Atmospheric Administration, to
5 enhance the understanding of coastal ecosystems. In
6 carrying out this program, the Director shall
7 prioritize efforts to enhance the collection of obser-
8 vational data, and shall develop models to analyze
9 the ecological, biogeochemical, hydrological and
10 physical processes that interact in coastal zones.

11 “(2) NATIONAL SYSTEM FOR COASTAL DATA
12 COLLECTION.—The Director shall establish, in con-
13 sultation with the National Oceanic and Atmospheric
14 Administration and other relevant agencies, an inte-
15 grated system of geographically diverse field re-
16 search sites in order to improve the quantity and
17 quality of observational data, and that encompass
18 the major land water interfaces of the United
19 States, including—

20 “(A) the Great Lakes region;

21 “(B) the Pacific coast;

22 “(C) the Atlantic coast;

23 “(D) the Arctic; and

24 “(E) the Gulf coast.

1 “(3) EXISTING INFRASTRUCTURE.—In carrying
2 out the programs and establishing the field research
3 sites under paragraph (1) and (2), the Secretary
4 shall leverage existing research and development in-
5 frastructure supported by the Department, including
6 the Department’s existing marine and coastal re-
7 search lab.

8 “(4) COORDINATION.—For the purposes of car-
9 rying out the programs and establishing the field re-
10 search sites under the Initiative, the Secretary may
11 enter into agreements with Federal Departments
12 and agencies with complementary capabilities.

13 “(5) REPORT.—Not less than 2 years after the
14 date of the enactment of the Department of Energy
15 Science for the Future Act, the Director shall pro-
16 vide to the Committee on Science, Space, and Tech-
17 nology and the Committee on Appropriations of the
18 House of Representatives and the Committee on En-
19 ergy and Natural Resources and the Committee on
20 Appropriations of the Senate a report examining
21 whether the system described in this section should
22 be established as a National User Facility.

23 “(j) TECHNOLOGY DEVELOPMENT.—The Director
24 shall support a technology research program for the devel-
25 opment of instrumentation and other research tools re-

1 quired to meet the missions of the Department and to pro-
2 vide platform technologies for the broader scientific com-
3 munity. Technologies shall include but are not limited to—

4 “(1) cryo-electron microscopy;

5 “(2) fabricated ecosystems;

6 “(3) next generation sensors including quantum
7 sensors for biological integration and bioproduction;

8 “(4) technologies to accelerate data analysis;

9 and

10 “(5) plant and microbial phenotyping for gene
11 discovery.

12 “(k) EMERGING TECHNOLOGIES.—

13 “(1) IN GENERAL.—The Secretary shall estab-
14 lish within the Biological and Environmental Re-
15 search program an initiative focused on the develop-
16 ment of engineered ecosystems through the applica-
17 tion of artificial intelligence, novel sensing capabili-
18 ties, and other emerging technologies.

19 “(2) INTERAGENCY COORDINATION.—The Sec-
20 retary shall coordinate with the Director of the Na-
21 tional Science Foundation, the Administrator of the
22 National Oceanic and Atmospheric Administration,
23 the Director of the U.S. Geological Survey, and
24 other relevant officials to avoid duplication of re-
25 search and observational activities and to ensure

1 that activities carried out under this initiative are
2 complimentary to those currently being undertaken
3 by other agencies.

4 “(3) REPORT.—Not later than 180 days after
5 the enactment of this Act, the Secretary shall pro-
6 vide a report to the Committee on Science, Space,
7 and Technology of the House, and the Committee on
8 Energy and Natural Resources of the Senate, on the
9 activity mandated in subsection (k).

10 “(1) AUTHORIZATION OF APPROPRIATIONS.—There
11 are authorized to be appropriated to the Secretary to carry
12 out the activities described in this section—

13 “(1) \$820,360,000 for fiscal year 2022;

14 “(2) \$886,385,200 for fiscal year 2023;

15 “(3) \$956,332,164 for fiscal year 2024;

16 “(4) \$1,020,475,415 for fiscal year 2025; and

17 “(5) \$1,099,108,695 for fiscal year 2026.”.

18 **SEC. 5. ADVANCED SCIENTIFIC COMPUTING RESEARCH**
19 **PROGRAM.**

20 (a) ADVANCED SCIENTIFIC COMPUTING RE-
21 SEARCH.—Section 304 of the Department of Energy Re-
22 search and Innovation Act (42 U.S.C. 18642) is amend-
23 ed—

24 (1) by redesignating subsections (a) through (c)
25 as subsections (b) through (d), respectively; and

1 (2) by inserting before subsection (b), as so re-
2 designated, the following:

3 “(a) IN GENERAL.—As part of the activities author-
4 ized under section 209 of the Department of Energy Orga-
5 nization Act (42 U.S.C. 7139), the Director shall carry
6 out, in coordination with academia and relevant public and
7 private sector entities, a research, development, and dem-
8 onstration program to—

9 “(1) steward applied mathematics, computa-
10 tional science, and computer science research rel-
11 evant to the missions of the Department and the
12 competitiveness of the United States;

13 “(2) develop modeling, simulation, and other
14 computational tools relevant to other scientific dis-
15 ciplines and to the development of new energy tech-
16 nologies and other technologies;

17 “(3) advance computing and networking capa-
18 bilities for data-driven discovery; and

19 “(4) develop advanced scientific computing
20 hardware and software tools for science and engi-
21 neering.”;

22 (3) in subsection (c) (as redesignated under
23 paragraph (1))—

24 (A) by striking “The Director” and insert-
25 ing the following:

1 “(1) DIRECTOR.—The Director”; and

2 (B) by adding at the end the following:

3 “(2) COORDINATION.—The Under Secretary for
4 Science shall ensure the coordination of the activities
5 of the Department, including activities under this
6 section, to determine and meet the computational
7 and networking research and facility needs of the
8 Office of Science and all other relevant energy tech-
9 nology and energy efficiency programs within the
10 Department and with other Federal agencies as ap-
11 propriate.”;

12 (4) by amending subsection (d), as so redesign-
13 nated, to read as follows:

14 “(d) APPLIED MATHEMATICS AND SOFTWARE DE-
15 VELOPMENT FOR HIGH-END COMPUTING SYSTEMS AND
16 COMPUTER SCIENCES RESEARCH.—

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

19 “(A) mathematics, statistics, and algo-
20 rithms for modeling complex systems relevant
21 to the missions of the Department, including on
22 advanced computing architectures; and

23 “(B) tools, languages, programming envi-
24 ronments, and operations for high-end com-
25 puting systems (as defined in section 2 of the

1 American Super Computing Leadership Act (15
2 U.S.C. 5541).

3 “(2) PORTFOLIO BALANCE.—

4 “(A) IN GENERAL.—The Director shall
5 maintain a balanced portfolio within the ad-
6 vanced scientific computing research and devel-
7 opment program established under section 976
8 of the Energy Policy Act of 2005 (42 U.S.C.
9 16316) that supports robust investment in—

10 “(i) applied mathematical, computa-
11 tional, and computer sciences research
12 needs relevant to the mission of the De-
13 partment, including foundational areas
14 that are critical to the advancement of en-
15 ergy sciences and technologies and new
16 and emerging computing technologies; and

17 “(ii) associated high-performance
18 computing hardware and facilities.

19 “(B) EXASCALE ECOSYSTEM
20 SUSTAINMENT.—

21 “(i) SENSE OF CONGRESS.—It is the
22 sense of Congress that the Exascale Com-
23 puting Project has successfully created a
24 broad ecosystem that provides shared soft-
25 ware packages, novel evaluation systems,

1 and applications relevant to the science
2 and engineering requirements of the De-
3 partment, and that such products must be
4 maintained and improved in order that the
5 full potential of the deployed systems can
6 be continuously realized.

7 “(ii) IN GENERAL.—The Secretary
8 shall seek to sustain and evolve the eco-
9 system referenced in clause (i) to ensure
10 that the exascale software stack and other
11 research software will continue to be main-
12 tained, hardened, and otherwise optimized
13 for long-term use on exascale systems and
14 beyond and reliable availability to the user
15 community.”; and

16 (5) by inserting after subsection (d) the fol-
17 lowing:

18 “(e) NEXT GENERATION COMPUTING PROGRAM.—

19 “(1) IN GENERAL.—The Secretary shall estab-
20 lish a program to develop and implement a strategy
21 for achieving computing systems with capabilities be-
22 yond exascale computing systems. In establishing
23 this program, the Secretary shall—

24 “(A) maintain foundational research pro-
25 grams in mathematical, computational, and

1 computer sciences focused on new and emerging
2 computing needs within the mission of the De-
3 partment, including post-Moore’s law computing
4 architectures, novel approaches to modeling and
5 simulation, artificial intelligence and scientific
6 machine learning, quantum computing, edge
7 computing, extreme heterogeneity, and distrib-
8 uted high-performance computing; and

9 “(B) retain best practices and maintain
10 support for essential hardware, applications,
11 and software elements of the Exascale Com-
12 puting Program that are necessary for sus-
13 taining the vitality of a long-term capable soft-
14 ware ecosystem for exascale and beyond; and

15 “(C) develop a Department-wide strategy
16 for balancing on-premises and cloud-based com-
17 puting and scientific data management.

18 “(2) REPORT.—Not later than one year after
19 the date of the enactment of the Department of En-
20 ergy Science for the Future Act, the Secretary shall
21 submit to the Committee on Science, Space, and
22 Technology of the House of Representatives, and the
23 Committee on Energy and Natural Resources of the
24 Senate, a report on the development and implemen-
25 tation of the strategy outlined in paragraph (1).

1 “(f) ARCHITECTURAL RESEARCH IN HETERO-
2 GENEUS COMPUTING SYSTEMS.—

3 “(1) IN GENERAL.—The Secretary shall carry
4 out a program of research and development in het-
5 erogeneous and reconfigurable computing systems to
6 expand understanding of the potential for hetero-
7 geneous and reconfigurable computing systems to
8 deliver high performance, high efficiency computing
9 for Department of Energy mission challenges. This
10 shall include research and development that explores
11 the convergence of big data analytics, simulations,
12 and artificial intelligence to drive the design of het-
13 erogenous computing system architectures.

14 “(2) COORDINATION.—In carrying out this pro-
15 gram, the Secretary shall ensure coordination be-
16 tween research activities undertaken by the Ad-
17 vanced Scientific Computing Research program and
18 materials research supported by the Basic Energy
19 Sciences program within the Department of Energy
20 Office of Science.

21 “(g) ENERGY EFFICIENT COMPUTING PROGRAM.—

22 “(1) IN GENERAL.—The Secretary shall sup-
23 port a program of fundamental research, develop-
24 ment, and demonstration of energy efficient com-
25 puting and data center technologies relevant to ad-

1 vanced computing applications, including high per-
2 formance computing, artificial intelligence, and sci-
3 entific machine learning.

4 “(2) EXECUTION.—

5 “(A) PROGRAM.—In carrying out the pro-
6 gram under paragraph (1), the Secretary
7 shall—

8 “(i) establish a partnership for Na-
9 tional Laboratories, industry partners, and
10 institutions of higher education for co-
11 design of energy efficient hardware, tech-
12 nology, software, and applications across
13 all applicable program offices of the De-
14 partment, and provide access to energy ef-
15 ficient computing resources to such part-
16 ners;

17 “(ii) develop hardware and software
18 technologies that decrease the energy needs
19 of advanced computing practices, including
20 through data center co-design; and

21 “(iii) consider multiple heterogeneous
22 computing architectures in collaboration
23 with the program established under sub-
24 section (f) including neuromorphic com-

1 puting, persistent computing, and ultrafast
2 networking; and

3 “(iv) provide, as appropriate, on a
4 competitive, merit-reviewed basis, access
5 for researchers from institutions of higher
6 education, National Laboratories, industry,
7 and other Federal agencies to the energy
8 efficient computing technologies developed
9 pursuant to clause (i).

10 “(B) SELECTION OF PARTNERS.—In se-
11 lecting participants for the partnership estab-
12 lished under subparagraph (A)(i), the Secretary
13 shall select participants through a competitive,
14 merit review process.

15 “(C) REPORT.—Not later than one year
16 after the date of the enactment of the Depart-
17 ment of Energy Science for the Future Act, the
18 Secretary shall submit to the Committee on
19 Science, Space, and Technology of the House of
20 Representatives, and the Committee on Energy
21 and Natural Resources of the Senate, a report
22 on—

23 “(i) the activities conducted under
24 subparagraph (A); and

1 “(ii) the coordination and manage-
2 ment of the program under subparagraph
3 (A) to ensure an integrated research pro-
4 gram across the Department.

5 “(h) ENERGY SCIENCES NETWORK.—

6 “(1) IN GENERAL.—The Secretary shall provide
7 for upgrades to the Energy Sciences Network user
8 facility in order to meet the research needs of the
9 Department for highly reliable data transport capa-
10 bilities optimized for the requirements of large-scale
11 science.

12 “(2) CAPABILITIES.—In carrying out paragraph
13 (1), the Secretary shall ensure the following capabili-
14 ties:

15 “(A) To provide high bandwidth scientific
16 networking across the continental United States
17 and the Atlantic Ocean.

18 “(B) To ensure network reliability.

19 “(C) To protect the network infrastructure
20 from cyber-attacks.

21 “(D) To manage transport of exponentially
22 increasing levels of data from the Department’s
23 National Laboratories and sites, user facilities,
24 experiments, and sensors.

1 “(E) To contribute to the integration of
2 heterogeneous computing frameworks and sys-
3 tems.

4 “(i) COMPUTATIONAL SCIENCE GRADUATE FELLOW-
5 SHIP.—

6 “(1) IN GENERAL.—The Secretary shall sup-
7 port the Computational Science Graduate Fellowship
8 program in order to facilitate collaboration between
9 graduate students and researchers at the National
10 Laboratories, and contribute to the development of
11 a diverse and inclusive computational workforce to
12 help advance research in areas relevant to the mis-
13 sion of the Department.

14 “(2) FUNDING.—From within funds authorized
15 to be appropriated for Advanced Scientific Com-
16 puting Research Program, the Secretary shall make
17 available for carrying out the activities under this
18 section—

19 “(A) \$21,000,000 for fiscal year 2022;

20 “(B) \$22,050,000 for fiscal year 2023;

21 “(C) \$23,152,500 for fiscal year 2024;

22 “(D) \$24,310,125 for fiscal year 2025;

23 and

24 “(E) \$25,525,631 for fiscal year 2026.

1 “(j) AUTHORIZATION OF APPROPRIATIONS.—There
2 are authorized to be appropriated to the Secretary to carry
3 out the activities described in this section—

4 “(1) \$1,126,350,000 for fiscal year 2022;

5 “(2) \$1,222,674,500 for fiscal year 2023;

6 “(3) \$1,324,320,715 for fiscal year 2024;

7 “(4) \$1,431,660,115 for fiscal year 2025; and

8 “(5) \$1,535,090,121 for fiscal year 2026.”.

9 (b) QUANTUM SCIENCE NETWORK.—

10 (1) DEFINITIONS.—Section 2 of the National
11 Quantum Initiative Act (15 U.S.C. 8801) is amend-
12 ed—

13 (A) by redesignating paragraph (7) as
14 paragraph (8); and

15 (B) by inserting after paragraph (6) the
16 following:

17 “(7) QUANTUM NETWORK INFRASTRUCTURE.—

18 The term ‘quantum network infrastructure’ means
19 any facility, expertise, or capability that is necessary
20 to enable the development and deployment of scal-
21 able and diverse quantum network technologies.”.

22 (2) DEPARTMENT OF ENERGY QUANTUM NET-
23 WORK INFRASTRUCTURE RESEARCH AND DEVELOP-
24 MENT PROGRAM.—(A) Title IV of the National

1 Quantum Initiative Act (15 U.S.C. 8851 et seq.) is
2 amended by adding at the end the following:

3 **“SEC. 403. DEPARTMENT OF ENERGY QUANTUM NETWORK**
4 **INFRASTRUCTURE RESEARCH AND DEVELOP-**
5 **MENT PROGRAM.**

6 “(a) IN GENERAL.—The Secretary of Energy (re-
7 ferred to in this section as the ‘Secretary’) shall carry out
8 a research, development, and demonstration program to
9 accelerate innovation in quantum network infrastructure
10 in order to—

11 “(1) facilitate the advancement of distributed
12 quantum computing systems through the internet
13 and intranet;

14 “(2) improve the precision of measurements of
15 scientific phenomena and physical imaging tech-
16 nologies;

17 “(3) develop secure national quantum commu-
18 nications technologies and strategies; and

19 “(4) demonstrate these capabilities utilizing the
20 Department of Energy’s Energy Sciences Network
21 User Facility.

22 “(b) PROGRAM.—In carrying out this section, the
23 Secretary shall—

24 “(1) coordinate with—

1 “(A) the Director of the National Science
2 Foundation;

3 “(B) the Director of the National Institute
4 of Standards and Technology;

5 “(C) the Chair of the Subcommittee on
6 Quantum Information Science of the National
7 Science and Technology Council established
8 under section 103(a); and

9 “(D) the Chair of the Subcommittee on the
10 Economic and Security Implications of Quan-
11 tum Science;

12 “(2) conduct cooperative research with indus-
13 try, National Laboratories, institutions of higher
14 education, and other research institutions to facili-
15 tate new quantum infrastructure methods and tech-
16 nologies, including—

17 “(A) quantum-limited detectors, ultra-low
18 loss optical channels, space-to-ground connec-
19 tions, and classical networking and cybersecu-
20 rity protocols;

21 “(B) entanglement and hyper-entangled
22 state sources and transmission, control, and
23 measurement of quantum states;

1 “(C) quantum interconnects that allow
2 short range local connections between quantum
3 processors;

4 “(D) transducers for quantum sources and
5 signals between optical and telecommunications
6 regimes and quantum computer-relevant do-
7 mains, including microwaves;

8 “(E) development of quantum memory
9 buffers and small-scale quantum computers
10 that are compatible with photon-based quantum
11 bits in the optical or telecommunications wave-
12 lengths;

13 “(F) long-range entanglement distribution
14 at both the terrestrial and space-based level
15 using quantum repeaters, allowing entangle-
16 ment-based protocols between small- and large
17 scale quantum processors;

18 “(G) quantum routers, multiplexers, re-
19 peaters, and related technologies necessary to
20 create secure long-distance quantum commu-
21 nication; and

22 “(H) integration of systems across the
23 quantum technology stack into traditional com-
24 puting networks, including the development of
25 remote controlled, high performance, and reli-

1 able implementations of key quantum network
2 components by leveraging the expertise, infra-
3 structure and supplemental investments in the
4 Energy Sciences Network User Facility;

5 “(3) engage with the Quantum Economic De-
6 velopment Consortium (QED-C) to transition com-
7 ponent technologies to help facilitate as appropriate
8 the development of a quantum supply chain for
9 quantum network technologies;

10 “(4) advance basic research in advanced sci-
11 entific computing, particle and nuclear physics, and
12 material science to enhance the understanding, pre-
13 diction, and manipulation of materials, processes,
14 and physical phenomena relevant to quantum net-
15 work infrastructure;

16 “(5) develop experimental tools and testbeds in
17 collaboration with the Department of Energy’s En-
18 ergy Sciences Network User Facility necessary to
19 support cross-cutting fundamental research and de-
20 velopment activities with diverse stakeholders from
21 industry, National Laboratories, and institutions of
22 higher education; and

23 “(6) consider quantum network infrastructure
24 applications that span the Department of Energy’s

1 missions in energy, environment, and national secu-
2 rity.

3 “(c) LEVERAGING.—In carrying out this section, the
4 Secretary shall leverage resources, infrastructure, and ex-
5 pertise across the Department of Energy and from—

6 “(1) the National Institute of Standards and
7 Technology;

8 “(2) the National Science Foundation;

9 “(3) the National Aeronautics and Space Ad-
10 ministration;

11 “(4) other relevant Federal agencies;

12 “(5) the National Laboratories;

13 “(6) industry stakeholders;

14 “(7) institutions of higher education; and

15 “(8) the National Quantum Information
16 Science Research Centers.

17 “(d) RESEARCH PLAN.—Not later than 180 days
18 after the date of the enactment of the Department of En-
19 ergy Science for the Future Act, the Secretary shall sub-
20 mit to the Committee on Science, Space, and Technology
21 of the House of Representatives and the Committee on
22 Energy and Natural Resources of the Senate, a 4-year re-
23 search plan that identifies and prioritizes basic research
24 needs relating to quantum network infrastructure.

1 “(e) STANDARD OF REVIEW.—The Secretary shall
2 review activities carried out under this section to deter-
3 mine the achievement of technical milestones.

4 “(f) FUNDING.—Out of funds authorized to be appro-
5 priated for the Department of Energy’s Office of Science,
6 there shall be made available to the Secretary to carry out
7 the activities under this section, \$100,000,000 for each
8 of fiscal years 2022 through 2026.

9 **“SEC. 404. DEPARTMENT OF ENERGY QUANTUM USER EX-**
10 **PANSION FOR SCIENCE AND TECHNOLOGY**
11 **PROGRAM.**

12 “(a) IN GENERAL.—The Secretary of Energy (re-
13 ferred to in this section as the ‘Secretary’) shall establish
14 and carry out a program (to be known as the ‘Quantum
15 User Expansion for Science and Technology program’ or
16 ‘QUEST program’) to encourage and facilitate access to
17 United States quantum computing hardware and quantum
18 computing clouds for research purposes to—

19 “(1) enhance the United States quantum re-
20 search enterprise;

21 “(2) educate the future quantum computing
22 workforce; and

23 “(3) accelerate the advancement of United
24 States quantum computing capabilities.

1 “(b) PROGRAM.—In carrying out this section, the
2 Secretary shall—

3 “(1) coordinate with—

4 “(A) the Director of the National Science
5 Foundation;

6 “(B) the Director of the National Institute
7 of Standards and Technology;

8 “(C) the Chair of the Subcommittee on
9 Quantum Information Science of the National
10 Science and Technology Council established
11 under section 103(a); and

12 “(D) the Chair of the Subcommittee on the
13 Economic and Security Implications of Quan-
14 tum Science;

15 “(2) provide researchers based within the
16 United States with access to, and use of, United
17 States quantum computing resources through a com-
18 petitive, merit-reviewed process;

19 “(3) consider applications from the National
20 Laboratories, multi-institutional collaborations, insti-
21 tutions of higher education, industry stakeholders,
22 and any other entities that the Secretary determines
23 are appropriate to provide national leadership on
24 quantum computing related issues; and

1 “(4) consult and coordinate with private sector
2 stakeholders, the user community, and interagency
3 partners on program development and best manage-
4 ment practices.

5 “(c) LEVERAGING.—In carrying out this section, the
6 Secretary shall leverage resources and expertise across the
7 Department of Energy and from—

8 “(1) the National Institute of Standards and
9 Technology;

10 “(2) the National Science Foundation;

11 “(3) the National Aeronautics and Space Ad-
12 ministration;

13 “(4) other relevant Federal agencies;

14 “(5) the National Laboratories;

15 “(6) industry stakeholders;

16 “(7) institutions of higher education; and

17 “(8) the National Quantum Information
18 Science Research Centers.

19 “(d) SECURITY.—In carrying out the activities au-
20 thorized by this section, the Secretary, in consultation
21 with the Director of the National Science Foundation and
22 the Director of the National Institute of Standards and
23 Technology, shall ensure proper security controls are in
24 place to protect sensitive information, as appropriate.

1 “(e) FUNDING.—Out of funds authorized to be ap-
2 propriated for the Department of Energy’s Office of
3 Science, there shall be made available to the Secretary to
4 carry out the activities under this section—

5 “(1) \$30,000,000 for fiscal year 2022;

6 “(2) \$50,000,000 for fiscal year 2023;

7 “(3) \$70,000,000 for fiscal year 2024;

8 “(4) \$90,000,000 for fiscal year 2025; and

9 “(5) \$100,000,000 for fiscal year 2026.

10 “(f) EQUITABLE USE OF HIGH-PERFORMANCE COM-
11 PUTING CAPABILITIES.—

12 “(1) SENSE OF CONGRESS.—It is the sense of
13 Congress that machine learning algorithms can ex-
14 hibit biases that cause harm to historically
15 marginalized communities.

16 “(2) POLICY.—In leveraging high-performance
17 computing systems for research purposes, including
18 through the use of machine learning algorithms for
19 data analysis, the Secretary shall ensure that such
20 capabilities are employed in a manner that mitigates
21 and, to the maximum extent practicable, avoids
22 harmful algorithmic bias and equitably addresses
23 challenges impacting different populations, including
24 historically marginalized communities.”.

1 (B) The table of contents in section 1(b) of the
2 National Quantum Initiative Act is amended by in-
3 serting after the item relating to section 402 the fol-
4 lowing items:

“Sec. 403. Department of energy quantum network infrastructure research and
development program.

“Sec. 404. Department of energy quantum user expansion for science and tech-
nology program.”.

5 **SEC. 6. FUSION ENERGY RESEARCH.**

6 (a) FUSION ENERGY RESEARCH.—Section 307 of the
7 Department of Energy Research and Innovation Act (42
8 U.S.C. 18645) is amended—

9 (1) in subsection (b)—

10 (A) in the matter preceding paragraph (1),
11 by striking “As part of” and inserting the fol-
12 lowing:

13 “(1) IN GENERAL.—As part of”;

14 (B) by redesignating—

15 (i) paragraphs (1) and (2) as sub-
16 paragraphs (A) and (B), respectively (and
17 by adjusting the margins of such subpara-
18 graphs accordingly); and

19 (ii) in subparagraph (B) (as redesign-
20 ated by clause (i)), subparagraphs (A)
21 and (B) as clauses (i) and (ii), respectively
22 (and by adjusting the margins of such
23 clauses accordingly); and

1 (C) by adding at the end the following:

2 “(2) AUTHORIZATION OF APPROPRIATIONS.—

3 Out of funds authorized to be appropriated under
4 subsection (r), there are authorized to be appro-
5 priated to the Secretary to carry out activities de-
6 scribed in paragraph (1) \$50,000,000 for each of
7 fiscal years 2022 through 2026.”;

8 (2) in subsection (d)(3)—

9 (A) by striking the period at the end and
10 inserting “and \$40,000,000 for fiscal year
11 2026.”; and

12 (B) by striking “(o)” and inserting “(r)”;
13 and

14 (3) in subsection (e)(4)—

15 (A) by striking the period at the end and
16 inserting “and \$75,000,000 for fiscal year
17 2026.”; and

18 (B) by striking “(o)” and inserting “(r)”;

19 (4) in subsection (i)(10)—

20 (A) In the matter preceding subparagraph
21 (A), by striking “(o)” and inserting “(r)”;

22 (B) in subparagraph (D), by striking “;
23 and” and inserting a semicolon;

24 (C) in subparagraph (E), by striking the
25 period at the end and inserting “; and”; and

1 (D) by adding at the end the following:

2 “(F) \$45,000,000 for fiscal year 2026.”;

3 (5) in subsection (j)—

4 (A) by striking “The Director” and all
5 that follows through the period and inserting
6 the following:

7 “(1) IN GENERAL.—

8 “(A) ESTABLISHMENT.—Within 180 days
9 of enactment of the Department of Energy
10 Science for the Future Act, the Director shall
11 establish at least 2 national teams, including
12 public-private partnerships, that will develop
13 conceptual pilot plant designs and technology
14 roadmaps and lead to an engineering design of
15 a pilot plant that will bring fusion to commer-
16 cial viability.

17 “(B) COMPOSITION.—The national teams
18 shall be composed of developers, manufacturers,
19 universities, national laboratories, and engineer-
20 ing, procurement, and construction industries.”;
21 and

22 (B) by adding at the end the following:

23 “(2) AUTHORIZATION OF APPROPRIATIONS.—

24 There are authorized to be appropriated to carry out
25 activities described in paragraph (1)—

1 “(A) \$20,000,000 for fiscal year 2022;

2 “(B) \$35,000,000 for fiscal year 2023;

3 “(C) \$50,000,000 for fiscal year 2024;

4 “(D) \$65,000,000 for fiscal year 2025;

5 and

6 “(E) \$80,000,000 for fiscal year 2026.”;

7 (6) in subsection (l)—

8 (A) by striking “sense of Congress that the
9 United States should support” and inserting
10 “sense of Congress that—”;

11 “(1) the United States should support”;

12 (B) in paragraph (1) (as so designated by
13 subparagraph (A) of this paragraph), by strik-
14 ing the period at the end and inserting “; and”;
15 and

16 (C) by adding at the end the following:

17 “(2) the Director shall incorporate the findings
18 and recommendations of the report of the Fusion
19 Energy Sciences Advisory Committee entitled
20 ‘Powering the Future: Fusion and Plasmas’ and the
21 report of the National Academies of Science, Engi-
22 neering, and Medicine entitled “Bringing Fusion to
23 the U.S. Grid” into the planning process of the De-
24 partment, including the development of future budg-
25 et requests to Congress.”;

1 (7) by redesignating subsection (o) as sub-
2 section (r);

3 (8) by inserting after subsection (n) the fol-
4 lowing:

5 “(o) HIGH-PERFORMANCE COMPUTATION COLLABO-
6 RATIVE RESEARCH PROGRAM.—

7 “(1) IN GENERAL.—The Secretary shall carry
8 out a program to conduct and support collaborative
9 research, development, and demonstration of fusion
10 energy technologies, through high-performance com-
11 putation modeling and simulation techniques, in
12 order to—

13 “(A) support fundamental research in plas-
14 mas and matter at very high temperatures and
15 densities;

16 “(B) inform the development of a broad
17 range of fusion energy systems; and

18 “(C) facilitate the translation of research
19 results in fusion energy science to industry.

20 “(2) COORDINATION.—In carrying out the pro-
21 gram under paragraph (1), the Secretary shall co-
22 ordinate with relevant Federal agencies, and
23 prioritize the following objectives:

24 “(A) Using expertise from the private sec-
25 tor, institutions of higher education, and the

1 National Laboratories to leverage existing, and
2 develop new, computational software and capa-
3 bilities that prospective users may use to accel-
4 erate research and development of fusion energy
5 systems.

6 “(B) Developing computational tools to
7 simulate and predict fusion energy science phe-
8 nomena that may be validated through physical
9 experimentation.

10 “(C) Increasing the utility of the research
11 infrastructure of the Department by coordi-
12 nating with the Advanced Scientific Computing
13 Research program within the Office of Science.

14 “(D) Leveraging experience from existing
15 modeling and simulation entities sponsored by
16 the Department.

17 “(E) Ensuring that new experimental and
18 computational tools are accessible to relevant
19 research communities, including private sector
20 entities engaged in fusion energy technology de-
21 velopment.

22 “(F) Ensuring that newly developed com-
23 putational tools are compatible with modern vir-
24 tual engineering and visualization capabilities to

1 accelerate the realization of fusion energy tech-
2 nologies and systems.

3 “(3) DUPLICATION.—The Secretary shall en-
4 sure the coordination of, and avoid unnecessary du-
5 plication of, the activities of this program with the
6 activities of—

7 “(A) other research entities of the Depart-
8 ment, including the National Laboratories, the
9 Advanced Research Projects Agency–Energy,
10 the Advanced Scientific Computing Research
11 program; and

12 “(B) industry.

13 “(4) HIGH-PERFORMANCE COMPUTING FOR FU-
14 SION INNOVATION CENTER.—In carrying out the
15 program under paragraph (1), the Secretary shall,
16 in coordination with the Innovation Network for Fu-
17 sion Energy, establish and operate a national High-
18 Performance Computing for Fusion Innovation Cen-
19 ter (referred to in this subsection as the ‘Center’),
20 to support the program under paragraph (1) by pro-
21 viding, to the extent practicable, a centralized entity
22 for multidisciplinary, collaborative, fusion energy re-
23 search and development through high performance
24 computing and advanced data analytics technologies
25 and processes.

1 “(5) SELECTION.—The Secretary shall select
2 the Center under this subsection on a competitive,
3 merit-reviewed basis. The Secretary shall consider
4 applications from National Laboratories, institutions
5 of higher education, multi-institutional collabora-
6 tions, and other appropriate entities.

7 “(6) EXISTING ACTIVITIES.—The Center may
8 incorporate existing research activities that are con-
9 sistent with the program described in paragraph (1).

10 “(7) DURATION.—The Center established under
11 this subsection shall receive support for a period of
12 not more than 5 years, subject to the availability of
13 appropriations.

14 “(8) RENEWAL.—Upon the expiration of any
15 period of support of the Center, the Secretary may
16 renew support for the Center, on a merit-reviewed
17 basis, for a period of not more than 5 years.

18 “(9) TERMINATION.—Consistent with the exist-
19 ing authorities of the Department, the Secretary
20 may terminate the Center for cause during the per-
21 formance period.

22 “(p) MATERIAL PLASMA EXPOSURE EXPERIMENT.—

23 “(1) IN GENERAL.—The Secretary shall con-
24 struct a Material Plasma Exposure Experiment fa-
25 cility as described in the 2020 publication approved

1 by the Fusion Energy Sciences Advisory Committee
2 titled ‘Powering the Future: Fusion and Plasmas’.
3 The Secretary shall consult with the private sector,
4 universities, National Laboratories, and relevant
5 Federal agencies to ensure that this facility is capa-
6 ble of meeting Federal research needs for steady
7 state, high-heat-flux and plasma-material interaction
8 testing of fusion materials over a range of fusion en-
9 ergy relevant parameters.

10 “(2) FACILITY CAPABILITIES.—The Secretary
11 shall ensure that the facility described in paragraph
12 (1) will provide the following capabilities:

13 “(A) A magnetic field at the target of 1
14 Tesla.

15 “(B) An energy flux at the target of 10
16 MW/m².

17 “(C) The ability to expose previously irra-
18 diated plasma facing material samples to plas-
19 ma.

20 “(3) START OF OPERATIONS.—The Secretary
21 shall, subject to the availability of appropriations,
22 ensure that the start of full operations of the facility
23 under this section occurs before December 31, 2027.

24 “(4) FUNDING.—Out of funds authorized to be
25 appropriated for Fusion Energy Sciences, there are

1 funds authorized to be appropriated to the Secretary
2 for the Office of Fusion Energy Sciences to carry
3 out to completion the construction of the facility
4 under this section:

5 “(A) \$32,800,000 for fiscal year 2022;

6 “(B) \$13,400,000 for fiscal year 2023;

7 “(C) \$12,600,000 for fiscal year 2024; and

8 “(D) \$400,000 for fiscal year 2025.

9 “(q) MATTER IN EXTREME CONDITIONS INSTRU-
10 MENT UPGRADE.—

11 “(1) IN GENERAL.—The Secretary shall provide
12 for the upgrade to the Matter in Extreme Conditions
13 endstation at the Linac Coherent Light Source as
14 described in the 2020 publication approved by the
15 Fusion Energy Sciences Advisory Committee titled
16 ‘Powering the Future: Fusion and Plasmas’. The
17 Secretary shall consult with the private sector, uni-
18 versities, National Laboratories, and relevant Fed-
19 eral agencies to ensure that this facility is capable
20 of meeting Federal research needs for understanding
21 physical and chemical changes to plasmas at funda-
22 mental timescales, and explore new regimes of dense
23 material physics, astrophysics, planetary physics,
24 and short-pulse laser-plasma interactions.

1 “(2) START OF OPERATIONS.—The Secretary
2 shall, subject to the availability of appropriations,
3 ensure that the start of full operations of the facility
4 under this section occurs before December 31,
5 2028.”; and

6 (9) in subsection (r), as so redesignated, by
7 striking paragraphs (2) through (5) and inserting
8 the following:

9 “(2) \$1,002,900,000 for fiscal year 2022;

10 “(3) \$1,095,707,000 for fiscal year 2023;

11 “(4) \$1,129,368,490 for fiscal year 2024;

12 “(5) \$1,149,042,284 for fiscal year 2025; and

13 “(6) \$1,243,097,244 for fiscal year 2026.”.

14 (b) ITER CONSTRUCTION.—Section 972 of the En-
15 ergy Policy Act of 2005 (42 U.S.C. 16312) is amended
16 in subsection (c)(3)—

17 (1) in subparagraph (A), by striking “and” at
18 the end; and

19 (2) by striking subparagraph (B) and inserting
20 the following:

21 “(B) \$300,000,000 for fiscal year 2022;

22 “(C) \$325,000,000 for fiscal year 2023;

23 “(D) \$350,000,000 for fiscal year 2024;

24 “(E) \$350,000,000 for fiscal year 2025;

25 and

1 “(F) \$350,000,000 for fiscal year 2026.”.

2 **SEC. 7. HIGH ENERGY PHYSICS PROGRAM.**

3 (a) PROGRAM.—Section 305 of the Department of
4 Energy Research and Innovation Act (42 U.S.C. 18643)
5 is amended—

6 (1) by redesignating subsections (b) through (d)
7 as subsections (d) through (f), respectively; and

8 (2) by inserting the following after subsection
9 (a):

10 “(b) PROGRAM.—As part of the activities authorized
11 under section 209 of the Department of Energy Organiza-
12 tion Act (42 U.S.C. 7139), the Director shall carry out
13 a research program in elementary particle physics and ad-
14 vanced technology research and development to improve
15 the understanding of the fundamental properties of the
16 universe, including constituents of matter and energy and
17 the nature of space and time.

18 “(c) HIGH ENERGY FRONTIER RESEARCH.—As part
19 of the program described in subsection (b), the Director
20 shall carry out research using high energy accelerators
21 and advanced detectors, including accelerators and detec-
22 tors that will function as national user facilities, to create
23 and study interactions of elementary particles and inves-
24 tigate fundamental forces.”.

1 (b) INTERNATIONAL COLLABORATION.—Section
2 305(d) of the Department of Energy Research and Inno-
3 vation Act (42 U.S.C. 18643(d)), as redesignated under
4 subsection (a), is amended to read as follows:

5 “(d) INTERNATIONAL COLLABORATION.—The Direc-
6 tor shall—

7 “(1) as practicable and in coordination with
8 other appropriate Federal agencies as necessary, en-
9 sure the access of United States researchers to the
10 most advanced accelerator facilities and research ca-
11 pabilities in the world, including the Large Hadron
12 Collider;

13 “(2) to the maximum extent practicable, con-
14 tinue to leverage United States participation in the
15 Large Hadron Collider, and prioritize expanding
16 international partnerships and investments in the
17 Long-Baseline Neutrino Facility and Deep Under-
18 ground Neutrino Experiment; and

19 “(3) to the maximum extent practicable,
20 prioritize engagement in collaborative efforts in sup-
21 port of future international facilities that would pro-
22 vide access to the most advanced accelerator facili-
23 ties in the world to United States researchers.”.

24 (c) COSMIC FRONTIER RESEARCH.—Section 305(f)
25 of the Department of Energy Research and Innovation Act

1 (42 U.S.C. 18645(f)), as redesignated by subsection (a),
2 is amended to read as follows:

3 “(f) COSMIC FRONTIER RESEARCH.—The Director
4 shall carry out research activities on the nature of the pri-
5 mary contents of the universe, including the nature of
6 dark energy and dark matter. These activities shall, to the
7 maximum extent practicable, be consistent with the re-
8 search priorities identified by the High Energy Physics
9 Advisory Panel or the National Academy of Sciences, and
10 may include—

11 “(1) collaborations with the National Aero-
12 nautics and Space Administration, the National
13 Science Foundation, or international partners on rel-
14 evant projects; and

15 “(2) the development of space-based, land-
16 based, water-based, and underground facilities and
17 experiments.”.

18 (d) FURTHER ACTIVITIES.—Section 305 of the De-
19 partment of Energy Research and Innovation Act (42
20 U.S.C. 18645) is further amended by adding at the end
21 the following:

22 “(g) FACILITY CONSTRUCTION AND MAJOR ITEMS
23 OF EQUIPMENT.—

24 “(1) PROJECTS.—Consistent with the Office of
25 Science’s project management practices, the Director

1 shall, to the maximum extent practicable, incor-
2 porate the findings and recommendations of the
3 2014 Particle Physics Project Prioritization Panel
4 (P5) report titled ‘Building for Discovery’, and sup-
5 port construction or fabrication of—

6 “(A) an international Long-Baseline Neu-
7 trino Facility based in the United States;

8 “(B) the Proton Improvement Plan II;

9 “(C) Second Generation Dark Matter ex-
10 periments;

11 “(D) the Legacy Survey of Space and
12 Time camera;

13 “(E) upgrades to detectors and other com-
14 ponents of the Large Hadron Collider; and

15 “(F) other high priority projects rec-
16 ommended in the most recent report of the Par-
17 ticle Physics Project Prioritization Panel of the
18 High Energy Physics Advisory Panel.

19 “(2) LONG-BASELINE NEUTRINO FACILITY.—

20 “(A) IN GENERAL.—The Secretary shall
21 support construction of a Long-Baseline Neu-
22 trino Facility to facilitate the international
23 Deep Underground Neutrino Experiment to ex-
24 amine the fundamental properties of neutrinos,
25 explore physics beyond the Standard Model,

1 and better clarify the existence and nature of
2 antimatter.

3 “(B) FACILITY CAPABILITIES.—The Sec-
4 retary shall ensure that the facility described in
5 subparagraph (A) will provide, at a minimum,
6 the following capabilities:

7 “(i) A neutrino beam with wideband
8 capability of 1.2 megawatts (MW) of beam
9 power and upgradable to 2.4 MW of beam
10 power.

11 “(ii) Three caverns excavated for a 70
12 kiloton fiducial detector mass and sup-
13 porting surface buildings and utilities.

14 “(iii) Cryogenic systems to support
15 neutrino detectors.

16 “(C) START OF OPERATIONS.—The Sec-
17 retary shall, subject to the availability of appro-
18 priations, ensure that the start of full oper-
19 ations of the facility under this subsection oc-
20 curs before December 31, 2031.

21 “(D) FUNDING.—Out of funds authorized
22 to be appropriated under subsection (k), there
23 shall be made available to the Secretary to
24 carry out construction of the facility under this
25 subsection—

1 “(i) \$200,000,000 for fiscal year
2 2022;

3 “(ii) \$325,000,000 for fiscal year
4 2023;

5 “(iii) \$400,000,000 for fiscal year
6 2024;

7 “(iv) \$375,000,000 for fiscal year
8 2025; and

9 “(v) \$250,000,000 for fiscal year
10 2026.

11 “(3) PROTON IMPROVEMENT PLAN—II ACCEL-
12 ERATOR UPGRADE PROJECT.—

13 “(A) IN GENERAL.—The Secretary of En-
14 ergy shall support construction of the Proton
15 Improvement Plan II, an upgrade to the
16 Fermilab accelerator complex identified in the
17 2014 Particle Physics Project Prioritization
18 Panel (P5) report titled ‘Building for Dis-
19 covery’, to provide the world’s most intense
20 beam of neutrinos to the international Long
21 Baseline Neutrino Facility as well as abroad
22 range of future high energy physics experi-
23 ments. The Secretary of Energy shall work with
24 international partners to enable further signifi-

1 cant contributions to the capabilities of this
2 project.

3 “(B) FACILITY CAPABILITIES.—The Sec-
4 retary shall ensure that the facility described in
5 paragraph (1) will provide, at a minimum, the
6 following capabilities:

7 “(i) A state-of-the-art 800
8 megaelectron volt (MeV) superconducting
9 linear accelerator.

10 “(ii) Proton beam power of 1.2 MW
11 at the start of LBNF/DUNE, upgradeable
12 to 2.4 MW of beam power.

13 “(iii) A flexible design to enable high
14 power beam delivery to multiple users si-
15 multaneously and customized beams tai-
16 lored to specific scientific needs.

17 “(iv) Sustained high reliability oper-
18 ation of the Fermilab accelerator complex.

19 “(C) START OF OPERATIONS.—The Sec-
20 retary shall, subject to the availability of appro-
21 priations, ensure that the start of full oper-
22 ations of the facility under this section occurs
23 before December 31, 2028.

24 “(D) FUNDING.—Out of funds authorized
25 to be appropriated under subsection (k), there

1 shall be made available to the Secretary to
2 carry out construction of the facility under this
3 subsection—

4 “(i) \$191,000,000 for fiscal year
5 2022;

6 “(ii) \$150,000,000 for fiscal year
7 2023;

8 “(iii) \$120,000,000 for fiscal year
9 2024;

10 “(iv) \$120,000,000 for fiscal year
11 2025; and

12 “(v) \$100,000,000 for fiscal year
13 2026.

14 “(4) COSMIC MICROWAVE BACKGROUND STAGE
15 4.—

16 “(A) IN GENERAL.—The Secretary of En-
17 ergy, in partnership with the Director of the
18 National Science Foundation, shall support con-
19 struction of the Cosmic Microwave Background
20 Stage 4 project to survey the cosmic microwave
21 background to test theories of cosmic inflation
22 as described in the 2014 Particle Physics
23 Prioritization Panel (P5) report titled ‘Building
24 for Discovery: Strategic Plan for U.S. Particle
25 Physics in the Global Context.’.

1 “(B) CONSULTATION.—The Secretary
2 shall consult with the private sector, univer-
3 sities, National Laboratories, and relevant Fed-
4 eral agencies to ensure that this experiment is
5 capable of meeting Federal research needs in
6 accessing the ultra-high energy physics of infla-
7 tion and important neutrino properties.

8 “(C) EXPERIMENTAL CAPABILITIES.—The
9 Secretary shall ensure to the maximum extent
10 practicable that the facility described in sub-
11 section (a) will provide at minimum, 500,000
12 superconducting detectors deployed on an array
13 of mm wave telescopes with the required range
14 in frequency, sensitivity, and survey speed
15 which will provide sufficient capability to enable
16 an order of magnitude advance in observations
17 of the Cosmic Microwave Background, deliv-
18 ering transformative discoveries in fundamental
19 physics, cosmology, and astrophysics.

20 “(D) START OF OPERATIONS.—The Sec-
21 retary shall, subject to the availability of appro-
22 priations, ensure that the start of full oper-
23 ations of the facility under this section occurs
24 before December 31, 2030.

1 “(E) FUNDING.—Out of funds authorized
2 to be appropriated under subsection (k), there
3 shall be made available to the Secretary to
4 carry out construction of the facility under this
5 subsection—

6 “(i) \$37,000,000 for fiscal year 2022;

7 “(ii) \$50,000,000 for fiscal year 2023;

8 “(iii) \$70,000,000 for fiscal year
9 2024;

10 “(iv) \$80,000,000 for fiscal year
11 2025; and

12 “(v) \$90,000,000 for fiscal year 2026.

13 “(h) ACCELERATOR AND DETECTOR UPGRADES.—
14 The Director shall upgrade accelerator facilities and detec-
15 tors, as necessary and appropriate, to increase beam
16 power, sustain high reliability, and improve precision
17 measurement to advance the highest priority particle phys-
18 ics research programs. In carrying out facility upgrades,
19 the Director shall continue to work with international
20 partners, when appropriate and in the United States’ in-
21 terest, to leverage investments and expertise in critical
22 technologies to help build and upgrade accelerator and de-
23 tector facilities in the United States.

24 “(i) ACCELERATOR AND DETECTOR RESEARCH AND
25 DEVELOPMENT.—As part of the program described in

1 subsection (b), the Director shall carry out research and
2 development in particle beam physics, accelerator science
3 and technology, and particle and radiation detection with
4 relevance to the specific needs of the High Energy Physics
5 program, in coordination with the Accelerator Research
6 and Development program authorized in section 310.

7 “(j) UNDERGROUND SCIENCE.—The Director shall—

8 “(1) support an underground science program
9 consistent with the missions of the Department and
10 the scientific needs of the High Energy Physics pro-
11 gram, including those articulated in the most recent
12 report of the Particle Physics Project Prioritization
13 Panel of the High Energy Physics Advisory Panel,
14 that leverages the capabilities of relevant under-
15 ground science and engineering facilities; and

16 “(2) carry out a competitive grant program to
17 award scientists and engineers at institutions of
18 higher education, nonprofit institutions, and Na-
19 tional Laboratories to conduct research in under-
20 ground science and engineering.

21 “(k) AUTHORIZATION OF APPROPRIATIONS.—There
22 are authorized to be appropriated to the Secretary to carry
23 out the activities described in this section—

24 “(1) \$1,355,690,000 for fiscal year 2022;

25 “(2) \$1,517,628,300 for fiscal year 2023;

- 1 “(3) \$1,652,112,281 for fiscal year 2024;
2 “(4) \$1,711,460,141 for fiscal year 2025; and
3 “(5) \$1,656,012,351 for fiscal year 2026.”.

4 **SEC. 8. NUCLEAR PHYSICS PROGRAM.**

5 (a) PROGRAM.—Section 308 of the Department of
6 Energy Research and Innovation Act (42 U.S.C. 18646)
7 is amended—

8 (1) by striking subsection (a);

9 (2) by redesignating subsection (b) as sub-
10 section (d); and

11 (3) by inserting the following before subsection
12 (d), as so redesignated:

13 “(a) PROGRAM.—As part of the activities authorized
14 under section 209 of the Department of Energy Organiza-
15 tion Act (42 U.S.C. 7139), the Director shall carry out
16 a research program, and support relevant facilities, to dis-
17 cover and understand various forms of nuclear matter.

18 “(b) USER FACILITIES.—

19 “(1) FACILITY FOR RARE ISOTOPE BEAMS.—

20 “(A) IN GENERAL.—The Secretary shall
21 support construction of a Facility for Rare Iso-
22 tope Beams to advance the understanding of
23 rare nuclear isotopes and the evolution of the
24 cosmos.

1 “(B) FUNDING.—Out of funds authorized
2 to be appropriated under subsection (c), there
3 shall be made available to the Secretary to
4 carry out construction of the facility under this
5 subsection \$2,000,000 for fiscal year 2022.

6 “(C) START OF OPERATIONS.—The Sec-
7 retary shall, subject to the availability of appro-
8 priations, ensure that the start of full oper-
9 ations of the facility under this section occurs
10 before March 1, 2022.

11 “(2) ELECTRON-ION COLLIDER.—

12 “(A) IN GENERAL.—The Secretary shall
13 support construction of an Electron Ion Collider
14 as described in the 2015 Long Range Plan of
15 the Nuclear Science Advisory Committee and
16 the report from the National Academies of
17 Science, Engineering, and Medicine titled ‘An
18 Assessment of U.S.-Based Electron-Ion Collider
19 Science’, in order to measure the internal struc-
20 ture of the proton and the nucleus and answer
21 fundamental questions about the nature of visi-
22 ble matter.

23 “(B) FACILITY CAPABILITY.—The Sec-
24 retary shall ensure that the facility meets the

1 requirements in the 2015 Long Range Plan, in-
2 cluding—

3 “(i) at least 70 percent polarized
4 beams of electrons and light ions;

5 “(ii) ion beams from deuterium to the
6 heaviest stable nuclei;

7 “(iii) variable center of mass energy
8 from 20 to 140 GeV;

9 “(iv) high collision luminosity of
10 $10^{33-34}\text{cm}^{-2}\text{s}^{-1}$; and

11 “(v) the possibility of more than one
12 interaction region.

13 “(C) START OF OPERATIONS.—The Sec-
14 retary shall, subject to the availability of appro-
15 priations, ensure that the start of full oper-
16 ations of the facility under this section occurs
17 before December 31, 2030.

18 “(D) FUNDING.—Out of funds authorized
19 to be appropriated under subsection (c), there
20 shall be made available to the Secretary to
21 carry out construction of the facility under this
22 subsection—

23 “(i) \$101,000,000 for fiscal year
24 2022;

1 “(ii) \$155,000,000 for fiscal year
2 2023;

3 “(iii) \$250,000,000 for fiscal year
4 2024;

5 “(iv) \$300,000,000 for fiscal year
6 2025; and

7 “(v) \$305,000,000 for fiscal year
8 2026.

9 “(c) AUTHORIZATION OF APPROPRIATIONS.—There
10 are authorized to be appropriated to the Secretary to carry
11 out the activities described in this section—

12 “(1) \$780,000,000 for fiscal year 2022;

13 “(2) \$879,390,000 for fiscal year 2023;

14 “(3) \$1,025,097,300 for fiscal year 2024;

15 “(4) \$1,129,354,111 for fiscal year 2025; and

16 “(5) \$1,192,408,899 for fiscal year 2026.”.

17 **SEC. 9. ACCELERATOR RESEARCH AND DEVELOPMENT.**

18 The Department of Energy Research and Innovation
19 Act (42 U.S.C. 18601 et seq.) is amended by adding after
20 section 309 the following:

21 **“SEC. 310. ACCELERATOR RESEARCH AND DEVELOPMENT.**

22 “(a) PROGRAM.—As part of the activities authorized
23 under section 209 of the Department of Energy Organiza-
24 tion Act (42 U.S.C. 7139), the Director shall carry out
25 a research program to—

1 “(1) advance accelerator science and technology
2 relevant to the Department, other Federal agencies,
3 and U.S. industry;

4 “(2) foster partnerships to develop, dem-
5 onstrate, and enable the commercial application of
6 accelerator technologies;

7 “(3) support the development of a skilled, di-
8 verse, and inclusive accelerator workforce; and

9 “(4) provide access to accelerator design and
10 engineering resources.

11 “(b) ACCELERATOR RESEARCH.—In carrying out the
12 program authorized under subsection (a), the Director
13 shall support—

14 “(1) research activities in cross-cutting accel-
15 erator technologies including superconducting
16 magnets and accelerators, beam physics, data ana-
17 lytics-based accelerator controls, simulation software,
18 new particle sources, advanced laser technology, and
19 transformative research; and

20 “(2) optimal operation of the Accelerator Test
21 Facility.

22 “(c) ACCELERATOR DEVELOPMENT.—In carrying out
23 the program authorized under subsection (a), the Director
24 shall support partnerships to foster the development, dem-
25 onstration, and commercial application of accelerator tech-

1 nologies including, advanced superconducting wire and
2 cable, superconducting RF cavities, and high efficiency ra-
3 diofrequency power sources for accelerators.

4 “(d) RESEARCH COLLABORATIONS.—In developing
5 accelerator technologies under the program authorized in
6 subsection (a), the Director shall—

7 “(1) consider the requirements necessary to
8 support translational research and development for
9 medical, industrial, security, and defense applica-
10 tions; and

11 “(2) leverage investments in accelerator tech-
12 nologies and fundamental research in particle phys-
13 ics by partnering with institutes of higher education,
14 industry, and other Federal agencies to enable the
15 commercial application of advanced accelerator tech-
16 nologies.

17 “(e) AUTHORIZATION OF APPROPRIATIONS.—There
18 are authorized to be appropriated to the Secretary to carry
19 out the activities described in this section—

20 “(1) \$24,000,000 for fiscal year 2022;

21 “(2) \$25,680,000 for fiscal year 2023;

22 “(3) \$27,477,600 for fiscal year 2024;

23 “(4) \$29,401,032 for fiscal year 2025; and

24 “(5) \$31,459,104 for fiscal year 2026.”

1 **SEC. 10. ISOTOPE DEVELOPMENT AND PRODUCTION FOR**
2 **RESEARCH APPLICATIONS.**

3 The Department of Energy Research and Innovation
4 Act (42 U.S.C. 18601 et seq.) is amended by adding after
5 section 310 as added by this Act the following:

6 **“SEC. 311. ISOTOPE DEVELOPMENT AND PRODUCTION FOR**
7 **RESEARCH APPLICATIONS.**

8 “(a) IN GENERAL.—The Director—

9 “(1) shall carry out a program in coordination
10 with other relevant programs across the Department
11 for the production of isotopes, including the develop-
12 ment of techniques to produce isotopes, that the Sec-
13 retary determines are needed for research, medical,
14 industrial, or related purposes, to the maximum ex-
15 tent practicable, in accordance with the 2015 Nu-
16 clear Science Advisory Committee ‘Meeting Isotope
17 Needs and Capturing Opportunities For The Fu-
18 ture’ report; and

19 “(2) shall ensure that isotope production activi-
20 ties carried out under the program under this para-
21 graph do not compete with private industry unless
22 the Director determines that critical national inter-
23 ests require the involvement of the Federal Govern-
24 ment.

1 “(b) AUTHORIZATION OF APPROPRIATIONS.—There
2 are authorized to be appropriated to carry out the pro-
3 gram under this section—

4 “(1) \$90,000,000 for fiscal year 2022;

5 “(2) \$96,300,000 for fiscal year 2023;

6 “(3) \$103,041,000 for fiscal year 2024;

7 “(4) \$110,253,870 for fiscal year 2025; and

8 “(5) \$117,971,641 for fiscal year 2026.”.

9 **SEC. 11. SCIENCE LABORATORIES INFRASTRUCTURE PRO-**
10 **GRAM.**

11 (a) PROGRAM.—Section 309 of the Department of
12 Energy Research and Innovation Act (42 U.S.C. 18647)
13 is amended by adding at the end the following:

14 “(c) APPROACH.—In carrying out this section, the
15 Director shall utilize all available approaches and mecha-
16 nisms, including capital line items, minor construction
17 projects, energy savings performance contracts, utility en-
18 ergy service contracts, alternative financing and expense
19 funding, as appropriate.

20 “(d) MID-SCALE INSTRUMENTATION PROGRAM.—
21 The Director, in coordination with each of the programs
22 carried out by the Office of Science, shall establish a mid-
23 scale instrumentation program to enable the development
24 and acquisition of novel, state-of-the-art instruments rang-
25 ing in cost from \$1 million to \$20 million each that would

1 significantly accelerate scientific breakthroughs at user fa-
2 cilities.

3 “(e) AUTHORIZATION OF APPROPRIATIONS.—There
4 are authorized to be appropriated to the Secretary to carry
5 out the activities described in this section \$500,000,000
6 for each of fiscal years 2022 through 2026.”.

7 **SEC. 12. INCREASED COLLABORATION WITH TEACHERS**
8 **AND SCIENTISTS.**

9 (a) IN GENERAL.—The Department of Energy Re-
10 search and Innovation Act (42 U.S.C. 18601 et seq.) is
11 amended by adding after section 311, as added by this
12 Act, the following:

13 **“SEC. 312. INCREASED COLLABORATION WITH TEACHERS**
14 **AND SCIENTISTS.**

15 “The Director shall support the development of a sci-
16 entific workforce through programs that facilitate collabo-
17 ration between K–12, university students, early-career re-
18 searchers, faculty, and the National Laboratories, includ-
19 ing through the use of proven techniques to expand the
20 number of individuals from underrepresented groups pur-
21 suing and attaining skills or undergraduate and graduate
22 degrees relevant to the Office’s mission.”.

23 (b) AUTHORIZATION OF APPROPRIATIONS.—Section
24 3169 of the Department of Energy Science Education En-
25 hancement Act (42 U.S.C. 7381e) is amended—

1 (1) by striking, “programs”, and inserting
2 “programs, including the NSF INCLUDES Na-
3 tional Network,”; and

4 (2) by striking, “year 1991”, and inserting
5 “years 2022 through 2026”.

6 (c) BROADENING PARTICIPATION IN WORKFORCE
7 DEVELOPMENT FOR TEACHERS AND SCIENTISTS.—

8 (1) IN GENERAL.—The Department of Energy
9 Science Education Enhancement Act (42 U.S.C.
10 7381 et seq.) is amended by inserting the following
11 sections after section 3167 (42 U.S.C. 7381e–1):

12 **“SEC. 3167A. BROADENING PARTICIPATION FOR TEACHERS**
13 **AND SCIENTISTS.**

14 “(a) IN GENERAL.—The Secretary shall expand op-
15 portunities to increase the number and the diversity, eq-
16 uity, and inclusion of highly skilled science, technology, en-
17 gineering, and mathematics (STEM) professionals work-
18 ing in Department of Energy mission-relevant disciplines
19 and broaden the recruitment pool to increase diversity, in-
20 cluding expanded partnerships with Historically Black
21 Colleges, Tribal Colleges, Minority Serving Institutions,
22 emerging research institutions, and scientific societies.

23 “(b) PLAN.—Not later than 1 year after the date of
24 enactment of the Department of Energy Science for the
25 Future Act, the Secretary shall submit to the Committee

1 on Science, Space, and Technology of the House of Rep-
2 resentatives and the Committee on Energy and Natural
3 Resources and the Committee on Commerce, Science, and
4 Transportation of the Senate and make available to the
5 public a plan for broadening participation of underrep-
6 resented groups in science, technology, engineering, and
7 mathematics in programs supported by the Department
8 programs, including—

9 “(1) a plan for supporting and leveraging the
10 National Science Foundation INCLUDES National
11 Network;

12 “(2) metrics for assessing the participation of
13 underrepresented groups in Department programs;

14 “(3) experienced and potential barriers to
15 broadening participation of underrepresented groups
16 in Department programs, including recommended
17 solutions; and

18 “(4) any other activities the Secretary finds ap-
19 propriate.

20 “(c) AUTHORIZATION OF APPROPRIATIONS.—Of the
21 amounts authorized to be appropriated in section 3169
22 (42 U.S.C. 7381e), at least \$2,000,000 shall be made
23 available each fiscal year for the activities described under
24 this subsection.

1 **“SEC. 3167B. EXPANDING OPPORTUNITIES TO INCREASE**
2 **THE DIVERSITY, EQUITY, AND INCLUSION OF**
3 **HIGHLY SKILLED SCIENCE, TECHNOLOGY,**
4 **ENGINEERING, AND MATHEMATICS (STEM)**
5 **PROFESSIONALS.**

6 “(a) IN GENERAL.—The Secretary shall expand op-
7 portunities to increase the number and the diversity, eq-
8 uity, and inclusion of highly skilled science, technology, en-
9 gineering, and mathematics (STEM) professionals work-
10 ing in Department of Energy mission-relevant disciplines
11 and broaden the recruitment pool to increase diversity, in-
12 cluding expanded partnerships with minority-serving insti-
13 tutions, non-Research I universities, and scientific soci-
14 eties.

15 “(b) PLAN AND OUTREACH STRATEGY.—

16 “(1) PLAN.—Not later than 6 months after the
17 date of enactment of the Department of Energy
18 Science for the Future Act, the Secretary shall sub-
19 mit to the Committee on Science, Space, and Tech-
20 nology of the House of Representatives and the
21 Committee on Energy and Natural Resources of the
22 Senate a 10-year educational plan to fund and ex-
23 pand new or existing programs administered by the
24 Office of Science and sited at the National Labora-
25 tories and Department of Energy user facilities to
26 expand educational and workforce opportunities for

1 underrepresented high school, undergraduate, and
2 graduate students as well as recent graduates,
3 teachers and faculty in STEM fields. This may in-
4 clude paid internships, fellowships, temporary em-
5 ployment, training programs, visiting student and
6 faculty programs, sabbaticals, and research support.

7 “(2) OUTREACH CAPACITY.—The Secretary
8 shall include in the plan under paragraph (1) an
9 outreach strategy to improve the advertising, recruit-
10 ment, and promotion of educational and workforce
11 programs to community colleges, Historically Black
12 Colleges and Universities, Tribal Colleges, Minority
13 Serving Institutions, and emerging research institu-
14 tions.

15 “(c) BUILDING RESEARCH CAPACITY.—The Sec-
16 retary shall develop programs that strengthen the research
17 capacity relevant to Office of Science disciplines at emerg-
18 ing research institutions, including minority-serving insti-
19 tutions, tribal colleges and universities, Historically Black
20 Colleges and Universities, and colleges and universities.
21 This may include enabling mutually beneficial and jointly
22 managed partnerships between research-intensive institu-
23 tions and emerging research institutions, and soliciting re-
24 search proposals, fellowships, training programs, and re-

1 search support directly from emerging research institu-
2 tions.

3 “(d) **TRAINEESHIPS.**—The Secretary shall establish
4 a university-led Traineeship Program to address workforce
5 training needs in STEM fields relevant to the Depart-
6 ment. The focus should be on supporting training and re-
7 search experiences for underrepresented undergraduate
8 and graduate students and increasing participation from
9 underrepresented populations. The traineeships should in-
10 clude opportunities to build the next-generation workforce
11 in research areas critical to maintaining core competencies
12 across the Office of Science’s programs.

13 “(e) **EVALUATION.**—The Secretary shall establish key
14 performance indicators to measure and monitor progress
15 of education and workforce programs and expand Depart-
16 mental activities for data collection and analysis. The Sec-
17 retary shall submit a report 2 years after the date of en-
18 actment of the Department of Energy Science for the Fu-
19 ture Act, and every 2 years thereafter, to the Committee
20 on Science, Space, and Technology of the House of Rep-
21 resentatives and the Committee on Energy and Natural
22 Resources of the Senate summarizing progress toward
23 meeting key performance indicators.

24 “(f) **DEFINITIONS.**—In this section:

1 “(1) MINORITY-SERVING INSTITUTION.—The
2 term ‘minority-serving institution’ includes the enti-
3 ties described in any of paragraphs (1) through (7)
4 of section 371(a) of the Higher Education Act of
5 1965 (20 U.S.C. 1067q(a)).

6 “(2) HISTORICALLY BLACK COLLEGE AND UNI-
7 VERSITIES.—The term ‘Historically Black Colleges
8 and Universities’ has the meaning given in ‘part B
9 institution’ in section 322 of the Higher Education
10 Act of 1965 (20 U.S.C. 1061).

11 “(3) STEM.—The term ‘STEM’ means the
12 field or disciplines listed in section 2 of the STEM
13 Education Act of 2015 (42 U.S.C. 6621 note).

14 “(4) TRIBAL COLLEGES AND UNIVERSITIES.—
15 The term ‘Tribal College or University’ has the
16 meaning given in section 316 of the Higher Edu-
17 cation Act of 1965 (20 U.S.C. 1059c).”.

18 (2) Clerical amendment.—The table of contents
19 in section 2(b) of the National Defense Authoriza-
20 tion Act for Fiscal Year 1991 is amended by insert-
21 ing after the item relating to section 3167 the fol-
22 lowing:

“Sec. 3167A. Broadening participation for teachers and scientists.

“Sec. 3167B. Expanding opportunities to increase the diversity, equity, and in-
clusion of highly skilled science, technology, engineering, and
mathematics (STEM) professionals.”.

1 **SEC. 13. HIGH INTENSITY LASER RESEARCH INITIATIVE;**
2 **OFFICE OF SCIENCE EMERGING INFECTIOUS**
3 **DISEASE COMPUTING RESEARCH INITIATIVE;**
4 **HELIUM CONSERVATION PROGRAM; AUTHOR-**
5 **IZATION OF APPROPRIATIONS.**

6 (a) IN GENERAL.—The Department of Energy Re-
7 search and Innovation Act (42 U.S.C. 18601 et seq.) is
8 amended by adding at the end the following:

9 **“SEC. 313. HIGH INTENSITY LASER RESEARCH INITIATIVE.**

10 “(a) IN GENERAL.—The Director shall establish a
11 high intensity laser research initiative consistent with the
12 recommendations of the National Academies report, ‘Op-
13 portunities in Intense Ultrafast Lasers: Reaching for the
14 Brightest Light’, and the report from the Brightest Light
15 Initiative workshop on ‘The Future of Intense Ultrafast
16 Lasers in the U.S.’. This initiative should include research
17 and development of petawatt-scale and of high average
18 power laser technologies necessary for future facility needs
19 in discovery science and to advance energy technologies,
20 as well as support for a user network of academic and
21 national laboratory high intensity laser facilities.

22 “(b) LEVERAGE.—The Director shall leverage new
23 laser technologies for more compact, less complex, and
24 low-cost accelerator systems needed for science applica-
25 tions.

1 “(c) COORDINATION.—The Director shall coordinate
2 this initiative among all relevant programs within the Of-
3 fice of Science, and the Under Secretary for Science shall
4 coordinate this initiative with other relevant programs
5 within the Department as well as within other Federal
6 agencies.

7 “(d) AUTHORIZATION OF APPROPRIATIONS.—Out of
8 funds authorized to be appropriated for the Office of
9 Science there are authorized to be appropriated to the Sec-
10 retary to carry out the activities described in this sec-
11 tion—

12 “(1) \$50,000,000 for fiscal year 2022;

13 “(2) \$100,000,000 for fiscal year 2023;

14 “(3) \$150,000,000 for fiscal year 2024;

15 “(4) \$200,000,000 for fiscal year 2025; and

16 “(5) \$250,000,000 for fiscal year 2026.

17 **“SEC. 314. HELIUM CONSERVATION PROGRAM.**

18 “(a) IN GENERAL.—The Secretary shall establish a
19 program to reduce the consumption of helium for Depart-
20 ment grant recipients and facilities and encourage helium
21 recycling and reuse. The program shall competitively
22 award grants for—

23 “(1) the purchase of equipment to capture,
24 reuse, and recycle helium;

1 “(2) the installation, maintenance, and repair
2 of new and existing helium capture, reuse, and recy-
3 cling equipment; and

4 “(3) helium alternatives research and develop-
5 ment activities.

6 “(b) REPORT.—In carrying out the program under
7 this section, the Director shall submit to the Committee
8 on Science, Space, and Technology of House of Represent-
9 atives and the Committee on Energy and Natural Re-
10 sources of the Senate a report, not later than two years
11 after the date of enactment of the Department of Energy
12 Science for the Future Act, and every 3 years thereafter,
13 on the purchase of helium as part of research projects and
14 facilities supported by the Department. The report shall
15 include—

16 “(1) the quantity of helium purchased for
17 projects and facilities supported by Department
18 grants;

19 “(2) a cost-analysis for such helium;

20 “(3) the predominant production sources for
21 such helium;

22 “(4) expected or experienced impacts of helium
23 supply shortages or prices on the research projects
24 and facilities supported by the Department; and

1 “(5) recommendations for reducing Department
2 grant recipients’ exposure to volatile helium prices.

3 “(c) COORDINATION.—In carrying out the program
4 under this section, the Director shall coordinate with the
5 National Science Foundation and other relevant Federal
6 agencies on helium conservation activities.

7 “(d) DURATION.—The program established under
8 this section shall receive support for a period of not more
9 than 5 years, subject to the availability of appropriations.

10 “(e) RENEWAL.—Upon expiration of any period of
11 support of the program under this section, the Director
12 may renew support for the program for a period of not
13 more than 5 years.

14 **“SEC. 315. OFFICE OF SCIENCE EMERGING INFECTIOUS**
15 **DISEASE COMPUTING RESEARCH INITIATIVE.**

16 “(a) IN GENERAL.—The Secretary, in coordination
17 with the Director of the National Science Foundation and
18 the Administrator of the National Aeronautics and Space
19 Administration, shall establish within the Office of
20 Science, a cross-cutting research initiative to leverage the
21 Federal Government’s innovative analytical resources and
22 tools, user facilities, and advanced computational and net-
23 working capabilities in order to prevent, prepare for, and
24 respond to emerging infectious diseases, including
25 COVID–19. The Secretary shall carry out this initiative

1 through a competitive, merit-reviewed process, and con-
2 sider applications from National Laboratories, institutions
3 of higher education, multi-institutional collaborations, in-
4 dustry partners and other appropriate entities.

5 “(b) ACTIVITIES.—In carrying out the initiative es-
6 tablished under subsection (a), the Secretary shall coordi-
7 nate with programs across the Office of Science and with
8 relevant Federal agencies to determine a comprehensive
9 set of technical milestones for these research activities and
10 prioritize the following objectives—

11 “(1) supporting fundamental research and de-
12 velopment in advanced analytics, experimental stud-
13 ies, materials synthesis, high-performance computing
14 technologies needed to characterize, model, simulate,
15 and predict complex phenomena and biological mate-
16 rials related to emerging infectious diseases, includ-
17 ing COVID–19 challenges, including a focus on test-
18 ing and diagnostics, experimental data acquisition,
19 sharing and management, advanced manufacturing,
20 and molecular design and modeling;

21 “(2) using expertise from the private sector, in-
22 stitutions of higher education, and the National
23 Laboratories to develop computational software and
24 capabilities that prospective users may accelerate

1 emerging infectious diseases research and develop-
2 ment;

3 “(3) leveraging the research infrastructure of
4 the Department, including scientific computing user
5 facilities, x-ray light sources, neutron scattering fa-
6 cilities, nanoscale science research centers, and se-
7 quencing and bio-characterization facilities by co-
8 ordinating with the Advanced Scientific Computing
9 Research, Basic Energy Sciences, and Biological and
10 Environmental Research programs within the Office
11 of Science;

12 “(4) leveraging experience from existing mod-
13 eling and simulation research and work sponsored by
14 the Department and promoting collaboration and
15 data sharing between National Laboratories, re-
16 search entities, and user facilities of the Department
17 by providing the necessary access and secure data
18 transfer capabilities; and

19 “(5) ensuring that new experimental and com-
20 putational tools are accessible to relevant research
21 communities, including private sector entities to ad-
22 dress emerging infectious diseases, including
23 COVID–19 challenges.

24 “(c) COORDINATION.—In carrying out this initiative,
25 the Secretary shall ensure, to the maximum extent prac-

1 ticable, coordination of these activities with the Depart-
2 ment of Energy National Laboratories, institutions of
3 higher education, and the private sector.

4 “(d) EMERGING INFECTIOUS DISEASES HIGH PER-
5 FORMANCE COMPUTING RESEARCH CONSORTIUM.—

6 “(1) IN GENERAL.—The Secretary in coordina-
7 tion with the Director of the National Science Foun-
8 dation and the Director of the Office of Science and
9 Technology Policy shall establish and operate an
10 Emerging Infectious Diseases High Performance
11 Computing Research Consortium (referred to in this
12 section as the ‘Consortium’), to support the initiative
13 under subsection (a) by providing, to the extent
14 practicable, a centralized entity for multidisciplinary,
15 collaborative, emerging infectious disease research
16 and development through high performance com-
17 puting and advanced data analytics technologies and
18 processes.

19 “(2) MEMBERSHIP.—The members of such con-
20 sortium may include representatives from relevant
21 Federal agencies, the private sector, institutions of
22 higher education, which can each contribute relevant
23 compute time, capabilities, or other resources.

24 “(3) ACTIVITIES.—The Consortium shall—

1 “(A) match applicants with available Fed-
2 eral and private sector computing resources;

3 “(B) consider supplemental awards for
4 computing partnerships with Consortium mem-
5 bers to qualifying entities on a competitive
6 merit-review basis;

7 “(C) encourage collaboration and commu-
8 nication among member representatives of the
9 consortium and awardees;

10 “(D) make available the high-performance
11 computing capabilities, expertise, and user fa-
12 cilities of the Department and the National
13 Laboratories; and

14 “(E) submit an annual report to the Sec-
15 retary summarizing the activities of the Consor-
16 tium, including—

17 “(i) describing each project under-
18 taken by the Consortium;

19 “(ii) detailing organizational expendi-
20 tures; and

21 “(iii) evaluating contribution to the
22 achievement of technical milestones as de-
23 termined in subsection (a).

24 “(4) COORDINATION.—The Secretary shall en-
25 sure the coordination of, and avoid unnecessary du-

1 plication of, the activities of the Consortium with the
2 activities of other research entities of the Depart-
3 ment, institutions of higher education and the pri-
4 vate sector.

5 “(e) REPORT.—Not later than 2 years after the date
6 of enactment of the Department of Energy Science for the
7 Future Act, the Secretary shall submit to the Committee
8 on Science, Space, and Technology of the House, and the
9 Committee on Energy and Natural Resources of the Sen-
10 ate, and the Committee on Commerce, Science, and
11 Transportation of the Senate a report detailing the effec-
12 tiveness of—

13 “(1) the interagency coordination between each
14 Federal agency involved in the research initiative
15 carried out under this section;

16 “(2) the collaborative research achievements of
17 the initiative, including the achievement of the tech-
18 nical milestones determined under subsection (a);
19 and

20 “(3) potential opportunities to expand the tech-
21 nical capabilities of the Department.

22 “(f) FUNDING.—From within funds authorized to be
23 appropriated for the Department’s Office of Science, there
24 shall be made available to the Secretary to carry out the

1 activities under this subsection, \$50,000,000 for fiscal
2 years 2022 and 2023.

3 “(g) PROHIBITION.—

4 “(1) IN GENERAL.—In carrying out this Act,
5 the Secretary may not carry out gain-of-function re-
6 search of concern.

7 “(2) GAIN-OF-FUNCTION RESEARCH DE-
8 FINED.—For the purposes of this subsection, ‘gain-
9 of-function research of concern’ means research ac-
10 tivities with the potential to generate pathogens with
11 high transmissibility and high virulence in humans.

12 **“SEC. 316. AUTHORIZATION OF APPROPRIATIONS.**

13 “There are authorized to be appropriated to the Sec-
14 retary to carry out the activities described in this title—

15 “(1) \$8,801,915,000 for fiscal year 2022;

16 “(2) \$9,451,015,300 for fiscal year 2023;

17 “(3) \$10,160,677,621 for fiscal year 2024;

18 “(4) \$10,693,625,004 for fiscal year 2025; and

19 “(5) \$11,145,798,345 for fiscal year 2026.”.

20 (b) TABLE OF CONTENTS.—Section 1(b) of the De-
21 partment of Energy Research and Innovation Act is
22 amended in the table of contents by inserting after the
23 item relating to section 309 the following:

“Sec. 310. Accelerator research and development.

“Sec. 311. Isotope Development and Production for Research Applications.

“Sec. 312. Increased collaboration with teachers and scientists.

“Sec. 313. High intensity laser research initiative.

“Sec. 314. Helium conservation program.

“Sec. 315. Office of Science Emerging Infectious Disease Computing Research Initiative.

“Sec. 316. Authorization of appropriations.”.

1 **SEC. 14. STATE-OWNED ENTERPRISES PROHIBITION.**

2 (a) INNOVATE IN AMERICA.—In carrying out this Act
3 or the amendments made by this Act, the Secretary may
4 not award a contract, subcontract, grant, or loan to an
5 entity that—

6 (1) is owned or controlled by, is a subsidiary of,
7 or is otherwise related legally or financially to a cor-
8 poration based in a country that—

9 (A) is identified as a nonmarket economy
10 country (as defined in section 771(18) of the
11 Tariff Act of 1930 (19 U.S.C. 1677(18))) as of
12 the date of enactment of this Act;

13 (B) was identified by the United States
14 Trade Representative in the most recent report
15 required by section 182 of the Trade Act of
16 1974 (19 U.S.C. 2242) as a priority foreign
17 country under subsection (a)(2) of that section;
18 and

19 (C) is subject to monitoring by the Trade
20 Representative under section 306 of the Trade
21 Act of 1974 (19 U.S.C. 2416); or

22 (2) is listed pursuant to section 9(b)(3) of the
23 Uyghur Human Rights Policy Act of 2020 (Public
24 Law 116–145).

1 (b) EXCEPTION.—For purposes of subsection (a), the
2 Secretary may issue a waiver, to be made publicly avail-
3 able, to an entity in which the legal or financial connection
4 to a corporation is a minority relationship or investment.

5 (c) INTERNATIONAL AGREEMENTS.—This section
6 shall be applied in a manner consistent with the obliga-
7 tions of the United States under international agreements.