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H. R. 3593

[Report No. 117-72]

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

JUNE 28, 2021

Additional sponsors: Mr. MCNERNEY, Mrs. BICE of Oklahoma, Ms. ROSS, Mr. WALTZ, Mr. PERLMUTTER, Mr. MELJER, Mr. BEYER, Mr. BAIRD, Mr. MORELLE, Mr. GIMENEZ, Ms. MOORE of Wisconsin, Mr. OBERNOLTE, Ms. BONAMICI, Mr. BABIN, Mr. CRIST, Mr. GONZALEZ of Ohio, Mr. GRIJALVA, Mrs. KIM of California, Mr. FOSTER, Mr. FEENSTRA, Mr. SAN NICOLAS, Miss GONZÁLEZ-COLÓN, Ms. LEGER FERNANDEZ, Mr. LATURNER, Mr. NORCROSS, Mr. KILDEE, Ms. WILD, Ms. STEVENS, Ms. LOFGREN, Mr. SHERMAN, Ms. SHERRILL, Ms. STANSBURY, Mr. BERA, Mrs. FLETCHER, Mr. TONKO, and Mr. LAMB

JUNE 28, 2021

Reported with an amendment, committed to the Committee of the Whole House on the State of the Union, and ordered to be printed

[Strike out all after the enacting clause and insert the part printed in *italic*]

[For text of introduced bill, see copy of bill as introduced on May 28, 2021]

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”.*

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

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

10 “(d) *USER FACILITIES.*—*The Director shall carry out*
11 *the construction, operation, and maintenance of user facili-*
12 *ties to support the mission described in subsection (c). As*
13 *practicable, these facilities shall serve the needs of the De-*
14 *partment, industry, the academic community, and other*
15 *relevant entities for the purposes of advancing the missions*
16 *of the Department, improving the competitiveness of the*
17 *United States, protecting public health and safety, and ad-*
18 *ressing other national priorities including emergencies.*

19 “(e) *COORDINATION.*—

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

21 “(A) *shall ensure the coordination of the Of-*
22 *fice of Science with the other activities of the De-*
23 *partment;*

24 “(B) *shall support joint activities among*
25 *the programs of the Department;*

1 “(C) shall coordinate with other relevant
2 Federal agencies in supporting advancements in
3 related research areas as appropriate; and

4 “(D) may form partnerships to enhance the
5 utilization of and ensure access to user facilities
6 by other Federal agencies.

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

8 “(A) shall ensure the coordination of pro-
9 grams and activities carried out by the Office of
10 Science; and

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

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

18 (a) DEPARTMENT OF ENERGY RESEARCH AND INNOVA-
19 TION ACT.—Section 303 of the Department of Energy Re-
20 search and Innovation Act (42 U.S.C. 18641) is amended—

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

23 (2) by inserting before subsection (c), as so redesi-
24 gnated, the following:

1 “(a) *PROGRAM.*—As part of the activities authorized
2 under section 209 of the Department of Energy Organiza-
3 tion Act (42 U.S.C. 7139), the Director shall carry out a
4 research and development program in basic energy sciences,
5 including materials sciences and engineering, chemical
6 sciences, physical biosciences, geosciences, and other dis-
7 ciplines, to understand, model, and control matter and en-
8 ergy at the electronic, atomic, and molecular levels in order
9 to provide the foundations for new energy technologies, ad-
10 dress scientific grand challenges, and support the energy,
11 environment, and national security missions of the Depart-
12 ment.

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

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

20 (A) in subparagraph (C), by striking “and”
21 at the end;

22 (B) by redesignating subparagraph (D) as
23 subparagraph (E); and

24 (C) by inserting after subparagraph (C) the
25 following:

1 “(D) *autonomous chemistry and materials*
 2 *synthesis and characterization facilities that le-*
 3 *verage advances in artificial intelligence; and*”;
 4 (4) *in subsection (d), as so redesignated, by add-*
 5 *ing at the end the following:*

6 “(4) *ADVANCED PHOTON SOURCE UPGRADE.—*

7 “(A) *DEFINITIONS.—In this paragraph:*

8 “(i) *FLUX.—The term ‘flux’ means the*
 9 *rate of flow of photons.*

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

13 “(B) *IN GENERAL.—The Secretary shall*
 14 *provide for the upgrade to the Advanced Photon*
 15 *Source described in the publication approved by*
 16 *the Basic Energy Sciences Advisory Committee*
 17 *on June 9, 2016, titled ‘Report on Facility Up-*
 18 *grades’, including the development of a multi-*
 19 *bend achromat lattice to produce a high flux of*
 20 *coherent x-rays within the hard x-ray energy re-*
 21 *gion and a suite of beamlines optimized for this*
 22 *source.*

23 “(C) *START OF OPERATIONS.—The Sec-*
 24 *retary shall, subject to the availability of appro-*
 25 *priations, ensure that the start of full operations*

1 *of the upgrade under this paragraph occurs be-*
2 *fore March 31, 2026.*

3 “(D) *FUNDING.*—*Out of funds authorized to*
4 *be appropriated under subsection (j), there shall*
5 *be made available to the Secretary to carry out*
6 *the upgrade under this paragraph \$157,000,000*
7 *for fiscal year 2022.*

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

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

13 “(B) *PROTON POWER UPGRADE DEFINED.*—
14 *For the purposes of this paragraph, the term*
15 *‘proton power upgrade’ means the Spallation*
16 *Neutron Source power upgrade described in—*

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

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

1 *the Department of Energy in August, 2007;*
 2 *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 operations*
 10 *of the upgrade under this paragraph occurs be-*
 11 *fore December 31, 2028.*

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

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

19 “(A) *IN GENERAL.—The Secretary shall*
 20 *provide for a second target station for the Spall-*
 21 *ation Neutron Source.*

22 “(B) *SECOND TARGET STATION DEFINED.—*
 23 *For the purposes of this paragraph, the term*
 24 *‘second target station’ means the Spallation Neu-*
 25 *tron Source second target station described in—*

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

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

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

16 “(C) *START OF OPERATIONS.*—The Sec-
17 retary shall, subject to the availability of appro-
18 priations, ensure that the start of full operations
19 of the second target station under this paragraph
20 occurs before December 31, 2030, with the option
21 for early operation in 2029.

22 “(D) *FUNDING.*—Out of funds authorized to
23 be appropriated under subsection (j), there shall
24 be made available to the Secretary to carry out

the activities under this paragraph, including
construction—

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

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

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

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

and

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

“(7) *ADVANCED LIGHT SOURCE UPGRADE.*—

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

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

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

“(B) *IN GENERAL.*—*The Secretary shall
provide for the upgrade to the Advanced Light
Source described in the publication approved by
the Basic Energy Sciences Advisory Committee
on June 9, 2016, titled ‘Report on Facility Up-
grades’, including the development of a
multibend achromat lattice to produce a high
flux of coherent x-rays within the soft x-ray en-
ergy region.*

1 “(C) *START OF OPERATIONS.*—*The Sec-*
 2 *retary shall, subject to the availability of appro-*
 3 *priations, ensure that the start of full operations*
 4 *of the upgrade under this paragraph occurs be-*
 5 *fore September 30, 2029.*

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

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

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

12 “(iii) \$102,500,000 for fiscal year
 13 2024;

14 “(iv) \$25,000,000 for fiscal year 2025;

15 *and*

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

17 “(8) *LINAC COHERENT LIGHT SOURCE II HIGH*
 18 *ENERGY UPGRADE.*—

19 “(A) *DEFINITIONS.*—*In this paragraph:*

20 “(i) *HIGH ENERGY X-RAY.*—*The term*
 21 *‘high energy x-ray’ means a photon with an*
 22 *energy in the 5 to 13 kiloelectron volt range.*

23 “(ii) *HIGH REPETITION RATE.*—*The*
 24 *term ‘high repetition rate’ means the deliv-*

1 *ery of x-ray pulses up to 1 million pulses*
2 *per second.*

3 “(iii) *ULTRA-SHORT PULSE X-RAYS.*—
4 *The term ‘ultra-short pulse x-rays’ means x-*
5 *ray bursts capable of durations of less than*
6 *100 femtoseconds.*

7 “(B) *IN GENERAL.*—*The Secretary shall—*

8 “(i) *provide for the upgrade to the*
9 *Linac Coherent Light Source II facility de-*
10 *scribed in the publication approved by the*
11 *Basic Energy Sciences Advisory Committee*
12 *on June 9, 2016, titled ‘Report on Facility*
13 *Upgrades’, including the development of ex-*
14 *perimental capabilities for high energy x-*
15 *rays to reveal fundamental scientific discov-*
16 *eries; and*

17 “(ii) *ensure such upgrade enables the*
18 *production and use of high energy, ultra-*
19 *short pulse x-rays delivered at a high rep-*
20 *etition rate.*

21 “(C) *START OF OPERATIONS.*—*The Sec-*
22 *retary shall, subject to the availability of appro-*
23 *priations, ensure that the start of full operations*
24 *of the upgrade under this paragraph occurs be-*
25 *fore December 31, 2026.*

1 “(D) *FUNDING.*—*Out of funds authorized to*
 2 *be appropriated under subsection (j), there shall*
 3 *be made available to the Secretary to carry out*
 4 *the upgrade under this paragraph—*

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

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

7 “(iii) \$115,000,000 for fiscal year
 8 2024;

9 “(iv) \$89,000,000 for fiscal year 2025;

10 and

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

12 “(9) *CRYOMODULE REPAIR AND MAINTENANCE*
 13 *FACILITY.*—

14 “(A) *IN GENERAL.*—*The Secretary shall*
 15 *provide for the construction of a cryomodule re-*
 16 *pair and maintenance facility to service the*
 17 *Linac Coherent Light Source II and upgrades to*
 18 *the facility. The Secretary shall consult with the*
 19 *private sector, universities, National Labora-*
 20 *tories, and relevant Federal agencies to ensure*
 21 *that this facility has the capability to maintain,*
 22 *repair, and test superconducting radiofrequency*
 23 *accelerator components.*

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

1 *be made available to the Secretary to carry out*
 2 *the activities under this paragraph—*

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

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

5 *“(iii) \$25,000,000 for fiscal year 2024;*

6 *and*

7 *“(iv) \$17,000,000 for fiscal year 2025.*

8 *“(10) NANOSCALE SCIENCE RESEARCH CENTER*
 9 *RECAPITALIZATION PROJECT.—*

10 *“(A) IN GENERAL.—The Secretary shall*
 11 *provide for the recapitalization of the Nanoscale*
 12 *Science Research Centers, to include the upgrade*
 13 *of equipment at each Center supported by the Of-*
 14 *fice of Science on the date of enactment of the*
 15 *Department of Energy Science for the Future*
 16 *Act, to accelerate advances in the various fields*
 17 *of science including nanoscience, materials,*
 18 *chemistry, biology, and quantum information*
 19 *science.*

20 *“(B) FUNDING.—Out of funds authorized to*
 21 *be appropriated under subsection (j), there shall*
 22 *be made available to the Secretary to carry out*
 23 *the recapitalization under this paragraph—*

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

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

1 “(iii) \$20,000,000 for fiscal year 2024;

2 and

3 “(iv) \$20,000,000 for fiscal year

4 2025.”;

5 (5) by adding at the end the following:

6 “(h) COMPUTATIONAL MATERIALS AND CHEMICAL

7 SCIENCES.—

8 “(1) IN GENERAL.—The Director shall support a
9 program of research and development for the applica-
10 tion of advanced computing practices to foundational
11 and emerging research problems in chemistry and
12 materials science. Research activities shall include—

13 “(A) chemical catalysis research and devel-
14 opment;

15 “(B) the use of large data sets to model ma-
16 terials phenomena, including through advanced
17 characterization of materials, materials syn-
18 thesis, processing, and innovative use of experi-
19 mental and theoretical data;

20 “(C) co-design of chemical system and
21 chemistry modeling software with advanced com-
22 puting systems and hardware technologies; and

23 “(D) modeling of chemical processes, assem-
24 blies, and reactions such as molecular dynamics

1 *and quantum chemistry, including through novel*
2 *computing methods.*

3 “(2) *COMPUTATIONAL MATERIALS AND CHEMICAL*
4 *SCIENCES CENTERS.*—

5 “(A) *IN GENERAL.*—*In carrying out the ac-*
6 *tivities authorized under paragraph (1), the Di-*
7 *rector shall select and establish up to six com-*
8 *putational materials and chemical sciences cen-*
9 *ters to—*

10 “(i) *develop open-source, robust, and*
11 *validated computational codes and user-*
12 *friendly software, coupled with innovative*
13 *use of experimental and theoretical data, to*
14 *enable the design, discovery, and develop-*
15 *ment of new materials and chemical sys-*
16 *tems; and*

17 “(ii) *focus on overcoming challenges*
18 *and maximizing the benefits of exascale and*
19 *other high performance computing under-*
20 *pinned by accelerated node technologies.*

21 “(B) *SELECTION.*—*The Director shall select*
22 *centers under subparagraph (A) on a competi-*
23 *tive, merit-reviewed basis. The Director shall*
24 *consider applications from the National Labora-*
25 *tories, institutes of higher education, multi-insti-*

1 *tutional collaborations, and other appropriate*
2 *entities.*

3 “(C) *DURATION.*—

4 “(i) *A center selected under subpara-*
5 *graph (A) shall receive support for a period*
6 *of not more than 5 years beginning on the*
7 *date of establishment of that center, subject*
8 *to the availability of appropriations.*

9 “(ii) *A center already in existence on*
10 *the date of enactment of the Department of*
11 *Energy Science for the Future Act may con-*
12 *tinue to receive support for a period of not*
13 *more than 5 years beginning on the date of*
14 *establishment of that center.*

15 “(D) *RENEWAL.*—*Upon the expiration of*
16 *any period of support of a center under this sub-*
17 *section, the Director may renew support for the*
18 *center, on a merit-reviewed basis, for a period of*
19 *not more than 5 years.*

20 “(E) *TERMINATION.*—*Consistent with the*
21 *existing authorities of the Department, the Direc-*
22 *tor may terminate an underperforming center*
23 *for cause during the performance period.*

24 “(i) *MATERIALS RESEARCH DATABASE.*—

1 “(1) *IN GENERAL.*—*The Director shall support*
2 *the development of a web-based platform to develop*
3 *and provide access to a database of computed infor-*
4 *mation on known and predicted materials properties*
5 *and computational tools to accelerate breakthroughs*
6 *in materials discovery and design.*

7 “(2) *PROGRAM.*—*In carrying out this subsection,*
8 *the Director shall—*

9 “(A) *conduct cooperative research with in-*
10 *dustry, academia, and other research institutions*
11 *to advance understanding, prediction, and ma-*
12 *nipulation of materials and facilitate the design*
13 *of novel materials;*

14 “(B) *develop and maintain data infrastruc-*
15 *ture at user facilities that generate data to col-*
16 *lect, analyze, label, and otherwise prepare the*
17 *data for inclusion in the database;*

18 “(C) *leverage existing high performance*
19 *computing systems to conduct high throughput*
20 *calculations, and develop computational and*
21 *data mining algorithms for the prediction of ma-*
22 *terial properties;*

23 “(D) *strengthen the foundation for new*
24 *technologies and advanced manufacturing; and*

1 “(E) drive the development of advanced ma-
 2 terials for applications that span the Depart-
 3 ment’s missions in energy, environment, and na-
 4 tional security.

5 “(3) COORDINATION.—In carrying out this sub-
 6 section, the Director shall leverage programs and ac-
 7 tivities across the Department, including computa-
 8 tional materials and chemical sciences centers estab-
 9 lished under subsection (h).

10 “(4) FUNDING.—Out of funds authorized to be
 11 appropriated under subsection (j), there shall be made
 12 available to the Secretary to carry out activities
 13 under this subsection \$10,000,000 for each of the fis-
 14 cal years 2022 through 2026.

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

18 “(1) \$2,727,705,000 for fiscal year 2022;

19 “(2) \$2,828,896,600 for fiscal year 2023;

20 “(3) \$3,019,489,612 for fiscal year 2024;

21 “(4) \$3,161,698,885 for fiscal year 2025; and

22 “(5) \$3,291,651,600 for fiscal year 2026.”.

23 “(b) ARTIFICIAL PHOTOSYNTHESIS.—Section 973 of the
 24 Energy Policy Act of 2005 (42 U.S.C. 16313) is amended—

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

3 “(4) *FUNDING.—From within funds authorized*
4 *to be appropriated for Basic Energy Sciences, the*
5 *Secretary shall make available for carrying out ac-*
6 *tivities under this subsection \$50,000,000 for each of*
7 *fiscal years 2022 through 2031.*”; and

8 (2) in subsection (c), by striking paragraph (4)
9 and inserting:

10 “(4) *FUNDING.—From within funds authorized*
11 *to be appropriated in section 316 of the Department*
12 *of Energy Research and Innovation Act, the Secretary*
13 *shall make available for carrying out activities under*
14 *this subsection \$50,000,000 for each of fiscal years*
15 *2022 through 2026.*”.

16 (c) *ELECTRICITY STORAGE RESEARCH INITIATIVE.—*
17 *Section 975 of the Energy Policy Act of 2005 (42*
18 *U.S.C.16315) is amended—*

19 (1) in subsection (b), by striking paragraph (4)
20 and inserting:

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

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

3 “(4) *FUNDING.*—*From within funds authorized*
4 *to be appropriated in section 316 of the Department*
5 *of Energy Research and Innovation Act, the Secretary*
6 *shall make available for carrying out activities under*
7 *this subsection \$50,000,000 for each of fiscal years*
8 *2022 through 2026.*”; and

9 (3) in subsection (d), by striking paragraph (4)
10 and inserting:

11 “(4) *FUNDING.*—*From within funds authorized*
12 *to be appropriated in section 316 of the Department*
13 *of Energy Research and Innovation Act, the Secretary*
14 *shall make available for carrying out activities under*
15 *this subsection \$20,000,000 for each of fiscal years*
16 *2022 through 2026.*”.

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

18 (a) *PROGRAM; BIOLOGICAL SYSTEMS; BIOMOLECULAR*
19 *CHARACTERIZATION AND IMAGING SCIENCE.*—*Section 306*
20 *of the Department of Energy Research and Innovation Act*
21 *(42 U.S.C. 18644) is amended—*

22 (1) by striking subsection (a) and inserting the
23 following:

24 “(a) *PROGRAM.*—*As part of the duties of the Director*
25 *authorized under section 209 of the Department of Energy*

1 *Organization Act (42 U.S.C. 7139), and coordinated with*
2 *the activities authorized under sections 303 and 304 of this*
3 *Act, the Director shall carry out a program of research and*
4 *development in the areas of biological systems science and*
5 *climate and environmental science, including subsurface*
6 *science, relevant to the development of new energy tech-*
7 *nologies and to support the energy, environmental, and na-*
8 *tional security missions of the Department.*

9 “(b) *BIOLOGICAL SYSTEMS.—The Director shall carry*
10 *out research and development activities in genomic science*
11 *including fundamental research on plants and microbes to*
12 *increase systems-level understanding of the complex biologi-*
13 *cal systems, which may include activities to—*

14 “(1) *accelerate breakthroughs and new knowledge*
15 *that would enable the cost-effective, sustainable pro-*
16 *duction of—*

17 “(A) *biomass-based liquid transportation*
18 *fuels;*

19 “(B) *bioenergy; and*

20 “(C) *biobased materials from renewable bio-*
21 *mass;*

22 “(2) *improve fundamental understanding of*
23 *plant and microbial processes impacting the global*
24 *carbon cycle, including processes for removing carbon*
25 *dioxide from the atmosphere, through photosynthesis*

1 *and other biological processes, for sequestration and*
2 *storage;*

3 “(3) *understand the microbiome mechanisms*
4 *used to transform, immobilize, or remove contami-*
5 *nants from subsurface environments;*

6 “(4) *develop the computational approaches and*
7 *integrated platforms for open access collaborative*
8 *science;*

9 “(5) *leverage tools and approaches across the Of-*
10 *fice of Science to expand research to include novel*
11 *processes, methods, and science to develop bio-based*
12 *chemicals, polymers, inorganic materials, including*
13 *research to—*

14 “(A) *advance biosystems design research to*
15 *advance the understanding of how CRISPR tools*
16 *and other gene editing tools and technologies*
17 *work in nature, in the laboratory, and in prac-*
18 *tice;*

19 “(B) *deepen genome-enabled knowledge of*
20 *root architecture and growth in crops, including*
21 *trees; and*

22 “(C) *develop biosystems design methods and*
23 *tools to increase the efficiency of photosynthesis*
24 *in plants; and*

1 “(6) *develop other relevant methods and processes*
2 *as determined by the Director.*

3 “(c) *BIOMOLECULAR CHARACTERIZATION AND IMAG-*
4 *ING SCIENCE.—The Director shall carry out research and*
5 *development activities in biomolecular characterization and*
6 *imaging science, including development of integrative im-*
7 *aging and analysis platforms and biosensors to understand*
8 *the expression, structure, and function of genome informa-*
9 *tion encoded within cells and for real-time measurements*
10 *in ecosystems and field sites of relevance to the mission of*
11 *the Department of Energy.”; and*

12 (2) *by redesignating subsections (b) through (d)*
13 *as subsections (d) through (f), respectively.*

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

17 “(f) *BIOENERGY RESEARCH CENTERS.—*

18 “(1) *IN GENERAL.—In carrying out the program*
19 *under section 306(a) of the Department of Energy Re-*
20 *search and Innovation Act (42 U.S.C. 18644(a)), the*
21 *Director shall support up to six bioenergy research*
22 *centers to conduct fundamental research in plant and*
23 *microbial systems biology, biological imaging and*
24 *analysis, and genomics, and to accelerate advanced*
25 *research and development of biomass-based liquid*

1 *transportation fuels, bioenergy, or biobased materials,*
2 *chemicals, and products that are produced from a va-*
3 *riety of regionally diverse feedstocks, and to facilitate*
4 *the translation of research results to industry. The ac-*
5 *tivities of the centers authorized under this subsection*
6 *may include—*

7 “(A) *accelerating the domestication of bio-*
8 *energy-relevant plants, microbes, and associated*
9 *microbial communities to enable high-impact,*
10 *value-added coproduct development at multiple*
11 *points in the bioenergy supply chain;*

12 “(B) *developing the science and techno-*
13 *logical advances to ensure process sustainability*
14 *is considered in the creation of biofuels and bio-*
15 *products from lignocellulose; and*

16 “(C) *using the latest tools in genomics, mo-*
17 *lecular biology, catalysis science, chemical engi-*
18 *neering, systems biology, and computational and*
19 *robotics technologies to sustainably produce and*
20 *transform biomass into biofuels and bioproducts.*

21 “(2) *SELECTION AND DURATION.—*

22 “(A) *IN GENERAL.—A center established*
23 *under paragraph (1) shall be selected on a com-*
24 *petitive, merit-reviewed basis for a period of not*
25 *more than 5 years, subject to the availability of*

1 *appropriations, beginning on the date of estab-*
2 *lishment of that center.*

3 “(B) *APPLICATIONS.—The Director shall*
4 *consider applications from National Labora-*
5 *tories, multi-institutional collaborations, and*
6 *other appropriate entities.*

7 “(C) *EXISTING CENTERS.—A center already*
8 *in existence on the date of enactment of the De-*
9 *partment of Energy Science for the Future Act*
10 *may continue to receive support for a period of*
11 *not more than 5 years beginning on the date of*
12 *establishment of that center.*

13 “(3) *RENEWAL.—After the end of either period*
14 *described in paragraph (2), the Director may renew*
15 *support for the center for a period of not more than*
16 *5 years on a merit-reviewed basis. For a center in op-*
17 *eration for 10 years after its previous selection on a*
18 *competitive, merit-reviewed basis, the Director may*
19 *renew support for the center on a competitive, merit-*
20 *reviewed basis for a period of not more than 5 years,*
21 *and may subsequently provide an additional renewal*
22 *on a merit-reviewed basis for a period of not more*
23 *than 5 years.*

24 “(4) *TERMINATION.—Consistent with the exist-*
25 *ing authorities of the Department, the Director may*

1 *terminate an underperforming center for cause during*
2 *the performance period.*

3 “(5) *ACTIVITIES.*—Centers shall undertake re-
4 *search activities to accelerate the production of*
5 *biofuels and bioproducts from advanced biomass re-*
6 *sources by identifying the most suitable species of*
7 *plants for use as energy crops; and improving meth-*
8 *ods of breeding, propagation, planting, producing,*
9 *harvesting, storage and processing. Activities may in-*
10 *clude the following:*

11 “(A) *Research activities to increase sustain-*
12 *ability, including—*

13 “(i) *advancing knowledge of how bio-*
14 *energy crop interactions with biotic and*
15 *abiotic environmental factors influence crop*
16 *growth, yield, and quality;*

17 “(ii) *identifying the most impactful re-*
18 *search areas that address the economics of*
19 *biofuels and bioproducts production; and*

20 “(iii) *utilizing multiscale modeling to*
21 *advance predictive understanding of biofuel*
22 *cropping ecosystems.*

23 “(B) *Research activities to further feedstock*
24 *development, including lignocellulosic, algal, gas-*
25 *eous wastes including carbon oxides and meth-*

ane, and direct air capture of single carbon gases
via plants and microbes, including—

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

“(ii) conducting field testing of new
potential bioenergy feedstock crops under
environmentally benign and geographically
diverse conditions to assess viability and
robustness; and

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

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

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

“(ii) gaining a detailed understanding
of plant cell wall biosynthesis, composition,

1 *structure, and properties during*
2 *deconstruction; and*

3 *“(iii) improving enzymes and ap-*
4 *proaches for biomass breakdown and cel-*
5 *lulose, hemicellulose, and lignin processing.*

6 *“(D) Research activities to improve the*
7 *feedstock conversion process for advanced biofuels*
8 *and bioproducts, including—*

9 *“(i) developing high-throughput meth-*
10 *ods to screen or select high-performance mi-*
11 *crobial strains and communities to improve*
12 *product formation rates, yields, and selec-*
13 *tivity;*

14 *“(ii) establishing a broad set of plat-*
15 *form microorganisms and microbial com-*
16 *munities suitable for metabolic engineering*
17 *to produce biofuels and bioproducts, as well*
18 *as high-throughput methods for experi-*
19 *mental validation of gene function;*

20 *“(iii) developing techniques to enhance*
21 *microbial robustness for tolerating toxins to*
22 *improve biofuel and bioproduct yields and*
23 *to gain a better understanding of the cel-*
24 *lular and molecular bases of tolerance for*

1 *major chemical classes of inhibitors found*
2 *in these processes;*

3 “(iv) *advancing technologies for the use*
4 *of batch, continuous, as well as consolidated*
5 *bioprocessing;*

6 “(v) *identifying, creating, and opti-*
7 *mizing microbial and chemical pathways to*
8 *produce promising, atom-economical inter-*
9 *mediates and final bioproducts from bio-*
10 *mass with considerations given to environ-*
11 *mentally benign processes;*

12 “(vi) *developing high-throughput, real-*
13 *time, in situ analytical techniques to under-*
14 *stand and characterize the pre- and post-*
15 *bioproduct separation streams in detail;*

16 “(vii) *creating methodologies for effi-*
17 *ciently identifying viable target molecules,*
18 *identifying high-value bioproducts in exist-*
19 *ing biomass streams, and utilizing current*
20 *byproduct streams;*

21 “(viii) *identifying and improving*
22 *plant feedstocks with enhanced extractable*
23 *levels of desired bioproducts or bioproduct*
24 *precursors, including lignin streams; and*

1 “(ix) developing integrated biological
 2 and chemical catalytic approaches to
 3 valorize and produce a diverse portfolio of
 4 advanced fuels and bioproducts.

5 “(6) *INDUSTRY PARTNERSHIPS*.—Centers shall
 6 establish industry partnerships to translate research
 7 results to commercial applications.

8 “(7) *COORDINATION*.—In coordination with the
 9 Bioenergy Technologies Office of the Department, the
 10 Director shall support interdisciplinary research ac-
 11 tivities to improve the capacity, efficiency, resilience,
 12 security, reliability, and affordability, of the produc-
 13 tion and use of biofuels and bioproducts, as well as
 14 activities to enable positive impacts and avoid the po-
 15 tential negative impacts that the production and use
 16 of biofuels and bioproducts may have on ecosystems,
 17 people, and historically marginalized communities.”.

18 (c) *LOW-DOSE RADIATION RESEARCH PROGRAM*.—
 19 Section 306(e)(8) of the Department of Energy Research
 20 and Innovation Act (42 U.S.C. 18644(c)(8)), as redesign-
 21 nated under subsection (a), is amended—

- 22 (1) in subparagraph (C), by striking “and”;
- 23 (2) in subparagraph (D), by striking the period
 24 at the end and inserting a semicolon; and
- 25 (3) by adding at the end the following:

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

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

3 (d) *LOW-DOSE RADIATION AND SPACE RADIATION RE-*
 4 *SEARCH PROGRAM.*—Section 306(f) of the Department of
 5 *Energy Research and Innovation Act (42 U.S.C. 18644(d)),*
 6 *as redesignated under subsection (a), is amended to read*
 7 *as follows:*

8 “(f) *LOW-DOSE RADIATION AND SPACE RADIATION*
 9 *RESEARCH PROGRAM.*—

10 “(1) *IN GENERAL.*—The Secretary of Energy, in
 11 *consultation with the Administrator of the National*
 12 *Aeronautics and Space Administration shall carry*
 13 *out a basic research program on the similarities and*
 14 *differences between the effects of exposure to low-dose*
 15 *radiation on Earth, in low Earth orbit, and in the*
 16 *space environment.*

17 “(2) *PURPOSE.*—The purpose of this program is
 18 *to accelerate breakthroughs in low-dose and low dose-*
 19 *rate radiation research and development as described*
 20 *in subsection (d) and to inform the advancement of*
 21 *new tools, technologies, and advanced materials need-*
 22 *ed to facilitate long-duration space exploration.”.*

23 (e) *CLIMATE, ENVIRONMENTAL SCIENCE, AND OTHER*
 24 *ACTIVITIES.*—Section 306 of the Department of Energy Re-

1 *search and Innovation Act (42 U.S.C. 18644) is further*
2 *amended by adding at the end the following:*

3 “(g) *EARTH AND ENVIRONMENTAL SYSTEMS SCIENCES*
4 *ACTIVITIES.*—

5 “(1) *IN GENERAL.*—*As part of the activities au-*
6 *thorized under subsection (a), and in coordination*
7 *with activities carried out under subsection (b), the*
8 *Director shall carry out earth and environmental sys-*
9 *tems science research, in consultation with the Na-*
10 *tional Oceanic and Atmospheric Administration and*
11 *other relevant agencies, which may include activities*
12 *to—*

13 “(A) *understand, observe, and model the re-*
14 *sponse of Earth’s atmosphere and biosphere to*
15 *increased concentrations of greenhouse gas emis-*
16 *sions and any associated changes in climate, in-*
17 *cluding frequency and intensity of extreme*
18 *weather events;*

19 “(B) *understand the coupled physical,*
20 *chemical, and biological processes to transform,*
21 *immobilize, remove, or move carbon, nitrogen,*
22 *and other energy production-derived contami-*
23 *nants such as radionuclides and heavy metals,*
24 *and understand the process of sequestration and*
25 *transformation of these, carbon dioxide, and*

1 *other relevant molecules in subsurface environ-*
2 *ments;*

3 *“(C) understand, observe, and model the cy-*
4 *cling of water, carbon, and nutrients in terres-*
5 *trial systems and at scales relevant to resources*
6 *management;*

7 *“(D) understand the biological, biogeo-*
8 *chemical, and physical processes across the mul-*
9 *tiple scales that control the flux of environ-*
10 *mentally relevant compounds between the terres-*
11 *trial surface and the atmosphere; and*

12 *“(E) inform potential natural mitigation*
13 *and adaptation options for increased concentra-*
14 *tions of greenhouse gas emissions and any associ-*
15 *ated changes in climate.*

16 *“(2) PRIORITIZATION.—In carrying out the pro-*
17 *gram authorized under paragraph (1), the Director*
18 *shall prioritize—*

19 *“(A) the development of software and algo-*
20 *rithms to enable the productive application of*
21 *environmental systems and extreme weather in*
22 *climate and Earth system prediction models in*
23 *high-performance computing systems; and*

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

4 “(3) ENVIRONMENTAL SYSTEMS SCIENCE RE-
5 SEARCH.—

6 “(A) IN GENERAL.—As part of the activities
7 described in paragraph (1), the Director shall
8 carry out research to advance an integrated, ro-
9 bust, and scale-aware predictive understanding
10 of environmental systems, including the role of
11 hydrobiogeochemistry, from the subsurface to the
12 top of the vegetative canopy that considers effects
13 of seasonal to interannual variability and
14 change.

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

18 “(i) support interdisciplinary research
19 to significantly advance our understanding
20 of water availability, quality, and the im-
21 pact of human activity and a changing cli-
22 mate on urban and rural watershed sys-
23 tems, including in freshwater environments;

24 “(ii) consult with the Interagency Re-
25 search, Development, and Demonstration

1 *Coordination Committee on the Nexus of*
2 *Energy and Water for Sustainability estab-*
3 *lished under section 1010 of the Energy Act*
4 *of 2020 (division Z of the Consolidated Ap-*
5 *propriations Act, 2021) on energy-water*
6 *nexus research activities; and*

7 “(iii) *engage with representatives of re-*
8 *search and academic institutions, nonprofit*
9 *organizations, State, local, and tribal gov-*
10 *ernments, and industry, who have expertise*
11 *in technologies, technological innovations,*
12 *or practices relating to the energy-water*
13 *nexus, as applicable.*

14 “(C) *COORDINATION.—*

15 “(i) *DIRECTOR.—The Director shall*
16 *carry out activities under this paragraph in*
17 *accordance with priorities established by the*
18 *Secretary to support and accelerate the de-*
19 *contamination of relevant facilities man-*
20 *aged by the Department.*

21 “(ii) *SECRETARY.—The Secretary shall*
22 *ensure the coordination of activities of the*
23 *Department, including activities under this*
24 *paragraph, to support and accelerate the de-*

1 *contamination of relevant facilities man-*
2 *aged by the Department.*

3 “(4) *CLIMATE AND EARTH MODELING.*—As part
4 *of the activities described in paragraph (1), the Direc-*
5 *tor, in collaboration with the Advanced Scientific*
6 *Computing Research program described in section*
7 *304 and other programs carried out by the Depart-*
8 *ment, as applicable, and in consultation with the Na-*
9 *tional Oceanic and Atmospheric Administration and*
10 *other relevant agencies, shall carry out research to de-*
11 *velop, evaluate, and use high-resolution regional cli-*
12 *mate, global climate, Earth system, and other relevant*
13 *models to inform decisions on reducing greenhouse gas*
14 *emissions and the resulting impacts of a changing*
15 *global climate. Such modeling shall include—*

16 “(A) *integrated capabilities for modeling*
17 *multisectoral interactions, including socio-*
18 *economic factors as appropriate, which may in-*
19 *clude the impacts of climate policies on social*
20 *and regional equity and well-being, and the*
21 *interdependencies and risks at the energy-water-*
22 *land nexus;*

23 “(B) *greenhouse gas emissions, air quality,*
24 *energy supply and demand, and other critical*
25 *elements; and*

1 “(C) *interaction among human and Earth*
 2 *systems informed by interdisciplinary research,*
 3 *including the economic and social sciences.*

4 “(5) *MID-SCALE FUNDING MECHANISM.*—

5 “(A) *IN GENERAL.*—*Any of the activities*
 6 *authorized in this subsection may be carried out*
 7 *by competitively selected mid-scale, multi-insti-*
 8 *tutional research centers in lieu of individual re-*
 9 *search grants, or large-scale experiments or user*
 10 *facilities.*

11 “(B) *CONSIDERATION.*—*The Biological and*
 12 *Environmental Research Advisory Committee*
 13 *shall provide recommendations to the Director on*
 14 *projects most suitable for the research centers de-*
 15 *scribed in subparagraph (A).*

16 “(h) *BIOLOGICAL AND ENVIRONMENTAL RESEARCH*
 17 *USER FACILITIES.*—

18 “(1) *IN GENERAL.*—*The Director shall carry out*
 19 *a program for the development, construction, oper-*
 20 *ation, and maintenance of user facilities to enhance*
 21 *the collection and analysis of observational data re-*
 22 *lated to complex biological, climate, and environ-*
 23 *mental systems.*

24 “(2) *FACILITY REQUIREMENTS.*—*To the max-*
 25 *imum extent practicable, the user facilities developed,*

1 *constructed, operated, or maintained under para-*
2 *graph (1) shall include—*

3 “(A) *distributed field research and observa-*
4 *tion platforms for understanding earth system*
5 *processes;*

6 “(B) *analytical techniques, instruments,*
7 *and modeling resources for understanding the*
8 *physical, chemical, and cellular processes of bio-*
9 *logical and environmental systems;*

10 “(C) *integrated high-throughput sequencing,*
11 *advanced bioanalytic techniques, DNA design*
12 *and synthesis, metabolomics, and computational*
13 *analysis; and*

14 “(D) *such other facilities as the Director*
15 *considers appropriate, consistent with section*
16 *209 of the Department of Energy Organization*
17 *Act (42 U.S.C. 7139).*

18 “(3) *EXISTING FACILITIES.—In carrying out the*
19 *program established in paragraph (1), the Director is*
20 *encouraged to evaluate the capabilities of existing*
21 *user facilities and, to the maximum extent prac-*
22 *ticable, invest in modernization of those capabilities*
23 *to address emerging research priorities.*

24 “(4) *USER FACILITIES INTEGRATION AND COL-*
25 *LABORATION PROGRAM.—*

1 “(A) *IN GENERAL.*—*The Director shall sup-*
 2 *port a program of collaboration between user fa-*
 3 *cilities as defined under this subsection to en-*
 4 *courage and enable researchers to more readily*
 5 *integrate the tools, expertise, resources, and capa-*
 6 *bilities of multiple Office of Science user facili-*
 7 *ties (as described in section 209(d) of the Depart-*
 8 *ment of Energy Organization Act (42 U.S.C.*
 9 *7139)) to further research and advance emerging*
 10 *technologies.*

11 “(B) *ACTIVITIES.*—*The program shall ad-*
 12 *vance the integration of automation, robotics,*
 13 *computational biology, bioinformatics, bio-*
 14 *sensing, cellular platforms and other relevant*
 15 *emerging technologies as determined by the Di-*
 16 *rector to enhance productivity and scientific im-*
 17 *pact of user facilities.*

18 “(5) *EARTH AND ENVIRONMENTAL SYSTEMS*
 19 *SCIENCES USER FACILITIES.*—

20 “(A) *IN GENERAL.*—*In carrying out the ac-*
 21 *tivities authorized under paragraph (1), the Di-*
 22 *rector shall establish and operate user facilities*
 23 *to advance the collection, validation, and anal-*
 24 *ysis of atmospheric data, including activities to*
 25 *advance knowledge and improve model represen-*

1 *tations and measure the impact of atmospheric*
2 *gases, aerosols, and clouds on earth and environ-*
3 *mental systems.*

4 “(B) *SELECTION.*—*The Director shall select*
5 *user facilities under paragraph (1) on a com-*
6 *petitive, merit-reviewed basis. The Director shall*
7 *consider applications from the National Labora-*
8 *tories, institutes of higher education, multi-insti-*
9 *tutional collaborations, and other appropriate*
10 *entities.*

11 “(C) *EXISTING FACILITIES.*—*To the max-*
12 *imum extent practicable, the Director shall uti-*
13 *lize existing facilities to carry out this sub-*
14 *section.*

15 “(6) *COORDINATION.*—*In carrying out the pro-*
16 *gram authorized in paragraph (1), the Director shall*
17 *ensure that the Office of Science—*

18 “(A) *consults and coordinates with the Na-*
19 *tional Oceanic Atmospheric Administration, the*
20 *Environmental Protection Agency, the National*
21 *Aeronautics and Space Administration, the De-*
22 *partment of Agriculture, the Department of the*
23 *Interior, and any other relevant Federal agency*
24 *on the collection, validation, and analysis of at-*
25 *mospheric data; and*

1 “(B) coordinates with relevant stakeholders,
2 including institutes of higher education, non-
3 profit research institutions, industry, State,
4 local, and tribal governments, and other appro-
5 priate entities to ensure access to the best avail-
6 able relevant atmospheric and historical weather
7 data.

8 “(i) COASTAL ZONE RESEARCH INITIATIVE.—

9 “(1) IN GENERAL.—The Director shall carry out
10 a research program, in consultation with the National
11 Oceanic and Atmospheric Administration, to enhance
12 the understanding of coastal ecosystems. In carrying
13 out this program, the Director shall prioritize efforts
14 to enhance the collection of observational data, and
15 shall develop models to analyze the ecological, biogeo-
16 chemical, hydrological and physical processes that
17 interact in coastal zones.

18 “(2) NATIONAL SYSTEM FOR COASTAL DATA COL-
19 LECTION.—The Director shall establish, in consulta-
20 tion with the National Oceanic and Atmospheric Ad-
21 ministration and other relevant agencies, an inte-
22 grated system of geographically diverse field research
23 sites in order to improve the quantity and quality of
24 observational data, and that encompass the major

1 *land water interfaces of the United States, includ-*
2 *ing—*

3 “(A) *the Great Lakes region;*

4 “(B) *the Pacific coast;*

5 “(C) *the Atlantic coast;*

6 “(D) *the Arctic; and*

7 “(E) *the Gulf coast.*

8 “(3) *EXISTING INFRASTRUCTURE.—In carrying*
9 *out the programs and establishing the field research*
10 *sites under paragraph (1) and (2), the Secretary shall*
11 *leverage existing research and development infrastruc-*
12 *ture supported by the Department, including the De-*
13 *partment’s existing marine and coastal research lab.*

14 “(4) *COORDINATION.—For the purposes of car-*
15 *rying out the programs and establishing the field re-*
16 *search sites under the Initiative, the Secretary may*
17 *enter into agreements with Federal Departments and*
18 *agencies with complementary capabilities.*

19 “(5) *REPORT.—Not less than 2 years after the*
20 *date of the enactment of the Department of Energy*
21 *Science for the Future Act, the Director shall provide*
22 *to the Committee on Science, Space, and Technology*
23 *and the Committee on Appropriations of the House of*
24 *Representatives and the Committee on Energy and*
25 *Natural Resources and the Committee on Appropria-*

1 *tions of the Senate a report examining whether the*
2 *system described in this section should be established*
3 *as a National User Facility.*

4 “(j) *TECHNOLOGY DEVELOPMENT.*—*The Director shall*
5 *support a technology research program for the development*
6 *of instrumentation and other research tools required to meet*
7 *the missions of the Department and to provide platform*
8 *technologies for the broader scientific community. Tech-*
9 *nologies shall include but are not limited to—*

10 “(1) *cryo-electron microscopy;*

11 “(2) *fabricated ecosystems;*

12 “(3) *next generation sensors including quantum*
13 *sensors for biological integration and bioproduction;*

14 “(4) *technologies to accelerate data analysis; and*

15 “(5) *plant and microbial phenotyping for gene*
16 *discovery.*

17 “(k) *EMERGING TECHNOLOGIES.*—

18 “(1) *IN GENERAL.*—*The Secretary shall establish*
19 *within the Biological and Environmental Research*
20 *program an initiative focused on the development of*
21 *engineered ecosystems through the application of arti-*
22 *ficial intelligence, novel sensing capabilities, and*
23 *other emerging technologies.*

24 “(2) *INTERAGENCY COORDINATION.*—*The Sec-*
25 *retary shall coordinate with the Director of the Na-*

1 *tional Science Foundation, the Administrator of the*
2 *National Oceanic and Atmospheric Administration,*
3 *the Director of the U.S. Geological Survey, and other*
4 *relevant officials to avoid duplication of research and*
5 *observational activities and to ensure that activities*
6 *carried out under this initiative are complimentary*
7 *to those currently being undertaken by other agencies.*

8 *“(3) REPORT.—Not later than 180 days after the*
9 *enactment of this Act, the Secretary shall provide a*
10 *report to the Committee on Science, Space, and Tech-*
11 *nology of the House, and the Committee on Energy*
12 *and Natural Resources of the Senate, on the activity*
13 *mandated in subsection (k).*

14 *“(l) AUTHORIZATION OF APPROPRIATIONS.—There are*
15 *authorized to be appropriated to the Secretary to carry out*
16 *the activities described in this section—*

17 *“(1) \$820,360,000 for fiscal year 2022;*

18 *“(2) \$886,385,200 for fiscal year 2023;*

19 *“(3) \$956,332,164 for fiscal year 2024;*

20 *“(4) \$1,020,475,415 for fiscal year 2025; and*

21 *“(5) \$1,099,108,695 for fiscal year 2026.”.*

1 **SEC. 5. ADVANCED SCIENTIFIC COMPUTING RESEARCH**
2 **PROGRAM.**

3 (a) *ADVANCED SCIENTIFIC COMPUTING RESEARCH.*—
4 *Section 304 of the Department of Energy Research and In-*
5 *novation Act (42 U.S.C. 18642) is amended—*

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

8 (2) *by inserting before subsection (b), as so redes-*
9 *ignated, the following:*

10 “(a) *IN GENERAL.*—*As part of the activities author-*
11 *ized under section 209 of the Department of Energy Organi-*
12 *zation Act (42 U.S.C. 7139), the Director shall carry out,*
13 *in coordination with academia and relevant public and*
14 *private sector entities, a research, development, and dem-*
15 *onstration program to—*

16 “(1) *steward applied mathematics, computa-*
17 *tional science, and computer science research relevant*
18 *to the missions of the Department and the competi-*
19 *tiveness of the United States;*

20 “(2) *develop modeling, simulation, and other*
21 *computational tools relevant to other scientific dis-*
22 *ciplines and to the development of new energy tech-*
23 *nologies and other technologies;*

24 “(3) *advance computating and networking capa-*
25 *bilities for data-driven discovery; and*

1 “(4) *develop advanced scientific computing hard-*
 2 *ware and software tools for science and engineering.*”;

3 (3) *in subsection (c) (as redesignated under*
 4 *paragraph (1))—*

5 (A) *by striking “The Director” and insert-*
 6 *ing the following:*

7 “(1) *DIRECTOR.—The Director*”; and

8 (B) *by adding at the end the following:*

9 “(2) *COORDINATION.—The Under Secretary for*
 10 *Science shall ensure the coordination of the activities*
 11 *of the Department, including activities under this sec-*
 12 *tion, to determine and meet the computational and*
 13 *networking research and facility needs of the Office of*
 14 *Science and all other relevant energy technology and*
 15 *energy efficiency programs within the Department*
 16 *and with other Federal agencies as appropriate.*”;

17 (4) *by amending subsection (d), as so redesign-*
 18 *ated, to read as follows:*

19 “(d) *APPLIED MATHEMATICS AND SOFTWARE DEVEL-*
 20 *OPMENT FOR HIGH-END COMPUTING SYSTEMS AND COM-*
 21 *PUTER SCIENCES RESEARCH.—*

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

24 (A) *mathematics, statistics, and algo-*
 25 *rithms for modeling complex systems relevant to*

1 *the missions of the Department, including on ad-*
 2 *vanced computing architectures; and*

3 *“(B) tools, languages, programming envi-*
 4 *ronments, and operations for high-end com-*
 5 *puting systems (as defined in section 2 of the*
 6 *American Super Computing Leadership Act (15*
 7 *U.S.C. 5541).*

8 *“(2) PORTFOLIO BALANCE.—*

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

15 *“(i) applied mathematical, computa-*
 16 *tional, and computer sciences research needs*
 17 *relevant to the mission of the Department,*
 18 *including foundational areas that are crit-*
 19 *ical to the advancement of energy sciences*
 20 *and technologies and new and emerging*
 21 *computing technologies; and*

22 *“(ii) associated high-performance com-*
 23 *puting hardware and facilities.*

24 *“(B) EXASCALE ECOSYSTEM*
 25 *SUSTAINMENT.—*

1 “(i) *SENSE OF CONGRESS.—It is the*
2 *sense of Congress that the Exascale Com-*
3 *puting Project has successfully created a*
4 *broad ecosystem that provides shared soft-*
5 *ware packages, novel evaluation systems,*
6 *and applications relevant to the science and*
7 *engineering requirements of the Depart-*
8 *ment, and that such products must be*
9 *maintained and improved in order that the*
10 *full potential of the deployed systems can be*
11 *continuously realized.*

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

21 (5) *by inserting after subsection (d) the fol-*
22 *lowing:*

23 “(e) *NEXT GENERATION COMPUTING PROGRAM.—*

24 “(1) *IN GENERAL.—The Secretary shall establish*
25 *a program to develop and implement a strategy for*

1 *achieving computing systems with capabilities beyond*
2 *exascale computing systems. In establishing this pro-*
3 *gram, the Secretary shall—*

4 “(A) *maintain foundational research pro-*
5 *grams in mathematical, computational, and*
6 *computer sciences focused on new and emerging*
7 *computing needs within the mission of the De-*
8 *partment, including post-Moore’s law computing*
9 *architectures, novel approaches to modeling and*
10 *simulation, artificial intelligence and scientific*
11 *machine learning, quantum computing, edge*
12 *computing, extreme heterogeneity, and distrib-*
13 *uted high-performance computing; and*

14 “(B) *retain best practices and maintain*
15 *support for essential hardware, applications, and*
16 *software elements of the Exascale Computing*
17 *Program that are necessary for sustaining the*
18 *vitality of a long-term capable software eco-*
19 *system for exascale and beyond; and*

20 “(C) *develop a Department-wide strategy*
21 *for balancing on-premises and cloud-based com-*
22 *puting and scientific data management.*

23 “(2) *REPORT.—Not later than one year after the*
24 *date of the enactment of this Act, the Secretary shall*
25 *submit to the Committee on Science, Space, and Tech-*

1 *nology of the House of Representatives, and the Com-*
 2 *mittee on Energy and Natural Resources of the Sen-*
 3 *ate, a report on the development and implementation*
 4 *of the strategy outlined in paragraph (1).*

5 “(f) *ARCHITECTURAL RESEARCH IN HETEROGENEOUS*
 6 *COMPUTING SYSTEMS.—*

7 “(1) *IN GENERAL.—The Secretary shall carry*
 8 *out a program of research and development in hetero-*
 9 *geneous and reconfigurable computing systems to ex-*
 10 *pand understanding of the potential for heterogeneous*
 11 *and reconfigurable computing systems to deliver high*
 12 *performance, high efficiency computing for Depart-*
 13 *ment of Energy mission challenges. This shall include*
 14 *research and development that explores the conver-*
 15 *gence of big data analytics, simulations, and artificial*
 16 *intelligence to drive the design of heterogenous*
 17 *computing system architectures.*

18 “(2) *COORDINATION.—In carrying out this pro-*
 19 *gram, the Secretary shall ensure coordination between*
 20 *research activities undertaken by the Advanced Sci-*
 21 *entific Computing Research program and materials*
 22 *research supported by the Basic Energy Sciences pro-*
 23 *gram within the Department of Energy Office of*
 24 *Science.*

25 “(g) *ENERGY EFFICIENT COMPUTING PROGRAM.—*

1 “(1) *IN GENERAL.*—*The Secretary shall support*
2 *a program of fundamental research, development, and*
3 *demonstration of energy efficient computing and data*
4 *center technologies relevant to advanced computing*
5 *applications, including high performance computing,*
6 *artificial intelligence, and scientific machine learn-*
7 *ing.*

8 “(2) *EXECUTION.*—

9 “(A) *PROGRAM.*—*In carrying out the pro-*
10 *gram under paragraph (1), the Secretary shall—*

11 “(i) *establish a partnership for Na-*
12 *tional Laboratories, industry partners, and*
13 *institutions of higher education for codesign*
14 *of energy efficient hardware, technology,*
15 *software, and applications across all appli-*
16 *cable program offices of the Department,*
17 *and provide access to energy efficient com-*
18 *puting resources to such partners;*

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

23 “(iii) *consider multiple heterogeneous*
24 *computing architectures in collaboration*
25 *with the program established under sub-*

1 *section (f) including neuromorphic com-*
2 *puting, persistent computing, and ultrafast*
3 *networking; and*

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

11 “(B) *SELECTION OF PARTNERS.*—*In select-*
12 *ing participants for the partnership established*
13 *under subparagraph (A)(i), the Secretary shall*
14 *select participants through a competitive, merit*
15 *review process.*

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

23 “(i) *the activities conducted under sub-*
24 *paragraph (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 fa-*
8 *cility in order to meet the research needs of the De-*
9 *partment for highly reliable data transport capabili-*
10 *ties 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 het-*
 2 *erogeneous computing frameworks and systems.*

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

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

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

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

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

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

21 “(D) *\$24,310,125 for fiscal year 2025; and*

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

23 “(j) *AUTHORIZATION OF APPROPRIATIONS.—There are*
 24 *authorized to be appropriated to the Secretary to carry out*
 25 *the activities described in this section—*

1 “(1) \$1,126,350,000 for fiscal year 2022;
 2 “(2) \$1,222,674,500 for fiscal year 2023;
 3 “(3) \$1,324,320,715 for fiscal year 2024;
 4 “(4) \$1,431,660,115 for fiscal year 2025; and
 5 “(5) \$1,535,090,121 for fiscal year 2026.”.

6 (b) *QUANTUM SCIENCE NETWORK*.—

7 (1) *DEFINITIONS*.—Section 2 of the National
 8 Quantum Initiative Act (15 U.S.C. 8801) is amend-
 9 ed—

10 (A) by redesignating paragraph (7) as
 11 paragraph (8); and

12 (B) by inserting after paragraph (6) the fol-
 13 lowing:

14 “(7) *QUANTUM NETWORK INFRASTRUCTURE*.—
 15 The term ‘quantum network infrastructure’ means
 16 any facility, expertise, or capability that is necessary
 17 to enable the development and deployment of scalable
 18 and diverse quantum network technologies.”.

19 (2) *DEPARTMENT OF ENERGY QUANTUM NET-*
 20 *WORK INFRASTRUCTURE RESEARCH AND DEVELOP-*
 21 *MENT PROGRAM*.—(A) Title IV of the National Quan-
 22 tum Initiative Act (15 U.S.C. 8851 et seq.) is amend-
 23 ed by adding at the end the following:

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

4 “(a) *IN GENERAL.*—*The Secretary of Energy (referred*
5 *to in this section as the ‘Secretary’)* shall carry out a re-
6 *search, development, and demonstration program to accel-*
7 *erate innovation in quantum network infrastructure in*
8 *order to—*

9 “(1) *facilitate the advancement of distributed*
10 *quantum computing systems through the internet and*
11 *intranet;*

12 “(2) *improve the precision of measurements of*
13 *scientific phenomena and physical imaging tech-*
14 *nologies;*

15 “(3) *develop secure national quantum commu-*
16 *nications technologies and strategies; and*

17 “(4) *demonstrate these capabilities utilizing the*
18 *Department’s Energy Sciences Network User Facility.*

19 “(b) *PROGRAM.*—*In carrying out this section, the Sec-*
20 *retary shall—*

21 “(1) *coordinate with—*

22 “(A) *the Director of the National Science*
23 *Foundation;*

24 “(B) *the Director of the National Institute*
25 *of Standards and Technology;*

1 “(C) the Chair of the subcommittee on
2 *Quantum Information Science of the National*
3 *Science and Technology Council established*
4 *under section 103(a); and*

5 “(D) the Chair of the subcommittee on the
6 *Economic and Security Implications of Quan-*
7 *tum Science;*

8 “(2) conduct cooperative research with industry,
9 *National Laboratories, institutions of higher edu-*
10 *cation, and other research institutions to facilitate*
11 *new quantum infrastructure methods and tech-*
12 *nologies, including—*

13 “(A) quantum-limited detectors, ultra-low
14 *loss optical channels, space-to-ground connec-*
15 *tions, and classical networking and cybersecurity*
16 *protocols;*

17 “(B) entanglement and hyper-entangled
18 *state sources and transmission, control, and*
19 *measurement of quantum states;*

20 “(C) quantum interconnects that allow
21 *short range local connections between quantum*
22 *processors;*

23 “(D) transducers for quantum sources and
24 *signals between optical and telecommunications*

1 regimes and quantum computer-relevant do-
2 mains, including microwaves;

3 “(E) development of quantum memory buff-
4 ers and small-scale quantum computers that are
5 compatible with photon-based quantum bits in
6 the optical or telecommunications wavelengths;

7 “(F) long-range entanglement distribution
8 at both the terrestrial and space-based level using
9 quantum repeaters, allowing entanglement-based
10 protocols between small- and large scale quan-
11 tum processors;

12 “(G) quantum routers, multiplexers, repeat-
13 ers, and related technologies necessary to create
14 secure long-distance quantum communication;
15 and

16 “(H) integration of systems across the
17 quantum technology stack into traditional com-
18 puting networks, including the development of
19 remote controlled, high performance, and reliable
20 implementations of key quantum network compo-
21 nents by leveraging the expertise, infrastructure
22 and supplemental investments in the Energy
23 Sciences Network User Facility;

24 “(3) engage with the Quantum Economic Devel-
25 opment Consortium (QED-C) to transition compo-

1 *ment technologies to help facilitate as appropriate the*
2 *development of a quantum supply chain for quantum*
3 *network technologies;*

4 *“(4) advance basic research in advanced sci-*
5 *entific computing, particle and nuclear physics, and*
6 *material science to enhance the understanding, pre-*
7 *diction, and manipulation of materials, processes,*
8 *and physical phenomena relevant to quantum net-*
9 *work infrastructure;*

10 *“(5) develop experimental tools and testbeds in*
11 *collaboration with the Department’s Energy Sciences*
12 *Network User Facility necessary to support cross-cut-*
13 *ting fundamental research and development activities*
14 *with diverse stakeholders from industry, National*
15 *Laboratories, and institutions of higher education;*
16 *and*

17 *“(6) consider quantum network infrastructure*
18 *applications that span the Department of Energy’s*
19 *missions in energy, environment, and national secu-*
20 *rity.*

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

24 *“(1) the National Institute of Standards and*
25 *Technology;*

1 “(2) *the National Science Foundation;*

2 “(3) *the National Aeronautics and Space Ad-*
3 *ministration;*

4 “(4) *other relevant Federal agencies;*

5 “(5) *the National Laboratories;*

6 “(6) *industry stakeholders;*

7 “(7) *institutions of higher education; and*

8 “(8) *the National Quantum Information Science*
9 *Research Centers.*

10 “(d) *RESEARCH PLAN.*—*Not later than 180 days after*
11 *the date of the enactment of the Department of Energy*
12 *Science for the Future Act, the Secretary shall submit to*
13 *the Committee on Science, Space, and Technology of the*
14 *House of Representatives and the Committee on Energy and*
15 *Natural Resources of the Senate, a 4-year research plan that*
16 *identifies and prioritizes basic research needs relating to*
17 *quantum network infrastructure.*

18 “(e) *STANDARD OF REVIEW.*—*The Secretary shall re-*
19 *view activities carried out under this section to determine*
20 *the achievement of technical milestones.*

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

1 **“SEC. 404. DEPARTMENT OF ENERGY QUANTUM USER EX-**
2 **PANSION FOR SCIENCE AND TECHNOLOGY**
3 **PROGRAM.**

4 “(a) *IN GENERAL.*—*The Secretary of Energy (referred*
5 *to in this section as the ‘Secretary’)* shall establish and
6 *carry out a program (to be known as the ‘Quantum User*
7 *Expansion for Science and Technology program’ or*
8 *‘QUEST program’)* to encourage and facilitate access to
9 *United States quantum computing hardware and quantum*
10 *computing clouds for research purposes in order to—*

11 “(1) *enhance the United States quantum re-*
12 *search enterprise;*

13 “(2) *educate the future quantum computing*
14 *workforce; and*

15 “(3) *accelerate the advancement of United States*
16 *quantum computing capabilities.*

17 “(b) *PROGRAM.*—*In carrying out this section, the Sec-*
18 *retary shall—*

19 “(1) *coordinate with—*

20 “(A) *the Director of the National Science*
21 *Foundation;*

22 “(B) *the Director of the National Institute*
23 *of Standards and Technology;*

24 “(C) *the Chair of the Quantum Information*
25 *Science of the National Science and Technology*
26 *Council established under section 103(a); and*

1 “(D) the Chair of the subcommittee on the
2 *Economic and Security Implications of Quan-*
3 *tum Science;*

4 “(2) provide researchers based within the United
5 *States with access to, and use of, United States quan-*
6 *tum computing resources through a competitive,*
7 *merit-reviewed process;*

8 “(3) consider applications from the National
9 *Laboratories, multi-institutional collaborations, insti-*
10 *tutions of higher education, industry stakeholders,*
11 *and any other entities that the Secretary determines*
12 *are appropriate to provide national leadership on*
13 *quantum computing related issues; and*

14 “(4) consult and coordinate with private sector
15 *stakeholders, the user community, and interagency*
16 *partners on program development and best manage-*
17 *ment practices.*

18 “(c) *LEVERAGING.—In carrying out this section, the*
19 *Secretary shall leverage resources and expertise across the*
20 *Department of Energy and from—*

21 “(1) *the National Institute of Standards and*
22 *Technology;*

23 “(2) *the National Science Foundation;*

24 “(3) *the National Aeronautics and Space Ad-*
25 *ministration;*

1 “(4) *other relevant Federal agencies;*
 2 “(5) *the National Laboratories;*
 3 “(6) *industry stakeholders;*
 4 “(7) *institutions of higher education; and*
 5 “(8) *the National Quantum Information Science*
 6 *Research Centers.*

7 “(d) *SECURITY.—In carrying out the activities au-*
 8 *thorized by this section, the Secretary, in consultation with*
 9 *the Director of the National Science Foundation and the*
 10 *Director of the National Institute of Standards and Tech-*
 11 *nology, shall ensure proper security controls are in place*
 12 *to protect sensitive information, as appropriate.*

13 “(e) *FUNDING.—Out of funds authorized to be appro-*
 14 *priated for the Department of Energy’s Office of Science,*
 15 *there shall be made available to the Secretary to carry out*
 16 *the activities under this section—*

17 “(1) *\$30,000,000 for fiscal year 2022;*
 18 “(2) *\$50,000,000 for fiscal year 2023;*
 19 “(3) *\$70,000,000 for fiscal year 2024;*
 20 “(4) *\$90,000,000 for fiscal year 2025; and*
 21 “(5) *\$100,000,000 for fiscal year 2026.*

22 “(f) *EQUITABLE USE OF HIGH-PERFORMANCE COM-*
 23 *PUTING CAPABILITIES.—*

24 “(1) *SENSE OF CONGRESS.—It is the sense of*
 25 *Congress that machine learning algorithms can ex-*

hibit biases that cause harm to historically marginalized communities.

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

(B) The table of contents in section 1(b) of the National Quantum Initiative Act is amended by inserting after the item relating to section 402 the following items:

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

“Sec. 404. Department of energy quantum user expansion for science and technology program.”.

16 **SEC. 6. FUSION ENERGY RESEARCH.**

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

(1) in subsection (b)—

(A) in the matter preceding paragraph (1), by striking “As part of” and inserting the following:

1 “(1) *IN GENERAL.—As part of*”;

2 *(B) by redesignating—*

3 *(i) paragraphs (1) and (2) as subpara-*
 4 *graphs (A) and (B), respectively (and by*
 5 *adjusting the margins of such subpara-*
 6 *graphs accordingly); and*

7 *(ii) in subparagraph (B) (as redesign-*
 8 *ated by clause (i)), subparagraphs (A) and*
 9 *(B) as clauses (i) and (ii), respectively (and*
 10 *by adjusting the margins of such clauses ac-*
 11 *cordingly); and*

12 *(C) by adding at the end the following:*

13 “(2) *AUTHORIZATION OF APPROPRIATIONS.—Out*
 14 *of funds authorized to be appropriated under sub-*
 15 *section (r), there are authorized to be appropriated to*
 16 *the Secretary to carry out activities described in*
 17 *paragraph (1) \$50,000,000 for each of fiscal years*
 18 *2022 through 2026.”;*

19 *(2) in subsection (d)(3)—*

20 *(A) by striking the period at the end and*
 21 *inserting “and \$40,000,000 for fiscal year*
 22 *2026.”; and*

23 *(B) by striking “(o)” and inserting “(r)”;*
 24 *and*

25 *(3) in subsection (e)(4)—*

1 (A) by striking the period at the end and
 2 inserting “and \$75,000,000 for fiscal year
 3 2026.”; and

4 (B) by striking “(o)” and inserting “(r)”;
 5 (4) in subsection (i)(10)—

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

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

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

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

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

14 (5) in subsection (j)—

15 (A) by striking “The Director” and all that
 16 follows through the period and inserting the fol-
 17 lowing:

18 “(1) IN GENERAL.—

19 “(A) ESTABLISHMENT.—Within 180 days of
 20 enactment of the Department of Energy Science
 21 for the Future Act, the Director shall establish at
 22 least 2 national teams, including public-private
 23 partnerships, that will develop conceptual pilot
 24 plant designs and technology roadmaps and lead

1 *to an engineering design of a pilot plant that*
 2 *will bring fusion to commercial viability.*

3 “(B) COMPOSITION.—*The national teams*
 4 *shall be composed of developers, manufacturers,*
 5 *universities, national laboratories, and engineer-*
 6 *ing, procurement, and construction industries.”;*
 7 *and*

8 *(B) by adding at the end the following:*

9 “(2) AUTHORIZATION OF APPROPRIATIONS.—
 10 *There are authorized to be appropriated to carry out*
 11 *activities described in paragraph (1)—*

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

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

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

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

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

17 *(6) in subsection (l)—*

18 *(A) by striking “sense of Congress that the*
 19 *United States should support” and inserting*
 20 *“sense of Congress that—”;*

21 *“(1) the United States should support”;*

22 *(B) in paragraph (1) (as so designated by*
 23 *subparagraph (A) of this paragraph), by striking*
 24 *the period at the end and inserting “; and”; and*

25 *(C) by adding at the end the following:*

1 “(2) the Director shall incorporate the findings
 2 and recommendations of the report of the Fusion En-
 3 ergy Sciences Advisory Committee entitled ‘Powering
 4 the Future: Fusion and Plasmas’ and the report of
 5 the National Academies entitled “Bringing Fusion to
 6 the U.S. Grid” into the planning process of the De-
 7 partment, including the development of future budget
 8 requests to Congress.”;

9 (7) by redesignating subsection (o) as subsection
 10 (r);

11 (8) by inserting after subsection (n) the fol-
 12 lowing:

13 “(o) *HIGH-PERFORMANCE COMPUTATION COLLABO-*
 14 *RATIVE RESEARCH PROGRAM.*—

15 “(1) *IN GENERAL.*—The Secretary shall carry
 16 out a program to conduct and support collaborative
 17 research, development, and demonstration of fusion
 18 energy technologies, through high-performance com-
 19 putation modeling and simulation techniques, in
 20 order to—

21 “(A) support fundamental research in plas-
 22 mas and matter at very high temperatures and
 23 densities;

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

1 “(C) facilitate the translation of research re-
2 sults in fusion energy science to industry.

3 “(2) COORDINATION.—In carrying out the pro-
4 gram under paragraph (1), the Secretary shall co-
5 ordinate with relevant Federal agencies, and
6 prioritize the following objectives:

7 “(A) Using expertise from the private sec-
8 tor, institutions of higher education, and the Na-
9 tional Laboratories to leverage existing, and de-
10 velop new, computational software and capabili-
11 ties that prospective users may use to accelerate
12 research and development of fusion energy sys-
13 tems.

14 “(B) Developing computational tools to sim-
15 ulate and predict fusion energy science phe-
16 nomena that may be validated through physical
17 experimentation.

18 “(C) Increasing the utility of the research
19 infrastructure of the Department by coordinating
20 with the Advanced Scientific Computing Re-
21 search program within the Office of Science.

22 “(D) Leveraging experience from existing
23 modeling and simulation entities sponsored by
24 the Department.

1 “(E) Ensuring that new experimental and
2 computational tools are accessible to relevant re-
3 search communities, including private sector en-
4 tities engaged in fusion energy technology devel-
5 opment.

6 “(F) Ensuring that newly developed com-
7 putational tools are compatible with modern vir-
8 tual engineering and visualization capabilities to
9 accelerate the realization of fusion energy tech-
10 nologies and systems.

11 “(3) *DUPLICATION.*—The Secretary shall ensure
12 the coordination of, and avoid unnecessary duplica-
13 tion of, the activities of this program with the activi-
14 ties of—

15 “(A) other research entities of the Depart-
16 ment, including the National Laboratories, the
17 Advanced Research Projects Agency–Energy, the
18 Advanced Scientific Computing Research pro-
19 gram; and

20 “(B) industry.

21 “(4) *HIGH-PERFORMANCE COMPUTING FOR FU-*
22 *SION INNOVATION CENTER.*—In carrying out the pro-
23 gram under paragraph (1), the Secretary shall, in co-
24 ordination with the Innovation Network for Fusion
25 Energy, establish and operate a national High-Per-

1 *formance Computing for Fusion Innovation Center*
2 *(referred to in this section as the ‘Center’), in order*
3 *to support the program under paragraph (1) by pro-*
4 *viding, to the extent practicable, a centralized entity*
5 *for multidisciplinary, collaborative, fusion energy re-*
6 *search and development through high performance*
7 *computing and advanced data analytics technologies*
8 *and processes.*

9 “(5) *SELECTION.*—*The Secretary shall select the*
10 *Center under this subsection on a competitive, merit-*
11 *reviewed basis. The Secretary shall consider applica-*
12 *tions from National Laboratories, institutions of*
13 *higher education, multi-institutional collaborations,*
14 *and other appropriate entities.*

15 “(6) *EXISTING ACTIVITIES.*—*The Center may in-*
16 *corporate existing research activities that are con-*
17 *sistent with the program described in paragraph (1).*

18 “(7) *DURATION.*—*The Center established under*
19 *this subsection shall receive support for a period of*
20 *not more than 5 years, subject to the availability of*
21 *appropriations.*

22 “(8) *RENEWAL.*—*Upon the expiration of any pe-*
23 *riod of support of the Center, the Secretary may*
24 *renew support for the Center, on a merit-reviewed*
25 *basis, for a period of not more than 5 years.*

1 “(9) *TERMINATION.*—*Consistent with the exist-*
2 *ing authorities of the Department, the Secretary may*
3 *terminate the Center for cause during the perform-*
4 *ance period.*

5 “(p) *MATERIAL PLASMA EXPOSURE EXPERIMENT.*—

6 “(1) *IN GENERAL.*—*The Secretary shall construct*
7 *a Material Plasma Exposure Experiment facility as*
8 *described in the 2020 publication approved by the*
9 *Fusion Energy Sciences Advisory Committee titled*
10 *‘Powering the Future: Fusion and Plasmas’. The Sec-*
11 *retary shall consult with the private sector, univer-*
12 *sities, National Laboratories, and relevant Federal*
13 *agencies to ensure that this facility is capable of meet-*
14 *ing Federal research needs for steady state, high-heat-*
15 *flux and plasma-material interaction testing of fusion*
16 *materials over a range of fusion energy relevant pa-*
17 *rameters.*

18 “(2) *FACILITY CAPABILITIES.*—*The Secretary*
19 *shall ensure that the facility described in subsection*
20 *(a) will provide the following capabilities:*

21 “(A) *A magnetic field at the target of 1*
22 *Tesla.*

23 “(B) *An energy flux at the target of 10 MW/*
24 *m².*

1 “(C) *The ability to expose previously irra-*
 2 *diated plasma facing material samples to plas-*
 3 *ma.*

4 “(3) *START OF OPERATIONS.—The Secretary*
 5 *shall, subject to the availability of appropriations, en-*
 6 *sure that the start of full operations of the facility*
 7 *under this section occurs before December 31, 2027.*

8 “(4) *FUNDING.—Out of funds authorized to be*
 9 *appropriated for Fusion Energy Sciences, there are*
 10 *funds authorized to be appropriated to the Secretary*
 11 *for the Office of Fusion Energy Sciences to carry out*
 12 *to completion the construction of the facility under*
 13 *this section:*

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

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

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

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

18 “(q) *MATTER IN EXTREME CONDITIONS INSTRUMENT*
 19 *UPGRADE.—*

20 “(1) *IN GENERAL.—The Secretary shall provide*
 21 *for the upgrade to the Matter in Extreme Conditions*
 22 *endstation at the Linac Coherent Light Source as de-*
 23 *scribed in the 2020 publication approved by the Fu-*
 24 *sion Energy Sciences Advisory Committee titled*
 25 *‘Powering the Future: Fusion and Plasmas’. The Sec-*

retary shall consult with the private sector, universities, National Laboratories, and relevant Federal agencies to ensure that this facility is capable of meeting Federal research needs for understanding physical and chemical changes to plasmas at fundamental timescales, and explore new regimes of dense material physics, astrophysics, planetary physics, and short-pulse laser-plasma interactions.

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

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

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

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

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

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

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

(b) *ITER CONSTRUCTION.*—Section 972 of the Energy Policy Act of 2005 (42 U.S.C. 16312) is amended in subsection (c)(3)—

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

3 (2) by striking subparagraph (B) and inserting
4 the following:

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

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

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

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

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

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

11 (a) *PROGRAM.*—Section 305 of the Department of En-
12 ergy Research and Innovation Act (42 U.S.C. 18643) is
13 amended—

14 (1) by redesignating subsections (b) through (d)
15 as subsections (d) through (f), respectively; and

16 (2) by inserting the following after subsection
17 (a):

18 “(b) *PROGRAM.*—As part of the activities authorized
19 under section 209 of the Department of Energy Organiza-
20 tion Act (42 U.S.C. 7139), the Director shall carry out a
21 research program in elementary particle physics and ad-
22 vanced technology research and development to improve the
23 understanding of the fundamental properties of the uni-
24 verse, including constituents of matter and energy and the
25 nature of space and time.

1 “(c) *HIGH ENERGY FRONTIER RESEARCH*.—As part
2 of the program described in subsection (a), the Director
3 shall carry out research using high energy accelerators and
4 advanced detectors, including accelerators and detectors
5 that will function as national user facilities, to create and
6 study interactions of elementary particles and investigate
7 fundamental forces.”.

8 (b) *INTERNATIONAL COLLABORATION*.—Section 305(d)
9 of the Department of Energy Research and Innovation Act
10 (42 U.S.C. 18643(d)), as redesignated under subsection (a),
11 is amended to read as follows:

12 “(d) *INTERNATIONAL COLLABORATION*.—The Director
13 shall—

14 “(1) as practicable and in coordination with
15 other appropriate Federal agencies as necessary, en-
16 sure the access of United States researchers to the
17 most advanced accelerator facilities and research ca-
18 pabilities in the world, including the Large Hadron
19 Collider;

20 “(2) to the maximum extent practicable, con-
21 tinue to leverage United States participation in the
22 Large Hadron Collider, and prioritize expanding
23 international partnerships and investments in the
24 Long-Baseline Neutrino Facility and Deep Under-
25 ground Neutrino Experiment; and

1 “(3) to the maximum extent practicable,
2 prioritize engagement in collaborative efforts in sup-
3 port of future international facilities that would pro-
4 vide access to the most advanced accelerator facilities
5 in the world to United States researchers.”.

6 (c) *COSMIC FRONTIER RESEARCH*.—Section 305(f) of
7 the Department of Energy Research and Innovation Act (42
8 U.S.C. 18645(f)), as redesignated by subsection (a), is
9 amended to read as follows:

10 “(f) *COSMIC FRONTIER RESEARCH*.—The Director
11 shall carry out research activities on the nature of the pri-
12 mary contents of the universe, including the nature of dark
13 energy and dark matter. These activities shall, to the max-
14 imum extent practicable, be consistent with the research
15 priorities identified by the High Energy Physics Advisory
16 Panel or the National Academy of Sciences, and may in-
17 clude—

18 “(1) collaborations with the National Aero-
19 nautics and Space Administration, the National
20 Science Foundation, or international partners on rel-
21 evant projects; and

22 “(2) the development of space-based, land-based,
23 water-based, and underground facilities and experi-
24 ments.”.

1 (d) *FURTHER ACTIVITIES.*—Section 305 of the Depart-
2 ment of Energy Research and Innovation Act (42 U.S.C.
3 18645), as amended, is further amended by adding at the
4 end the following:

5 “(g) *FACILITY CONSTRUCTION AND MAJOR ITEMS OF*
6 *EQUIPMENT.*—

7 “(1) *PROJECTS.*—Consistent with the Office of
8 Science’s project management practices, the Director
9 shall, to the maximum extent practicable, incorporate
10 the findings and recommendations of the 2014 Par-
11 ticle Physics Project Prioritization Panel (P5) report
12 titled ‘Building for Discovery’, and support construc-
13 tion or fabrication of—

14 “(A) *an international Long-Baseline Neu-*
15 *trino Facility based in the United States;*

16 “(B) *the Proton Improvement Plan II;*

17 “(C) *Second Generation Dark Matter ex-*
18 *periments;*

19 “(D) *the Legacy Survey of Space and Time*
20 *camera;*

21 “(E) *upgrades to detectors and other compo-*
22 *nents of the Large Hadron Collider; and*

23 “(F) *other high priority projects rec-*
24 *ommended in the most recent report of the Par-*

1 *ticle Physics Project Prioritization Panel of the*
2 *High Energy Physics Advisory Panel.*

3 “(2) *LONG-BASELINE NEUTRINO FACILITY.*—

4 “(A) *IN GENERAL.*—*The Secretary shall*
5 *support construction of a Long-Baseline Neu-*
6 *trino Facility to facilitate the international*
7 *Deep Underground Neutrino Experiment to ex-*
8 *amine the fundamental properties of neutrinos,*
9 *explore physics beyond the Standard Model, and*
10 *better clarify the existence and nature of anti-*
11 *matter.*

12 “(B) *FACILITY CAPABILITIES.*—*The Sec-*
13 *retary shall ensure that the facility described in*
14 *subparagraph (A) will provide, at a minimum,*
15 *the following capabilities:*

16 “(i) *A neutrino beam with wideband*
17 *capability of 1.2 megawatts (MW) of beam*
18 *power and upgradable to 2.4 MW of beam*
19 *power.*

20 “(ii) *Three caverns excavated for a 70*
21 *kiloton fiducial detector mass and sup-*
22 *porting surface buildings and utilities.*

23 “(iii) *Cryogenic systems to support*
24 *neutrino detectors.*

1 “(C) *START OF OPERATIONS.*—*The Sec-*
 2 *retary shall, subject to the availability of appro-*
 3 *priations, ensure that the start of full operations*
 4 *of the facility under this subsection occurs before*
 5 *December 31, 2031.*

6 “(D) *FUNDING.*—*Out of funds authorized to*
 7 *be appropriated under subsection (k), there shall*
 8 *be made available to the Secretary to carry out*
 9 *construction of the facility under this sub-*
 10 *section—*

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

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

13 “(iii) \$400,000,000 for fiscal year
 14 2024;

15 “(iv) \$375,000,000 for fiscal year 2025;

16 *and*

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

18 “(3) *PROTON IMPROVEMENT PLAN—II ACCEL-*
 19 *ERATOR UPGRADE PROJECT.*—

20 “(A) *IN GENERAL.*—*The Secretary of En-*
 21 *ergy shall support construction of the Proton Im-*
 22 *provement Plan II, an upgrade to the Fermilab*
 23 *accelerator complex identified in the 2014 Par-*
 24 *ticle Physics Project Prioritization Panel (P5)*
 25 *report titled ‘Building for Discovery’, to provide*

1 *the world’s most intense beam of neutrinos to the*
2 *international Long Baseline Neutrino Facility*
3 *as well as abroad range of future high energy*
4 *physics experiments. The Secretary of Energy*
5 *shall work with international partners to enable*
6 *further significant contributions to the capabili-*
7 *ties of this project.*

8 “(B) *FACILITY CAPABILITIES.—The Sec-*
9 *retary shall ensure that the facility described in*
10 *paragraph (1) will provide, at a minimum, the*
11 *following capabilities:*

12 “(i) *A state-of-the-art 800 megaelectron*
13 *volt (MeV) superconducting linear accel-*
14 *erator.*

15 “(ii) *Proton beam power of 1.2 MW at*
16 *the start of LBNF/DUNE, upgradeable to*
17 *2.4 MW of beam power.*

18 “(iii) *A flexible design to enable high*
19 *power beam delivery to multiple users si-*
20 *multaneously and customized beams tai-*
21 *lored to specific scientific needs.*

22 “(iv) *Sustained high reliability oper-*
23 *ation of the Fermilab accelerator complex.*

24 “(C) *START OF OPERATIONS.—The Sec-*
25 *retary shall, subject to the availability of appro-*

priations, ensure that the start of full operations of the facility under this section occurs before December 31, 2028.

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

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

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

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

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

and

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

“(4) *COSMIC MICROWAVE BACKGROUND STAGE*

4.—

“(A) *IN GENERAL*.—The Secretary of Energy, in partnership with the Director of the National Science Foundation, shall support construction of the Cosmic Microwave Background Stage 4 project to survey the cosmic microwave background to test theories of cosmic inflation as described in the 2014 Particle Physics Prioritization Panel (P5) report titled ‘Building

1 *for Discovery: Strategic Plan for U.S. Particle*
2 *Physics in the Global Context.’*

3 “(B) *CONSULTATION.*—*The Secretary shall*
4 *consult with the private sector, universities, Na-*
5 *tional Laboratories, and relevant Federal agen-*
6 *cies to ensure that this experiment is capable of*
7 *meeting Federal research needs in accessing the*
8 *ultra-high energy physics of inflation and im-*
9 *portant neutrino properties.*

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

22 “(D) *START OF OPERATIONS.*—*The Sec-*
23 *retary shall, subject to the availability of appro-*
24 *priations, ensure that the start of full operations*

1 *of the facility under this section occurs before*
2 *December 31, 2030.*

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

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

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

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

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

12 *and*

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

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

1 “(i) *ACCELERATOR AND DETECTOR RESEARCH AND*
 2 *DEVELOPMENT.*—*As part of the program described in sub-*
 3 *section (a), the Director shall carry out research and devel-*
 4 *opment in particle beam physics, accelerator science and*
 5 *technology, and particle and radiation detection with rel-*
 6 *evance to the specific needs of the High Energy Physics pro-*
 7 *gram, in coordination with the Accelerator Research and*
 8 *Development program authorized in section 311.*

9 “(j) *UNDERGROUND SCIENCE.*—*The Director shall—*
 10 “(1) *support an underground science program*
 11 *consistent with the missions of the Department and*
 12 *the scientific needs of the High Energy Physics pro-*
 13 *gram, including those articulated in the most recent*
 14 *report of the Particle Physics Project Prioritization*
 15 *Panel of the High Energy Physics Advisory Panel,*
 16 *that leverages the capabilities of relevant underground*
 17 *science and engineering facilities; and*

18 “(2) *carry out a competitive grant program to*
 19 *award scientists and engineers at institutions of high-*
 20 *er education, nonprofit institutions, and national lab-*
 21 *oratories to conduct research in underground science*
 22 *and engineering.*

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

1 “(1) \$1,355,690,000 for fiscal year 2022;
 2 “(2) \$1,517,628,300 for fiscal year 2023;
 3 “(3) \$1,652,112,281 for fiscal year 2024;
 4 “(4) \$1,711,460,141 for fiscal year 2025; and
 5 “(5) \$1,656,012,351 for fiscal year 2026.”.

6 **SEC. 8. NUCLEAR PHYSICS PROGRAM.**

7 (a) *PROGRAM.*—Section 308 of the Department of En-
 8 ergy Research and Innovation Act (42 U.S.C. 18646) is
 9 amended—

10 (1) by striking subsection (a);
 11 (2) by redesignating subsection (b) as subsection
 12 (d); and
 13 (3) by inserting the following before subsection
 14 (d), as so redesignated:

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

20 “(b) *USER FACILITIES.*—

21 “(1) *FACILITY FOR RARE ISOTOPE BEAMS.*—

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

1 “(B) *FUNDING.*—*Out of funds authorized to*
2 *be appropriated under subsection (c), there shall*
3 *be made available to the Secretary to carry out*
4 *construction of the facility under this subsection*
5 *\$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 operations*
9 *of the facility under this section occurs before*
10 *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 the*
15 *Nuclear Science Advisory Committee and the re-*
16 *port from the National Academies titled ‘An As-*
17 *essment of U.S.-Based Electron-Ion Collider*
18 *Science’, in order to measure the internal struc-*
19 *ture of the proton and the nucleus and answer*
20 *fundamental questions about the nature of visible*
21 *matter.*

22 “(B) *FACILITY CAPABILITY.*—*The Secretary*
23 *shall ensure that the facility meets the require-*
24 *ments in the 2015 Long Range Plan, includ-*
25 *ing—*

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

3 “(ii) ion beams from deuterium to the
4 heaviest stable nuclei;

5 “(iii) variable center of mass energy
6 from 20 to 140 GeV;

7 “(iv) high collision luminosity of
8 $10^{33-34} \text{cm}^{-2} \text{s}^{-1}$; and

9 “(v) the possibility of more than one
10 interaction region.

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

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

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

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

23 “(iii) \$250,000,000 for fiscal year
24 2024;

1 “(iv) \$300,000,000 for fiscal year 2025;

2 and

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

4 “(c) *AUTHORIZATION OF APPROPRIATIONS.*—*There are*
 5 *authorized to be appropriated to the Secretary to carry out*
 6 *the activities described in this section—*

7 “(1) \$780,000,000 for fiscal year 2022;

8 “(2) \$879,390,000 for fiscal year 2023;

9 “(3) \$1,025,097,300 for fiscal year 2024;

10 “(4) \$1,129,354,111 for fiscal year 2025; and

11 “(5) \$1,192,408,899 for fiscal year 2026.”.

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

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

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

17 “(a) *PROGRAM.*—*As part of the activities authorized*
 18 *under section 209 of the Department of Energy Organiza-*
 19 *tion Act (42 U.S.C. 7139), the Director shall carry out a*
 20 *research program to—*

21 “(1) *advance accelerator science and technology*
 22 *relevant to the Department, other Federal agencies,*
 23 *and U.S. industry;*

1 “(2) foster partnerships to develop, demonstrate,
2 and enable the commercial application of accelerator
3 technologies;

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

6 “(4) provide access to accelerator design and en-
7 gineering resources.

8 “(b) ACCELERATOR RESEARCH.—In carrying out the
9 program authorized under subsection (a), the Director shall
10 support—

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

17 “(2) optimal operation of the Accelerator Test
18 Facility.

19 “(c) ACCELERATOR DEVELOPMENT.—In carrying out
20 the program authorized under subsection (a), the Director
21 shall support partnerships to foster the development, dem-
22 onstration, and commercial application of accelerator tech-
23 nologies including, advanced superconducting wire and
24 cable, superconducting RF cavities, and high efficiency ra-
25 diofrequency power sources for accelerators.

1 “(d) *RESEARCH COLLABORATIONS.*—*In developing ac-*
 2 *celerator technologies under the program authorized in sub-*
 3 *section (a), the Director shall—*

4 “(1) *consider the requirements necessary to sup-*
 5 *port translational research and development for med-*
 6 *ical, industrial, security, and defense applications;*
 7 *and*

8 “(2) *leverage investments in accelerator tech-*
 9 *nologies and fundamental research in particle physics*
 10 *by partnering with institutes of higher education, in-*
 11 *dustry, and other Federal agencies to enable the com-*
 12 *mercial application of advanced accelerator tech-*
 13 *nologies.*

14 “(e) *AUTHORIZATION OF APPROPRIATIONS.*—*There are*
 15 *authorized to be appropriated to the Secretary to carry out*
 16 *the activities described in this section—*

17 “(1) *\$24,000,000 for fiscal year 2022;*

18 “(2) *\$25,680,000 for fiscal year 2023;*

19 “(3) *\$27,477,600 for fiscal year 2024;*

20 “(4) *\$29,401,032 for fiscal year 2025; and*

21 “(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 *of Energy for the production of isotopes, including the*
12 *development of techniques to produce isotopes, that the*
13 *Secretary determines are needed for research, medical,*
14 *industrial, or related purposes, to the maximum ex-*
15 *tent practicable, in accordance with the 2015 NSAC*
16 *‘Meeting Isotope Needs and Capturing Opportunities*
17 *For The Future’ report; and*

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

24 “(b) *AUTHORIZATION OF APPROPRIATIONS.*—*There*
25 *are authorized to be appropriated to carry out the program*
26 *under this subsection—*

- 1 “(1) \$90,000,000 for fiscal year 2022;
 2 “(2) \$96,300,000 for fiscal year 2023;
 3 “(3) \$103,041,000 for fiscal year 2024;
 4 “(4) \$110,253,870 for fiscal year 2025; and
 5 “(5) \$117,971,641 for fiscal year 2026.”.

6 **SEC. 11. SCIENCE LABORATORIES INFRASTRUCTURE PRO-**
 7 **GRAM.**

8 (a) *PROGRAM.*—Section 309 of the Department of En-
 9 ergy Research and Innovation Act (42 U.S.C. 18647) is
 10 amended by adding at the end the following:

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

17 “(d) *ALTERNATIVE FINANCING OF RESEARCH FACILI-*
 18 *TIES AND INFRASTRUCTURE.*—

19 “(1) *IN GENERAL.*—Consistent with section
 20 161(g) of the Atomic Energy Act of 1954 (42 U.S.C.
 21 2201(g)), the Management and Operating contractors
 22 of the Department may enter into the lease-purchase
 23 of research facilities and infrastructure under the
 24 scope of their contract with the Department with the
 25 approval of the Secretary or their designee.

1 “(2) *LIMITATIONS.*—*To carry out lease-purchases*
2 *approved by the Secretary under subsection (a), the*
3 *Department shall only be required to have budget au-*
4 *thority in an amount sufficient to cover the minimum*
5 *required lease payments through the period required*
6 *to exercise a termination provision in the lease agree-*
7 *ment, plus any associated lease termination penalties,*
8 *regardless of whether such leased facility and infra-*
9 *structure is on or off Government land, and if—*

10 “(A) *the Department has established a mis-*
11 *sion need for the facility or infrastructure to be*
12 *leased;*

13 “(B) *the facility or infrastructure is general*
14 *purpose, including offices, laboratories, cafe-*
15 *terias, utilities, and data centers;*

16 “(C) *the Department is not a party to and*
17 *has no financial obligations under the lease-pur-*
18 *chase transaction entered into by the Manage-*
19 *ment and Operating contractor, other than al-*
20 *lowability of the lease cost and conveyance of*
21 *Government land, if needed;*

22 “(D) *the lease-purchase has an advance no-*
23 *tice termination provision with reasonable pre-*
24 *defined penalties that the Management and Op-*
25 *erating contractor may exercise, at the direction*

1 *of the Department, if funding for the lease is no*
2 *longer available or the mission need ceases to*
3 *exist;*

4 *“(E) there is an option for a no cost trans-*
5 *fer of ownership to the Government once the un-*
6 *derlying financing is retired, but neither the*
7 *Management and Operating contractor nor the*
8 *Department are obligated to purchase the facility*
9 *or infrastructure at any time during or after the*
10 *lease term;*

11 *“(F) the lease-purchase transaction, assum-*
12 *ing exercise of the ownership option, is dem-*
13 *onstrated to be the lowest lifecycle cost alter-*
14 *native for the Government; and*

15 *“(G) the cumulative annual base rent for*
16 *all lease-purchases of facilities and infrastruc-*
17 *ture, inclusive of any transactions under consid-*
18 *eration, does not exceed 2 percent of the Manage-*
19 *ment and Operating contract operating budget*
20 *for the year the commitment is made for the*
21 *lease.*

22 *“(3) REPORTING.—Not later than one year after*
23 *the date of the enactment of the Department of En-*
24 *ergy Science for the Future Act, and biennially there-*
25 *after, the Department shall submit to the Committee*

1 *on Science, Space, and Technology and the Committee*
2 *on Appropriations of the House of Representatives,*
3 *and the Committee on Energy and Natural Resources*
4 *and the Committee on Appropriations of the Senate,*
5 *a report on the lease-purchase transactions that the*
6 *Management and Operating contractors of the De-*
7 *partment entered into under subsection (a) that in-*
8 *cludes—*

9 “(A) *a list of the lease-purchase trans-*
10 *actions entered into by each Management and*
11 *Operating contractor and their respective costs;*

12 “(B) *the annual percentage of each Manage-*
13 *ment and Operating contract operating budget*
14 *that is used for lease-purchase transactions for*
15 *the year the commitments were made; and*

16 “(C) *any other information the Secretary*
17 *finds appropriate.*

18 “(d) *MID-SCALE INSTRUMENTATION PROGRAM.—The*
19 *Director, in coordination with each of the programs carried*
20 *out by the Office of Science, shall establish a mid-scale in-*
21 *strumentation program to enable the development and ac-*
22 *quisition of novel, state-of-the-art instruments ranging in*
23 *cost from \$1 million to \$20 million each that would signifi-*
24 *cantly accelerate scientific breakthroughs at user facilities.*

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

5 **SEC. 12. INCREASED COLLABORATION WITH TEACHERS**
 6 **AND SCIENTISTS.**

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

11 **“SEC. 312. INCREASED COLLABORATION WITH TEACHERS**
 12 **AND SCIENTISTS.**

13 “(a) *IN GENERAL.*—*The Director shall support the de-*
 14 *velopment of a scientific workforce through programs that*
 15 *facilitate collaboration between K–12, university students,*
 16 *early-career researchers, faculty, and the National Labora-*
 17 *tories, including through the use of proven techniques to ex-*
 18 *pand the number of individuals from underrepresented*
 19 *groups pursuing and attaining skills or undergraduate and*
 20 *graduate degrees relevant to the Office’s mission.*

21 “(b) *AUTHORIZATION OF APPROPRIATIONS.*—*Section*
 22 *3169 of the Department of Energy Science Education En-*
 23 *hancement Act (42 U.S.C. 7381e) is amended—*

1 “(1) by striking, ‘programs’, and inserting ‘pro-
 2 grams, including the NSF INCLUDES National Net-
 3 work,’; and

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

6 (b) *BROADENING PARTICIPATION IN WORKFORCE DE-*
 7 *VELOPMENT FOR TEACHERS AND SCIENTISTS.*—

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

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

14 “(a) *IN GENERAL.*—*The Secretary shall expand oppor-*
 15 *tunities to increase the number and the diversity, equity,*
 16 *and inclusion of highly skilled science, technology, engineer-*
 17 *ing, and mathematics (STEM) professionals working in*
 18 *Department of Energy mission-relevant disciplines and*
 19 *broaden the recruitment pool to increase diversity, includ-*
 20 *ing expanded partnerships with Historically Black Colleges,*
 21 *Tribal Colleges, Minority Serving Institutions, emerging re-*
 22 *search 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 Fu-*
 25 *ture Act, the Secretary shall submit to the Committee on*

1 *Science, Space, and Technology of the House of Representa-*
2 *tives and the Committee on Energy and Natural Resources*
3 *and the Committee on Commerce, Science, and Transpor-*
4 *tation of the Senate and make available to the public a plan*
5 *for broadening participation of underrepresented groups in*
6 *science, technology, engineering, and mathematics in pro-*
7 *grams supported by the Department programs, including—*

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

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

13 “(3) *experienced and potential barriers to broad-*
14 *ening participation of underrepresented groups in De-*
15 *partment programs, including recommended solu-*
16 *tions; and*

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

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

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

6 “(a) *IN GENERAL.*—The Secretary shall expand oppor-
 7 tunities to increase the number and the diversity, equity,
 8 and inclusion of highly skilled science, technology, engineer-
 9 ing, and mathematics (STEM) professionals working in
 10 Department of Energy mission-relevant disciplines and
 11 broaden the recruitment pool to increase diversity, includ-
 12 ing expanded partnerships with minority-serving institu-
 13 tions, non-Research I universities, and scientific societies.

14 “(b) *PLAN AND OUTREACH STRATEGY.*—

15 “(1) *PLAN.*—Not later than 6 months after the
 16 date of enactment of the Department of Energy
 17 Science for the Future Act, the Secretary shall submit
 18 to the Committee on Science, Space, and Technology
 19 of the House of Representatives and the Committee on
 20 Energy and Natural Resources of the Senate a 10-
 21 year educational plan to fund and expand new or ex-
 22 isting programs administered by the Office of Science
 23 and sited at the national laboratories and Depart-
 24 ment of Energy user facilities to expand educational
 25 and workforce opportunities for underrepresented high
 26 school, undergraduate, and graduate students as well

1 *as recent graduates, teachers and faculty in STEM*
2 *fields. This may include paid internships, fellowships,*
3 *temporary employment, training programs, visiting*
4 *student and faculty programs, sabbaticals, and re-*
5 *search support.*

6 “(2) *OUTREACH CAPACITY.*—*The Secretary shall*
7 *include in the plan under paragraph (1) an outreach*
8 *strategy to improve the advertising, recruitment, and*
9 *promotion of educational and workforce programs to*
10 *community colleges, Historically Black Colleges and*
11 *Universities, Tribal Colleges, Minority Serving Insti-*
12 *tutions, and emerging research institutions.*

13 “(c) *BUILDING RESEARCH CAPACITY.*—*The Secretary*
14 *shall develop programs that strengthen the research capac-*
15 *ity relevant to Office of Science disciplines at emerging re-*
16 *search institutions, including minority-serving institutions,*
17 *tribal colleges and universities, Historically Black Colleges*
18 *and Universities, and colleges and universities. This may*
19 *include enabling mutually beneficial and jointly managed*
20 *partnerships between research-intensive institutions and*
21 *emerging research institutions, and soliciting research pro-*
22 *posals, fellowships, training programs, and research sup-*
23 *port directly from emerging research institutions.*

24 “(d) *TRAINEESHIPS.*—*The Secretary shall establish a*
25 *university-led Traineeship Program to address workforce*

1 *training needs in STEM fields relevant to the Department.*
 2 *The focus should be on supporting training and research*
 3 *experiences for underrepresented undergraduate and grad-*
 4 *uate students and increasing participation from underrep-*
 5 *resented populations. The traineeships should include op-*
 6 *portunities to build the next-generation workforce in re-*
 7 *search areas critical to maintaining core competencies*
 8 *across the Office of Science’s programs.*

9 “(e) *EVALUATION.*—*The Secretary shall establish key*
 10 *performance indicators to measure and monitor progress of*
 11 *education and workforce programs and expand Depart-*
 12 *mental activities for data collection and analysis. The Sec-*
 13 *retary shall submit a report 2 years after the date of enact-*
 14 *ment of the Department of Energy Science for the Future*
 15 *Act, and every 2 years thereafter, to the Committee on*
 16 *Science, Space, and Technology of the House of Representa-*
 17 *tives and the Committee on Energy and Natural Resources*
 18 *of the Senate summarizing progress toward meeting key*
 19 *performance indicators.*

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

21 “(1) *MINORITY-SERVING INSTITUTION.*—*The*
 22 *term ‘minority-serving institution’ includes the enti-*
 23 *ties described in any of paragraphs (1) through (7)*
 24 *of section 371(a) of the Higher Education Act of 1965*
 25 *(20 U.S.C. 1067q(a)).*

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

6 “(3) *STEM.*—*The term ‘STEM’ has the meaning*
 7 *given the term in the STEM Education Act of 2015*
 8 *(42 U.S.C. 1861 et seq.).*

9 “(4) *TRIBAL COLLEGES AND UNIVERSITIES.*—
 10 *The term ‘Tribal College or University’ has the mean-*
 11 *ing given in section 316 of the Higher Education Act*
 12 *of 1965 (20 U.S.C. 1059c).”.*

13 (2) *Clerical amendment.*—*The table of contents*
 14 *in section 2(b) of the National Defense Authorization*
 15 *Act for Fiscal Year 1991 is amended by inserting*
 16 *after the item relating to section 3167 the following:*

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

“Sec. 3167B. *Expanding opportunities to increase the diversity, equity, and inclusion 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 high
 11 intensity laser research initiative consistent with the rec-
 12 ommendations of the National Academies report, ‘Opportu-
 13 nities in Intense Ultrafast Lasers: Reaching for the Bright-
 14 est Light’, and the report from the Brightest Light Initia-
 15 tive workshop on ‘The Future of Intense Ultrafast Lasers
 16 in the U.S.’. This initiative should include research and
 17 development of petawatt-scale and of high average power
 18 laser technologies necessary for future facility needs in dis-
 19 covery science and to advance energy technologies, as well
 20 as support for a user network of academic and national
 21 laboratory high intensity laser facilities.

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

25 “(c) *COORDINATION.*—The Director shall coordinate
 26 this initiative among all relevant programs within the Of-

1 *Office of Science, and the Under Secretary for Science shall*
 2 *coordinate this initiative with other relevant programs*
 3 *within the Department as well as within other Federal*
 4 *agencies.*

5 “(d) *AUTHORIZATION OF APPROPRIATIONS.—Out of*
 6 *funds authorized to be appropriated for the Office of Science*
 7 *there are authorized to be appropriated to the Secretary to*
 8 *carry out the activities described in this subsection—*

9 “(1) *\$50,000,000 for fiscal year 2022;*

10 “(2) *\$100,000,000 for fiscal year 2023;*

11 “(3) *\$150,000,000 for fiscal year 2024;*

12 “(4) *\$200,000,000 for fiscal year 2025; and*

13 “(5) *\$250,000,000 for fiscal year 2026.*

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

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

20 “(1) *the purchase of equipment to capture, reuse,*
 21 *and recycle helium;*

22 “(2) *the installation, maintenance, and repair of*
 23 *new and existing helium capture, reuse, and recycling*
 24 *equipment; and*

1 “(3) *helium alternatives research and develop-*
2 *ment activities.*

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

12 “(1) *the quantity of helium purchased for*
13 *projects and facilities supported by Department*
14 *grants;*

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

16 “(3) *the predominant production sources for such*
17 *helium;*

18 “(4) *expected or experienced impacts of helium*
19 *supply shortages or prices on the research projects*
20 *and facilities supported by the Department; and*

21 “(5) *recommendations for reducing Department*
22 *grant recipients’ exposure to volatile helium prices.*

23 “(c) *COORDINATION.—In carrying out the program*
24 *under this section, the Director shall coordinate with the*

1 *National Science Foundation and other relevant Federal*
2 *agencies on helium conservation activities.*

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

6 “(e) *RENEWAL.*—*Upon expiration of any period of*
7 *support of the program under this section, the Director may*
8 *renew support for the program for a period of not more*
9 *than 5 years.*

10 **“SEC. 315. OFFICE OF SCIENCE EMERGING INFECTIOUS DIS-**
11 **EASE COMPUTING RESEARCH INITIATIVE.**

12 “(a) *IN GENERAL.*—*The Secretary, in coordination*
13 *with the Director of the National Science Foundation and*
14 *the Administrator of the National Aeronautics and Space*
15 *Administration, shall establish within the Office of Science,*
16 *a cross-cutting research initiative to leverage the Federal*
17 *Government’s innovative analytical resources and tools,*
18 *user facilities, and advanced computational and networking*
19 *capabilities in order to prevent, prepare for, and respond*
20 *to emerging infectious diseases, including COVID–19. The*
21 *Secretary shall carry out this initiative through a competi-*
22 *tive, merit-reviewed process, and consider applications from*
23 *National Laboratories, institutions of higher education,*
24 *multi-institutional collaborations, industry partners and*
25 *other appropriate entities.*

1 “(b) *ACTIVITIES.*—*In carrying out the initiative estab-*
2 *lished under subsection (a), the Secretary shall coordinate*
3 *with programs across the Office of Science and with rel-*
4 *evant Federal agencies to determine a comprehensive set of*
5 *technical milestones for these research activities and*
6 *prioritize the following objectives—*

7 “(1) *supporting fundamental research and devel-*
8 *opment in advanced analytics, experimental studies,*
9 *materials synthesis, high-performance computing*
10 *technologies needed to characterize, model, simulate,*
11 *and predict complex phenomena and biological mate-*
12 *rials related to emerging infectious diseases, including*
13 *COVID–19 challenges, including a focus on testing*
14 *and diagnostics, experimental data acquisition, shar-*
15 *ing and management, advanced manufacturing, and*
16 *molecular design and modeling;*

17 “(2) *using expertise from the private sector, in-*
18 *stitutions of higher education, and the National Lab-*
19 *oratories to develop computational software and capa-*
20 *bilities that prospective users may accelerate emerging*
21 *infectious diseases research and development;*

22 “(3) *leveraging the research infrastructure of the*
23 *Department, including scientific computing user fa-*
24 *cilities, x-ray light sources, neutron scattering facili-*
25 *ties, nanoscale science research centers, and sequenc-*

1 *ing and bio-characterization facilities by coordinating*
2 *with the Advanced Scientific Computing Research,*
3 *Basic Energy Sciences, and Biological and Environ-*
4 *mental Research programs within the Office of*
5 *Science;*

6 *“(4) leveraging experience from existing mod-*
7 *eling and simulation research and work sponsored by*
8 *the Department and promoting collaboration and*
9 *data sharing between National Laboratories, research*
10 *entities, and user facilities of the Department by pro-*
11 *viding the necessary access and secure data transfer*
12 *capabilities; and*

13 *“(5) ensuring that new experimental and com-*
14 *putational tools are accessible to relevant research*
15 *communities, including private sector entities to ad-*
16 *dress emerging infectious diseases, including COVID–*
17 *19 challenges.*

18 *“(c) COORDINATION.—In carrying out this initiative,*
19 *the Secretary shall ensure, to the maximum extent prac-*
20 *ticable, coordination of these activities with the Department*
21 *of Energy National Laboratories, institutions of higher edu-*
22 *cation, and the private sector.*

23 *“(d) EMERGING INFECTIOUS DISEASES HIGH PER-*
24 *FORMANCE COMPUTING RESEARCH CONSORTIUM.—*

1 “(1) *IN GENERAL.*—*The Secretary in coordina-*
2 *tion with the Director of the National Science Foun-*
3 *dation and the Director of the Office of Science and*
4 *Technology Policy shall establish and operate an*
5 *Emerging Infectious Diseases High Performance*
6 *Computing Research Consortium (referred to in this*
7 *section as the ‘Consortium’), in order to support the*
8 *initiative under subsection (a) by providing, to the*
9 *extent practicable, a centralized entity for multidisci-*
10 *plinary, collaborative, emerging infectious disease re-*
11 *search and development through high performance*
12 *computing and advanced data analytics technologies*
13 *and processes.*

14 “(2) *MEMBERSHIP.*—*The members of such con-*
15 *sortium may include representatives from relevant*
16 *Federal agencies, the private sector, institutions of*
17 *higher education, which can each contribute relevant*
18 *compute time, capabilities, or other resources.*

19 “(3) *ACTIVITIES.*—*The Consortium shall—*

20 “(A) *match applicants with available Fed-*
21 *eral and private sector computing resources;*

22 “(B) *consider supplemental awards for com-*
23 *puting partnerships with Consortium members*
24 *to qualifying entities on a competitive merit-re-*
25 *view basis;*

1 “(C) encourage collaboration and commu-
2 nication among member representatives of the
3 consortium and awardees;

4 “(D) make available the high-performance
5 computing capabilities, expertise, and user fa-
6 cilities of the Department and the National Lab-
7 oratories; and

8 “(E) submit an annual report to the Sec-
9 retary summarizing the activities of the Consor-
10 tium, including—

11 “(i) describing each project undertaken
12 by the Consortium;

13 “(ii) detailing organizational expendi-
14 tures; and

15 “(iii) evaluating contribution to the
16 achievement of technical milestones as deter-
17 mined in subsection (a).

18 “(4) COORDINATION.—The Secretary shall ensure
19 the coordination of, and avoid unnecessary duplica-
20 tion of, the activities of the Consortium with the ac-
21 tivities of other research entities of the Department,
22 institutions of higher education and the private sec-
23 tor.

24 “(e) REPORT.—Not later than 2 years after the date
25 of enactment of the Department of Energy Science for the

1 *Future Act, the Secretary shall submit to the Committee*
 2 *on Science, Space, and Technology of the House, and the*
 3 *Committee on Energy and Natural Resources of the Senate,*
 4 *and the Committee on Commerce, Science, and Transpor-*
 5 *tation of the Senate a report detailing the effectiveness of—*

6 “(1) *the interagency coordination between each*
 7 *Federal agency involved in the research initiative car-*
 8 *ried out under this section;*

9 “(2) *the collaborative research achievements of*
 10 *the initiative, including the achievement of the tech-*
 11 *nical milestones determined under subsection (a); and*

12 “(3) *potential opportunities to expand the tech-*
 13 *nical capabilities of the Department.*

14 “(f) *FUNDING.—From within funds authorized to be*
 15 *appropriated for the Department’s Office of Science, there*
 16 *shall be made available to the Secretary to carry out the*
 17 *activities under this subsection, \$50,000,000 for fiscal years*
 18 *2022 and 2023.*

19 “(g) *PROHIBITION ON USE OF FUNDS.—*

20 “(1) *IN GENERAL.—No funds allocated to the*
 21 *initiative described in subsection (a) may be obligated*
 22 *or expended for gain-of-function research of concern.*

23 “(2) *GAIN-OF-FUNCTION RESEARCH DEFINED.—*
 24 *For the purposes of this subsection, ‘gain-of-function*
 25 *research of concern’ means research activities with the*

1 *potential to generate pathogens with high trans-*
 2 *missibility and high virulence in humans.*

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

4 *“There are authorized to be appropriated to the Sec-*
 5 *retary to carry out the activities described in this title—*

6 *“(1) \$8,801,915,000 for fiscal year 2022;*

7 *“(2) \$9,451,015,300 for fiscal year 2023;*

8 *“(3) \$10,160,677,621 for fiscal year 2024;*

9 *“(4) \$10,693,625,004 for fiscal year 2025; and*

10 *“(5) \$11,145,798,345 for fiscal year 2026.”.*

11 *(b) TABLE OF CONTENTS.—Section 1(b) of the Depart-*
 12 *ment of Energy Research and Innovation Act is amended*
 13 *in the table of contents by inserting after the item relating*
 14 *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.”.

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

16 *(a) INNOVATE IN AMERICA.—None of the funds author-*
 17 *ized or made available by this Act, or the amendments made*
 18 *by this Act, may be used in awarding a contract, sub-*
 19 *contract, grant, or loan to an entity that—*

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

4 (A) *is identified as a nonmarket economy*
 5 *country (as defined in section 771(18) of the*
 6 *Tariff Act of 1930 (19 U.S.C. 1677(18))) as of*
 7 *the date of enactment of this Act;*

8 (B) *was identified by the United States*
 9 *Trade Representative in the most recent report*
 10 *required by section 182 of the Trade Act of 1974*
 11 *(19 U.S.C. 2242) as a priority foreign country*
 12 *under subsection (a)(2) of that section; and*

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

16 (2) *is listed pursuant to section 9(b)(3) of the*
 17 *Uyghur Human Rights Policy Act of 2020 (Public*
 18 *Law 116–145).*

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

23 (c) *INTERNATIONAL AGREEMENTS.—This section shall*
 24 *be applied in a manner consistent with the obligations of*
 25 *the United States under international agreements.*

Union Calendar No. 50

117TH CONGRESS
1ST Session

H. R. 3593

[Report No. 117-72]

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.

JUNE 28, 2021

Reported with an amendment, committed to the Committee of the Whole House on the State of the Union, and ordered to be printed