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(Original Signature of Member)

117TH CONGRESS  
1ST SESSION

# H. R. 3593

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

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## IN THE HOUSE OF REPRESENTATIVES

Ms. JOHNSON of Texas introduced the following bill; which was referred to the Committee on Science, Space, and Technology

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## A BILL

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

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

3 **SECTION 1. SHORT TITLE.**

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

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

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

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

15 “(e) **COORDINATION.**—

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

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

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

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

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

4           “(2) WITHIN THE OFFICE OF SCIENCE.—The  
5           Director shall ensure the coordination of programs  
6           and activities carried out by the Office of Science.”.

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

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

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

14           (2) by inserting before subsection (d), as so re-  
15           designated, the following:

16           “(a) PROGRAM.—As part of the activities authorized  
17           under section 209 of the Department of Energy Organiza-  
18           tion Act (42 U.S.C. 7139), the Director shall carry out  
19           a research and development program in basic energy  
20           sciences, including materials sciences and engineering,  
21           chemistry, physical biosciences, geosciences, and other dis-  
22           ciplines, to understand, model, and control matter and en-  
23           ergy at the electronic, atomic, and molecular levels in  
24           order to provide the foundations for new energy tech-  
25           nologies, address scientific grand challenges, and support

1 the energy, environment, and national security missions  
2 of the Department.

3 “(b) SUSTAINABLE CHEMISTRY.—In carrying out  
4 chemistry-related research and development activities  
5 under this section, the Director shall prioritize research  
6 and development sustainable chemistry to support clean,  
7 safe, and economic alternatives and methodologies to tra-  
8 ditional chemical products and processes.”;

9 (3) in subsection (c)(3), as so redesignated—

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

12 (B) by redesignating subparagraph (D) as  
13 subparagraph (E); and

14 (C) by inserting after subparagraph (C)  
15 the following:

16 “(D) autonomous chemistry and materials  
17 synthesis facilities that leverage advances in ar-  
18 tificial intelligence; and”;

19 (4) in subsection (d), as so redesignated, by  
20 adding at the end the following:

21 “(4) ADVANCED PHOTON SOURCE UPGRADE.—

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

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

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

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

14                  “(C) START OF OPERATIONS.—The Sec-  
15                  retary shall, to the maximum extent practicable,  
16                  ensure that the start of full operations of the  
17                  upgrade under this paragraph occurs before  
18                  March 31, 2026.

19                  “(D) FUNDING.—Out of funds authorized  
20                  to be appropriated under subsection (j), there  
21                  shall be made available to the Secretary to  
22                  carry out the upgrade under this paragraph  
23                  \$157,000,000 for fiscal year 2022.

24                  “(5) SPALLATION NEUTRON SOURCE PROTON  
25                  POWER UPGRADE.—

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

4           “(B) PROTON POWER UPGRADE DE-  
5 FINED.—For the purposes of this paragraph,  
6 the term ‘proton power upgrade’ means the  
7 Spallation Neutron Source power upgrade de-  
8 scribed in—

9           “(i) the publication titled ‘Facilities  
10 for the Future of Science: A Twenty-Year  
11 Outlook’, published by the Office of  
12 Science of the Department of Energy in  
13 December, 2003;

14           “(ii) the publication titled ‘Four Years  
15 Later: An Interim Report on Facilities for  
16 the Future of Science: A Twenty-Year  
17 Outlook’, published by the Office of  
18 Science of the Department of Energy in  
19 August, 2007; and

20           “(iii) the publication approved by the  
21 Basic Energy Sciences Advisory Committee  
22 on June 9, 2016, titled ‘Report on Facility  
23 Upgrades’.

24           “(C) START OF OPERATIONS.—The Sec-  
25 retary shall, to the maximum extent practicable,

1 ensure that the start of full operations of the  
2 upgrade under this paragraph occurs before De-  
3 cember 31, 2025.

4 “(D) FUNDING.—Out of funds authorized  
5 to be appropriated under subsection (j), there  
6 shall be made available to the Secretary to  
7 carry out the upgrade under this paragraph  
8 \$49,800,000 for fiscal year 2022.

9 “(6) SPALLATION NEUTRON SOURCE SECOND  
10 TARGET STATION.—

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

14 “(B) SECOND TARGET STATION DE-  
15 FINED.—For the purposes of this paragraph,  
16 the term ‘second target station’ means the  
17 Spallation Neutron Source second target station  
18 described in—

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

24 “(ii) the publication titled, ‘Four  
25 Years Later: An Interim Report on Facili-

1                   ties for the Future of Science: A Twenty-  
2                   Year Outlook’, published by the Office of  
3                   Science of the Department of Energy in  
4                   August, 2007; and

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

9                   “(C) START OF OPERATIONS.—The Sec-  
10                  retary shall, to the maximum extent practicable,  
11                  ensure that the start of full operations of the  
12                  second target station under this paragraph oc-  
13                  curs before December 31, 2030, with the option  
14                  for early operation in 2028.

15                  “(D) FUNDING.—Out of funds authorized  
16                  to be appropriated under subsection (j), there  
17                  shall be made available to the Secretary to  
18                  carry out the activities under this paragraph,  
19                  including construction—

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

21                          “(ii) \$127,000,000 for fiscal year  
22                          2023;

23                          “(iii) \$204,000,000 for fiscal year  
24                          2024;

1                   “(iv) \$279,000,000 for fiscal year  
2                   2025; and

3                   “(v) \$300,000,000 for fiscal year  
4                   2026.

5                   “(7) ADVANCED LIGHT SOURCE UPGRADE.—

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

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

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

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

21                  “(C) START OF OPERATIONS.—The Sec-  
22                  retary shall, to the maximum extent practicable,  
23                  ensure that the start of full operations of the  
24                  upgrade under this paragraph occurs before De-  
25                  cember 31, 2026.

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

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

6                     “(ii) \$135,000,000 for fiscal year  
7                     2023;

8                     “(iii) \$102,500,000 for fiscal year  
9                     2024;

10                    “(iv) \$25,000,000 for fiscal year  
11                    2025; and

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

13           “(8) LINAC COHERENT LIGHT SOURCE II HIGH  
14           ENERGY UPGRADE.—

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

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

20                             “(ii) HIGH REPETITION RATE.—The  
21                             term ‘high repetition rate’ means the deliv-  
22                             ery of x-ray pulses up to 1 million pulses  
23                             per second.

24                             “(iii) ULTRA-SHORT PULSE X-RAYS.—  
25                             The term ‘ultra-short pulse x-rays’ means

1 x-ray bursts capable of durations of less  
2 than 100 femtoseconds.

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

4 “(i) provide for the upgrade to the  
5 Linac Coherent Light Source II facility de-  
6 scribed in the publication approved by the  
7 Basic Energy Sciences Advisory Committee  
8 on June 9, 2016, titled ‘Report on Facility  
9 Upgrades’, including the development of  
10 experimental capabilities for high energy x-  
11 rays to reveal fundamental scientific dis-  
12 coveries; and

13 “(ii) ensure such upgrade enables the  
14 production and use of high energy, ultra-  
15 short pulse x-rays delivered at a high rep-  
16 etition rate.

17 “(C) START OF OPERATIONS.—The Sec-  
18 retary shall, to the maximum extent practicable,  
19 ensure that the start of full operations of the  
20 upgrade under this paragraph occurs before De-  
21 cember 31, 2026.

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

1 “(i) \$106,925,000 for fiscal year  
2 2022;

3 “(ii) \$125,925,000 for fiscal year  
4 2023;

5 “(iii) \$115,000,000 for fiscal year  
6 2024;

7 “(iv) \$89,000,000 for fiscal year  
8 2025; and

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

10 “(9) CRYOMODULE REPAIR AND MAINTENANCE  
11 FACILITY.—

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

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

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

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

3 “(iii) \$25,000,000 for fiscal year

4 2024; and

5 “(iv) \$17,000,000 for fiscal year

6 2025.

7 “(10) NANOSCALE SCIENCE RESEARCH CENTER

8 RECAPITALIZATION PROJECT.—

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

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

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  
2                   2024; 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 CHEMISTRY  
7 SCIENCE CENTERS.—

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

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

16                  “(B) the use of large data sets to model  
17                  materials phenomena, including through ad-  
18                  vanced characterization of materials, materials  
19                  synthesis, processing, and innovative use of ex-  
20                  perimental and theoretical data;

21                  “(C) adaptation of chemical system and  
22                  chemistry modeling software to advanced com-  
23                  puting systems and hardware; and

24                  “(D) modeling of chemical processes, as-  
25                  semblies, and reactions such as molecular dy-

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

3           “(2) COMPUTATIONAL MATERIALS AND CHEM-  
4           ISTRY SCIENCE CENTERS.—

5           “(A) IN GENERAL.—In carrying out the  
6           activities authorized under paragraph (1), the  
7           Director shall select and establish up to six  
8           computational materials and chemistry science  
9           centers 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,  
14           to enable the design, discovery, and devel-  
15           opment of new materials and chemical sys-  
16           tems, including chemical catalysis research  
17           and development; and

18           “(ii) focus on overcoming challenges  
19           and maximizing the benefits of exascale  
20           and other high performance computing.

21           “(B) SELECTION.—The Director shall se-  
22           lect centers under subparagraph (A) on a com-  
23           petitive, merit-reviewed basis. The Director  
24           shall consider applications from the National  
25           Laboratories, institutes of higher education,

1 multi-institutional collaborations, and other ap-  
2 propriate entities.

3 “(C) DURATION.—

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

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

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

21 “(E) TERMINATION.—Consistent with the  
22 existing authorities of the Department, the Di-  
23 rector may terminate an underperforming cen-  
24 ter for cause during the performance period.

25 “(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 sub-  
8           section, the Director shall—

9                   “(A) conduct cooperative research with in-  
10                  dustry, academia, and other research institu-  
11                  tions to advance understanding, prediction, and  
12                  manipulation of materials and facilitate the de-  
13                  sign 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  
22                  material properties;

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

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

5           “(3) COORDINATION.—In carrying out this sub-  
6 section, the Director shall leverage and activities  
7 across the Department, including computational ma-  
8 terials and chemistry science centers established  
9 under subsection (h).

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

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

18           “(1) \$2,757,705,000 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.—Subtitle G of  
24 title IX of the Energy Policy Act of 2005 (42 U.S.C.  
25 16311 et seq.) is amended—

1           (1) in section 973(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  
7           of fiscal years 2022 through 2031.”; and

8           (2) in section 975(c), by striking paragraph (4)  
9           and inserting:

10          “(4) FUNDING.—From within funds authorized  
11          to be appropriated in section 313 of this Act, the  
12          Secretary shall make available for carrying out ac-  
13          tivities under this subsection \$50,000,000 for each  
14          of fiscal 5 years 2022 through 2026.”.

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

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

20                 “(4) FUNDING.—From within funds authorized  
21                 to be appropriated for Basic Energy Sciences, the  
22                 Secretary shall make available for carrying out ac-  
23                 tivities under this subsection \$50,000,000 for each  
24                 of 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 313 of this Act, the  
5           Secretary shall make available for carrying out ac-  
6           tivities under this subsection \$30,000,000 for each  
7           of fiscal years 2022 through 2026.”; and

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

10          “(4) FUNDING.—From within funds authorized  
11          to be appropriated in section 313 of this Act, the  
12          Secretary shall make available for carrying out ac-  
13          tivities under this subsection \$20,000,000 for each  
14          of fiscal years 2022 through 2026.”.

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

16          (a) PROGRAM.—Section 306 of the Department of  
17          Energy Research and Innovation Act (42 U.S.C. 18644)  
18          is amended—

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

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

23                 “(a) PROGRAM.—As part of the duties of the Director  
24                 authorized under section 209 of the Department of En-  
25                 ergy Organization Act (42 U.S.C. 7139), and coordinated

1 with the activities authorized under sections 303 and 304  
2 of this Act, the Director shall carry out a program of re-  
3 search and development in the areas of biological systems  
4 science and climate and environmental science, including  
5 subsurface science, relevant to the development of new en-  
6 ergy technologies and to support the energy, environ-  
7 mental, and national security missions of the Depart-  
8 ment.”.

9 (b) BIOENERGY RESEARCH CENTERS.—Section  
10 977(f) of the Energy Policy Act of 2005 (42 U.S.C.  
11 16317(f)) is amended to read as follows:

12 “(f) BIOENERGY RESEARCH CENTERS.—

13 “(1) IN GENERAL.—In carrying out the pro-  
14 gram under section 306(a) of the Department of  
15 Energy Research and Innovation Act (42 U.S.C.  
16 18644(a)), the Director shall support up to six bio-  
17 energy research centers to conduct fundamental re-  
18 search in plant and microbial systems biology, bio-  
19 logical imaging and analysis, and genomics, and to  
20 accelerate advanced research and development of  
21 biomass-based liquid transportation fuels, bioenergy,  
22 or biobased materials, chemicals, and products that  
23 are produced from a variety of regionally diverse  
24 feedstocks, and to facilitate the translation of re-

1 search results to industry. The activities of the cen-  
2 ters authorized under this subsection may include—

3 “(A) accelerating the domestication of bio-  
4 energy-relevant plants and microbes to enable  
5 high-impact, value-added coproduct develop-  
6 ment at multiple points in the bioenergy supply  
7 chain;

8 “(B) developing the science and techno-  
9 logical advances to ensure process sustainability  
10 is considered in the creation of biofuels and bio-  
11 products from lignocellulose; and

12 “(C) using the latest tools in genomics,  
13 molecular biology, catalysis science, chemical  
14 engineering, systems biology, and computational  
15 and robotics technologies to sustainably produce  
16 and transform biomass into biofuels and bio-  
17 products.

18 “(2) SELECTION AND DURATION.—

19 “(A) IN GENERAL.—A center established  
20 under paragraph (1) shall be selected on a com-  
21 petitive, merit-reviewed basis for a period of not  
22 more than 5 years, subject to the availability of  
23 appropriations, beginning on the date of estab-  
24 lishment of that center.

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

5           “(C) EXISTING CENTERS.—A center al-  
6           ready in existence on the date of enactment of  
7           the Department of Energy Science for the Fu-  
8           ture Act may continue to receive support for a  
9           period of not more than 5 years beginning on  
10          the date of establishment of that center.

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

22          “(4) TERMINATION.—Consistent with the exist-  
23          ing authorities of the Department, the Director may  
24          terminate an underperforming center for cause dur-  
25          ing the performance period.

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

9                   “(A) Research activities to increase sus-  
10                  tainability, including—

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

15                           “(ii) identifying the most impactful  
16                           research areas that address the economics  
17                           of biofuels and bioproducts production; and

18                           “(iii) utilizing multiscale modeling to  
19                           advance predictive understanding of biofuel  
20                           cropping ecosystems.

21                   “(B) Research activities to further feed-  
22                   stock development, including lignocellulosic,  
23                   algal, gaseous wastes including carbon oxides  
24                   and methane, and direct air capture of single

1 carbon gases via plants and microbes, includ-  
2 ing—

3 “(i) developing genetic and genomic  
4 tools, high-throughput analytical tools, and  
5 biosystems design approaches to enhance  
6 bioenergy feedstocks;

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

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

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

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

23 “(ii) gaining a detailed understanding  
24 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  
8 biofuels and bioproducts, including—

9 “(i) developing high-throughput meth-  
10 ods to screen or select high-performance  
11 microbial strains to improve product for-  
12 mation rates, yields, and selectivity;

13 “(ii) establishing a broad set of plat-  
14 form microorganisms suitable for metabolic  
15 engineering to produce biofuels and bio-  
16 products, as well as high-throughput meth-  
17 ods for experimental validation of gene  
18 function;

19 “(iii) developing techniques to en-  
20 hance microbial robustness for tolerating  
21 toxins to improve biofuel and bioproduct  
22 yields and to gain a better understanding  
23 of the cellular and molecular bases of toler-  
24 ance for major chemical classes of inhibi-  
25 tors found in these processes;

1           “(iv) advancing technologies for the  
2           use of batch, continuous, as well as con-  
3           solidated bioprocessing;

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

10          “(vi) developing high-throughput,  
11          real-time, in situ analytical techniques to  
12          understand and characterize the pre- and  
13          post-bioproduct separation streams in de-  
14          tail;

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

20          “(viii) identifying and improving plant  
21          feedstocks with enhanced extractable levels  
22          of desired bioproducts or bioproduct pre-  
23          cursors, including lignin streams; and

24          “(ix) developing integrated biological  
25          and chemical catalytic approaches to

1                   valorize and produce a diverse portfolio of  
2                   advanced fuels and bioproducts.

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

6                   (c) LOW-DOSE RADIATION RESEARCH PROGRAM.—  
7                   Section 306(d)(7) of the Department of Energy Research  
8                   and Innovation Act (42 U.S.C. 18644(c)), as redesignated  
9                   under subsection (a), is amended to read as follows:

10                   “(7) FUNDING.—For purposes of carrying out  
11                   this subsection, the Secretary is authorized to make  
12                   available from funds provided to the Biological and  
13                   Environmental Research Program \$40,000,000 for  
14                   fiscal year 2025 and \$50,000,000 for fiscal year  
15                   2026.”.

16                   (d) BIOLOGICAL SCIENCES RESEARCH ACTIVITIES.—  
17                   Section 306(b) of the Department of Energy Research and  
18                   Innovation Act (42 U.S.C. 18644), as redesignated under  
19                   subsection (a), is amended as follows:

20                   “(b) BIOLOGICAL SYSTEMS.—The Director shall  
21                   carry out research and development activities in funda-  
22                   mental, structural, computational, and systems biology to  
23                   increase systems-level understanding of the complex bio-  
24                   logical systems, which may include activities to—

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

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

6                   “(B) bioenergy; and

7                   “(C) biobased materials;

8           “(2) improve understanding of the global car-  
9           bon cycle, including processes for removing carbon  
10          dioxide from the atmosphere, through photosynthesis  
11          and other biological processes, for sequestration and  
12          storage;

13          “(3) understand the biological mechanisms used  
14          to transform, immobilize, or remove contaminants  
15          from subsurface environments;

16          “(4) leverage tools and approaches across the  
17          Office of Science to expand research to include novel  
18          processes, methods, and science to develop bio-based  
19          chemicals, polymers, inorganic materials, including  
20          research to—

21                   “(A) advance the understanding of how  
22                   CRISPR tools and other gene editing tools and  
23                   technologies work in nature, in the laboratory,  
24                   and in practice;

1           “(B) deepen knowledge of the genetics of  
2           root architecture and growth in crops, including  
3           trees; and

4           “(C) develop methods and tools to increase  
5           the efficiency of photosynthesis in plants; and

6           “(5) develop other relevant methods and proc-  
7           esses as determined by the Director.”.

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

12          “(e) EARTH AND ENVIRONMENTAL SYSTEMS  
13          SCIENCES ACTIVITIES.—

14                 “(1) IN GENERAL.—As part of the activities au-  
15                 thorized under subsection (a), and in coordination  
16                 with activities carried out under subsection (b), the  
17                 Director shall carry out earth and environmental  
18                 systems science research, which may include activi-  
19                 ties to—

20                         “(A) understand, observe, and model the  
21                         response of Earth’s atmosphere and biosphere  
22                         to increased concentrations of greenhouse gas  
23                         emissions and any associated changes in cli-  
24                         mate, including frequency and intensity of ex-  
25                         treme weather events;

1           “(B) understand the coupled physical,  
2           chemical, and biological processes to transform,  
3           immobilize, remove, or move carbon, nitrogen,  
4           and other energy production-derived contami-  
5           nants such as radionuclides and heavy metals,  
6           and understand the process of sequestration  
7           and transformation of these, carbon dioxide,  
8           and other relevant molecules in subsurface envi-  
9           ronments;

10           “(C) understand, observe, and model the  
11           cycling of water, carbon, and nutrients in ter-  
12           restrial systems and at scales relevant to re-  
13           sources management;

14           “(D) understand the biological, biogeo-  
15           chemical, and physical processes across the  
16           multiple scales that control the flux of environ-  
17           mentally relevant compounds between the ter-  
18           restrial surface and the atmosphere; and

19           “(E) inform potential natural mitigation  
20           and adaptation options for increased concentra-  
21           tions of greenhouse gas emissions and any asso-  
22           ciated changes in climate.

23           “(2) PRIORITIZATION.—In carrying out the  
24           program authorized under paragraph (1), the Direc-  
25           tor shall prioritize—

1           “(A) the development of software and algo-  
2           rithms to enable the productive application of  
3           environmental systems and extreme weather  
4           prediction models in high-performance com-  
5           puting systems; and

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

9           “(3)   SUBSURFACE   BIOGEOCHEMICAL   RE-  
10          SEARCH.—

11           “(A) IN GENERAL.—As part of the activi-  
12           ties described in paragraph (1), the Director  
13           shall carry out research to advance a funda-  
14           mental understanding of coupled physical,  
15           chemical, and biological processes for control-  
16           ling the movement of sequestered carbon, nitro-  
17           gen, and other subsurface environmental con-  
18           taminants, including how hydrology drives bio-  
19           geochemistry across molecular to watershed  
20           scales, and how coupling between physical,  
21           chemical, and biological processes influence  
22           flows of water, carbon, nutrients, and contami-  
23           nants.

24           “(B) COORDINATION.—

1                   “(i) DIRECTOR.—The Director shall  
2                   carry out activities under this paragraph in  
3                   accordance with priorities established by  
4                   the Secretary to support and accelerate the  
5                   decontamination of relevant facilities man-  
6                   aged by the Department.

7                   “(ii) SECRETARY.—The Secretary  
8                   shall ensure the coordination of activities  
9                   of the Department, including activities  
10                  under this paragraph, to support and ac-  
11                  celerate the decontamination of relevant fa-  
12                  cilities managed by the Department.

13                  “(4) CLIMATE AND EARTH MODELING.—As  
14                  part of the activities described in paragraph (1), the  
15                  Director, in collaboration with the Advanced Sci-  
16                  entific Computing Research program described in  
17                  section 304, and in consultation with the National  
18                  Oceanic and Atmospheric Administration and other  
19                  relevant agencies, shall carry out research to de-  
20                  velop, evaluate, and use high-resolution regional cli-  
21                  mate, global climate, and Earth system models to in-  
22                  form decisions on reducing greenhouse gas emissions  
23                  and the resulting impacts of a changing global cli-  
24                  mate. Such modeling shall include, among other crit-  
25                  ical elements, greenhouse gas emissions, land use,

1 watershed responses, and interaction among human  
2 and Earth systems.

3 “(5) MID-SCALE FUNDING MECHANISM.—

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

10 “(B) CONSIDERATION.—The Biological  
11 and Environmental Research Advisory Com-  
12 mittee shall provide recommendations to the Di-  
13 rector on projects most suitable for the research  
14 centers described in subparagraph (A).

15 “(f) BIOLOGICAL AND ENVIRONMENTAL RESEARCH  
16 USER FACILITIES.—

17 “(1) IN GENERAL.—The Director shall carry  
18 out a program for the development, construction, op-  
19 eration, and maintenance of user facilities to en-  
20 hance the collection and analysis of observational  
21 data related to complex biological, climate, and envi-  
22 ronmental systems.

23 “(2) FACILITY REQUIREMENTS.—To the max-  
24 imum extent practicable, the user facilities devel-

1       oped, constructed, operated, or maintained under  
2       paragraph (1) shall include—

3               “(A) distributed field research and obser-  
4               vation platforms for understanding earth sys-  
5               tem processes;

6               “(B) instruments and modeling resources  
7               for understanding the physical, chemical, and  
8               cellular processes of biological and environ-  
9               mental systems;

10              “(C) integrated high-throughput sequenc-  
11              ing, advanced bioanalytic techniques, DNA de-  
12              sign and synthesis, metabolomics, and computa-  
13              tional 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  
19              the program established in paragraph (1), the Direc-  
20              tor is encouraged to evaluate the capabilities of ex-  
21              isting user facilities and, to the maximum extent  
22              practicable, invest in modernization of those capa-  
23              bilities to address emerging research priorities.

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

1           “(A) IN GENERAL.—The Director shall  
2           support a program of collaboration between  
3           user facilities as defined under this subsection  
4           to encourage and enable researchers to more  
5           readily integrate the tools, expertise, resources,  
6           and capabilities of multiple user facilities to fur-  
7           ther research and advance emerging tech-  
8           nologies.

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

16          “(5) EARTH AND ENVIRONMENTAL SYSTEMS  
17          SCIENCES USER FACILITIES.—In carrying out the  
18          activities authorized under paragraph (1), the Direc-  
19          tor shall establish and operate user facilities to ad-  
20          vance the collection, validation, and analysis of at-  
21          mospheric data, including activities to advance  
22          knowledge and improve model representations and  
23          measure the impact of atmospheric gases, aerosols,  
24          and clouds on earth and environmental systems.

1           “(A) SELECTION.—The Director shall se-  
2           lect user facilities under paragraph (1) on a  
3           competitive, merit-reviewed basis. The Director  
4           shall consider applications from the National  
5           Laboratories, institutes of higher education,  
6           multi-institutional collaborations, and other ap-  
7           propriate entities.

8           “(B) TERMINATION.—Consistent with the  
9           existing authorities of the Department, the Di-  
10          rector may terminate an underperforming user  
11          facility for cause during the performance pe-  
12          riod.

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

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

20                 “(A) consults and coordinates with the Na-  
21                 tional Oceanic Atmospheric Administration, the  
22                 Environmental Protection Agency, the National  
23                 Aeronautics and Space Administration, the De-  
24                 partment of Agriculture, the Department of the  
25                 Interior, and any other relevant Federal agency

1 on the collection, validation, and analysis of at-  
2 mospheric data; and

3 “(B) coordinates with relevant stake-  
4 holders, including institutes of higher education,  
5 nonprofit research institutions, industry, State,  
6 local, and tribal governments, and other appro-  
7 priate entities to ensure access to the best avail-  
8 able relevant atmospheric and historical weath-  
9 er data.

10 “(g) COASTAL ZONE RESEARCH INITIATIVE.—

11 “(1) IN GENERAL.—The Director shall carry  
12 out a research program to enhance the under-  
13 standing of coastal ecosystems. In carrying out this  
14 program, the Director shall prioritize efforts to en-  
15 hance the collection of observational data, and shall  
16 develop models to analyze the ecological, biogeo-  
17 chemical, hydrological and physical processes that  
18 interact in coastal zones.

19 “(2) NATIONAL SYSTEM FOR COASTAL DATA  
20 COLLECTION.—The Director shall establish an inte-  
21 grated system of geographically diverse field re-  
22 search sites in order to improve the quantity and  
23 quality of observational data, and that encompass  
24 the major land water interfaces of the United  
25 States, including—

1                   “(A) the Great Lakes region;

2                   “(B) the Pacific coast;

3                   “(C) the Atlantic coast;

4                   “(D) the Arctic; and

5                   “(E) the Gulf coast.

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

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

18                  “(5) REPORT.—Not less than 2 years after the  
19                  date of the enactment of the Department of Energy  
20                  Science for the Future Act, the Director shall pro-  
21                  vide to the Committee on Science, Space, and Tech-  
22                  nology and the Committee on Appropriations of the  
23                  House of Representatives and the Committee on En-  
24                  ergy and Natural Resources and the Committee on  
25                  Appropriations of the Senate a report examining

1       whether the system described in this section should  
2       be established as a National User Facility.

3       “(h) TECHNOLOGY DEVELOPMENT.—The Director  
4 shall support a technology research program for the devel-  
5 opment of instrumentation and other research tools re-  
6 quired to meet the missions of the Department and to pro-  
7 vide platform technologies for the broader scientific com-  
8 munity. Technologies shall include but are not limited to—

9               “(1) cryo-electron microscopy;

10              “(2) fabricated ecosystems; and

11              “(3) next generation sensors including quantum  
12 sensors for biological integration and bioproduction.

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

16              “(1) \$820,360,000 for fiscal year 2022;

17              “(2) \$886,385,200 for fiscal year 2023;

18              “(3) \$956,332,164 for fiscal year 2024;

19              “(4) \$1,020,475,415 for fiscal year 2025; and

20              “(5) \$1,099,108,695 for fiscal year 2026.”.

21 **SEC. 5. ADVANCED SCIENTIFIC COMPUTING RESEARCH**  
22 **PROGRAM.**

23       (a) ADVANCED SCIENTIFIC COMPUTING RE-  
24 SEARCH.—Section 304 of the Department of Energy Re-

1 search and Innovation Act (42 U.S.C. 18642) is amend-  
2 ed—

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

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

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

13 “(1) advance computational and networking ca-  
14 pabilities for data-driven discovery;

15 “(2) analyze, model, simulate, and predict com-  
16 plex phenomena relevant to the development of new  
17 energy technologies and other technologies; and

18 “(3) to steward applied mathematics, computa-  
19 tional science, and computer science; and other  
20 science disciplines relevant to the missions of the  
21 Department and the competitiveness of the United  
22 States.”;

23 (3) in subsection (b) (as redesignated under  
24 paragraph (1))—

1 (A) by striking “the Director” and insert-  
2 ing “(1) DIRECTOR.—The Director”; and

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

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

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

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

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

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

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

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

3 “(2) PORTFOLIO BALANCE.—

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

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

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

19 “(B) EXASCALE ECOSYSTEM  
20 SUSTAINMENT.—

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

1 and applications for exascale users, and  
2 that such products must be maintained  
3 and improved in order that the full poten-  
4 tial of the deployed systems can be con-  
5 tinuously realized.

6 “(ii) IN GENERAL.—The Secretary  
7 shall seek to sustain the ecosystem ref-  
8 erenced in clause (i) to ensure that the  
9 exascale software stack and other research  
10 software will continue to be maintained,  
11 hardened, and otherwise optimized for  
12 long-term use on exascale systems and reli-  
13 able availability to the user community.”;  
14 and

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

17 “(e) NEXT GENERATION COMPUTING PROGRAM.—

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

23 “(A) maintain foundational research pro-  
24 grams in mathematical, computational, and  
25 computer sciences focused on new and emerging

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

8 “(B) retain best practices and maintain  
9 support for essential hardware, applications,  
10 and software elements of the Exascale Com-  
11 puting Program that are necessary for sus-  
12 taining the vitality of a long-term exascale eco-  
13 system.

14 “(2) REPORT.—Not later than one year after  
15 the date of the enactment of this Act, the Secretary  
16 shall submit to the Committee on Science, Space,  
17 and Technology of the House of Representatives,  
18 and the Committee on Energy and Natural Re-  
19 sources of the Senate, a report on the development  
20 and implementation of the strategy outlined in para-  
21 graph (1).

22 “(f) ARCHITECTURAL RESEARCH IN HETERO-  
23 GENEUS COMPUTING SYSTEMS.—

24 “(1) IN GENERAL.—The Secretary shall carry  
25 out a program of research and development in het-

1 heterogeneous computing systems to address extreme  
2 heterogeneity and to expand understanding of the  
3 potential for heterogeneous computing systems to  
4 deliver high performance, high efficiency computing  
5 for Department of Energy mission challenges. This  
6 shall include research and development that explores  
7 the convergence of big data analytics, simulations,  
8 and artificial intelligence.

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

16 “(g) ENERGY EFFICIENT COMPUTING PROGRAM.—

17 “(1) IN GENERAL.—The Secretary shall sup-  
18 port a program of fundamental research, develop-  
19 ment, and demonstration of energy efficient com-  
20 puting and data center technologies relevant to ad-  
21 vanced computing applications, including high per-  
22 formance computing, artificial intelligence, and sci-  
23 entific machine learning.

24 “(2) EXECUTION.—

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

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

13                   “(ii) develop hardware and software  
14                   technologies that decrease the energy needs  
15                   of advanced computing practices, including  
16                   through data center co-design; and

17                   “(iii) consider multiple heterogeneous  
18                   computing architectures in collaboration  
19                   with the program established under sub-  
20                   section (f) including neuromorphic com-  
21                   puting, persistent computing, and ultrafast  
22                   networking; and

23                   “(iv) provide, as appropriate, on a  
24                   competitive, merit-reviewed basis, access  
25                   for researchers from institutions of higher

1 education, National Laboratories, industry,  
2 and other Federal agencies to the energy  
3 efficient computing technologies developed  
4 pursuant to clause (i).

5 “(B) SELECTION OF PARTNERS.—In se-  
6 lecting participants for the partnership estab-  
7 lished under subparagraph (A)(i), the Secretary  
8 shall select participants through a competitive,  
9 merit review process.

10 “(C) REPORT.—Not later than one year  
11 after the date of the enactment of this Act, the  
12 Secretary shall submit to the Committee on  
13 Science, Space, and Technology of the House of  
14 Representatives, and the Committee on Energy  
15 and Natural Resources of the Senate, a report  
16 on—

17 “(i) the activities conducted under  
18 subparagraph (A); and

19 “(ii) the coordination and manage-  
20 ment of the program under subparagraph  
21 (A) to ensure an integrated research pro-  
22 gram across the Department.

23 “(h) ENERGY SCIENCES NETWORK.—

24 “(1) IN GENERAL.—The Secretary shall provide  
25 for an upgrade to the Energy Sciences Network user

1 facility in order to meet Federal research needs for  
2 highly reliable data transport capabilities optimized  
3 for the requirements of large-scale science.

4 “(2) CAPABILITIES.—In carrying out paragraph  
5 (1), the Secretary shall ensure the following capabili-  
6 ties:

7 “(A) To provide high bandwidth scientific  
8 networking across the continental United States  
9 and the Atlantic Ocean.

10 “(B) To maximize network reliability.

11 “(C) To protect the network and data from  
12 cyber-attacks.

13 “(D) To support exponentially increasing  
14 levels of data from the Department’s scientific  
15 user facilities, experiments, and sensors.

16 “(E) To integrate heterogeneous com-  
17 puting frameworks and systems.

18 “(i) COMPUTATIONAL SCIENCE GRADUATE FELLOW-  
19 SHIP.—

20 “(1) IN GENERAL.—The Secretary shall sup-  
21 port the Computational Science Graduate Fellowship  
22 program in order to facilitate collaboration between  
23 graduate students and researchers at the National  
24 Laboratories, and contribute to the development of  
25 a diverse and inclusive computational workforce to

1 help advance research in areas relevant to the mis-  
2 sion of the Department.

3 “(2) FUNDING.—From within funds authorized  
4 to be appropriated for Advanced Scientific Com-  
5 puting Research Program, the Secretary shall make  
6 available for carrying out the activities under this  
7 section—

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

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

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

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

12 and

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

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

17 “(1) \$1,086,050,000 for fiscal year 2022;

18 “(2) \$1,162,073,500 for fiscal year 2023;

19 “(3) \$1,243,418,645 for fiscal year 2024;

20 “(4) \$1,330,457,950 for fiscal year 2025; and

21 “(5) \$1,423,590,007 for fiscal year 2026.”

22 (b) QUANTUM SCIENCE NETWORK.—

23 (1) DEFINITIONS.—Section 2 of the National  
24 Quantum Initiative Act (15 U.S.C. 8801) is amend-  
25 ed—

1 (A) by redesignating paragraph (7) as  
2 paragraph (8); and

3 (B) by inserting after paragraph (6) the  
4 following:

5 “(7) QUANTUM NETWORK INFRASTRUCTURE.—  
6 The term ‘quantum network infrastructure’ means  
7 any facility, expertise, or capability that is necessary  
8 to enable the development and deployment of scal-  
9 able and diverse quantum network technologies.”.

10 (2) DEPARTMENT OF ENERGY QUANTUM NET-  
11 WORK INFRASTRUCTURE RESEARCH AND DEVELOP-  
12 MENT PROGRAM.—Title IV of the National Quantum  
13 Initiative Act (15 U.S.C. 8851 et seq.) is amended  
14 by adding at the end the following:

15 **“SEC. 403. DEPARTMENT OF ENERGY QUANTUM NETWORK**  
16 **INFRASTRUCTURE RESEARCH AND DEVELOP-**  
17 **MENT PROGRAM.**

18 “(a) IN GENERAL.—The Secretary of Energy (re-  
19 ferred to in this section as the ‘Secretary’) shall carry out  
20 a research, development, and demonstration program to  
21 accelerate innovation in quantum network infrastructure  
22 in order to—

23 “(1) facilitate the advancement of distributed  
24 quantum computing systems through the internet  
25 and intranet;

1           “(2) improve the precision of measurements of  
2       scientific phenomena and physical imaging tech-  
3       nologies; and

4           “(3) develop secure national quantum commu-  
5       nications technologies and strategies.

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

8           “(1) coordinate with—

9               “(A) the Director of the National Science  
10       Foundation;

11               “(B) the Director of the National Institute  
12       of Standards and Technology;

13               “(C) the Chair of the subcommittee on  
14       Quantum Information Science of the National  
15       Science and Technology Council established  
16       under section 103(a); and

17               “(D) the Chair of the subcommittee on the  
18       Economic and Security Implications of Quan-  
19       tum Science;

20           “(2) conduct cooperative research with indus-  
21       try, National Laboratories, institutions of higher  
22       education, and other research institutions to facili-  
23       tate new quantum infrastructure methods and tech-  
24       nologies, including—

1           “(A) quantum-limited detectors, ultra-low  
2           loss optical channels, space-to-ground connec-  
3           tions, and classical networking and cybersecu-  
4           rity protocols;

5           “(B) entanglement and hyper-entangled  
6           state sources and transmission, control, and  
7           measurement of quantum states;

8           “(C) quantum interconnects that allow  
9           short range local connections between quantum  
10          processors;

11          “(D) transducers for quantum sources and  
12          signals between optical and telecommunications  
13          regimes and quantum computer-relevant do-  
14          mains, including microwaves;

15          “(E) development of quantum memory  
16          buffers and small-scale quantum computers  
17          that are compatible with photon-based quantum  
18          bits in the optical or telecommunications wave-  
19          lengths;

20          “(F) long-range entanglement distribution  
21          at both the terrestrial and space-based level  
22          using quantum repeaters, allowing entangle-  
23          ment-based protocols between small- and large  
24          scale quantum processors;

1           “(G) quantum routers, multiplexers, re-  
2           peaters, and related technologies necessary to  
3           create secure long-distance quantum commu-  
4           nication; and

5           “(H) integration of systems across the  
6           quantum technology stack into traditional com-  
7           puting networks, including the development of  
8           remote controlled, high performance, and reli-  
9           able implementations of key quantum network  
10          components;

11          “(3) engage with the Quantum Economic De-  
12          velopment Consortium (QED-C) to transition com-  
13          ponent technologies to help facilitate as appropriate  
14          the development of a quantum supply chain for  
15          quantum network technologies;

16          “(4) advance basic research in advanced sci-  
17          entific computing, particle physics, and material  
18          science to enhance the understanding, prediction,  
19          and manipulation of materials, processes, and phys-  
20          ical phenomena relevant to quantum network infra-  
21          structure;

22          “(5) develop experimental tools and testbeds  
23          necessary to support cross-cutting fundamental re-  
24          search and development activities with diverse stake-

1 holders from industry and institutions of higher edu-  
2 cation; and

3 “(6) consider quantum network infrastructure  
4 applications that span the Department of Energy’s  
5 missions in energy, environment, and national secu-  
6 rity.

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

10 “(1) the National Institute of Standards and  
11 Technology;

12 “(2) the National Science Foundation;

13 “(3) the National Aeronautics and Space Ad-  
14 ministration;

15 “(4) other relevant Federal agencies;

16 “(5) the National Laboratories;

17 “(6) industry stakeholders;

18 “(7) institutions of higher education; and

19 “(8) the National Quantum Information  
20 Science Research Centers.

21 “(d) RESEARCH PLAN.—Not later than 180 days  
22 after the date of the enactment of this Act, the Secretary  
23 shall submit to the Committee on Science, Space, and  
24 Technology of the House of Representatives and the Com-  
25 mittee on Energy and Natural Resources of the Senate,

1 a 4-year research plan that identifies and prioritizes basic  
2 research needs relating to quantum network infrastruc-  
3 ture.

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

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

12 **“SEC. 404. DEPARTMENT OF ENERGY QUANTUM USER EX-**  
13 **PANSION FOR SCIENCE AND TECHNOLOGY**  
14 **PROGRAM.**

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

22 “(1) enhance the United States quantum re-  
23 search enterprise;

24 “(2) educate the future quantum computing  
25 workforce; and

1           “(3) accelerate the advancement of United  
2 States quantum computing capabilities.

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

5           “(1) coordinate with—

6           “(A) the Director of the National Science  
7 Foundation;

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

10           “(C) the Chair of the Quantum Informa-  
11 tion Science of the National Science and Tech-  
12 nology Council established under section  
13 103(a); and

14           “(D) the Chair of the subcommittee on the  
15 Economic and Security Implications of Quan-  
16 tum Science;

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

21           “(3) consider applications from the National  
22 Laboratories, multi-institutional collaborations, insti-  
23 tutions of higher education, industry stakeholders,  
24 and any other entities that the Secretary determines

1 are appropriate to provide national leadership on  
2 quantum computing related issues; and

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

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

10 “(1) the National Institute of Standards and  
11 Technology;

12 “(2) the National Science Foundation;

13 “(3) the National Aeronautics and Space Ad-  
14 ministration;

15 “(4) other relevant Federal agencies;

16 “(5) the National Laboratories;

17 “(6) industry stakeholders;

18 “(7) institutions of higher education; and

19 “(8) the National Quantum Information  
20 Science Research Centers.

21 “(d) SECURITY.—In carrying out the activities au-  
22 thorized by this section, the Secretary, in consultation  
23 with the Director of the National Science Foundation and  
24 the Director of the National Institute of Standards and

1 Technology, shall ensure proper security controls are in  
2 place to protect sensitive information, as appropriate.”.

3 **SEC. 6. FUSION ENERGY RESEARCH.**

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

7 (1) in subsection (b)—

8 (A) in the matter preceding paragraph (1),  
9 by striking “As part of” and inserting “(1) IN  
10 GENERAL.—As part of”;

11 (B) by redesignating—

12 (i) paragraphs (1) and (2) as sub-  
13 paragraphs (A) and (B), respectively; and

14 (ii) in subparagraph (B) (as redesign-  
15 nated by clause (i)), subparagraphs (A)  
16 and (B) as clauses (i) and (ii), respectively;  
17 and

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

19 “(2) AUTHORIZATION OF APPROPRIATIONS.—Out of  
20 funds authorized to be appropriated under subsection (o),  
21 there are authorized to be appropriated to the Secretary  
22 to carry out activities described in paragraph (1)  
23 \$50,000,000 for each of fiscal years 2022 through 2026.”;

1           (2) in subsection (d)(3), by striking the period  
2           at the end and inserting “and \$40,000,000 for fiscal  
3           year 2026.”;

4           (3) in subsection (e)(4), by striking the period  
5           at the end and inserting “and \$75,000,000 for fiscal  
6           year 2026.”;

7           (4) in subsection (i)(10)—

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

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

12                (C) 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 insert-  
16                 ing “(1) IN GENERAL.—The Director”; and

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

18                   “(2) AUTHORIZATION OF APPROPRIATIONS.—

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

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

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

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

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

25           and

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

2 (6) in subsection (l)—

3 (A) by striking “sense of Congress that”  
4 and inserting “sense of Congress that—”;

5 (B) by striking “United States should sup-  
6 port” and inserting “(1) United States should  
7 support”; and

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

9 “(2) the Director shall incorporate the findings  
10 and recommendations of the report of the Fusion  
11 Energy Sciences Advisory Committee entitled  
12 ‘Powering the Future: Fusion and Plasmas’ and the  
13 report of the National Academies entitled “Bringing  
14 Fusion to the U.S. Grid” into the planning process  
15 of the Department, including the development of fu-  
16 ture budget requests to Congress.”;

17 (7) by redesignating subsection (o) as sub-  
18 section (r);

19 (8) by adding at the end the following:

20 “(o) HIGH-PERFORMANCE COMPUTATION COLLABO-  
21 RATIVE RESEARCH PROGRAM.—

22 “(1) IN GENERAL.—The Secretary shall carry  
23 out a program to conduct and support collaborative  
24 research, development, and demonstration of fusion  
25 energy technologies, through high-performance com-

1       putation modeling and simulation techniques, in  
2       order to—

3               “(A) support fundamental research in plas-  
4               mas and matter at very high temperatures and  
5               densities;

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

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

10              “(2) COORDINATION.—In carrying out the pro-  
11              gram under paragraph (1), the Secretary shall co-  
12              ordinate with relevant Federal agencies, and  
13              prioritize the following objectives:

14               “(A) Using expertise from the private sec-  
15               tor, institutions of higher education, and the  
16               National Laboratories to leverage existing, and  
17               develop new, computational software and capa-  
18               bilities that prospective users may use to accel-  
19               erate research and development of fusion energy  
20               systems.

21               “(B) Developing computational tools to  
22               simulate and predict fusion energy science phe-  
23               nomena that may be validated through physical  
24               experimentation.

1           “(C) Increasing the utility of the research  
2           infrastructure of the Department by coordi-  
3           nating with the Advanced Scientific Computing  
4           Research program within the Office of Science.

5           “(D) Leveraging experience from existing  
6           modeling and simulation entities sponsored by  
7           the Department.

8           “(E) Ensuring that new experimental and  
9           computational tools are accessible to relevant  
10          research communities, including private sector  
11          entities engaged in fusion energy technology de-  
12          velopment.

13          “(F) Ensuring that newly developed com-  
14          putational tools are compatible with modern vir-  
15          tual engineering and visualization capabilities to  
16          accelerate the realization of fusion energy tech-  
17          nologies and systems.

18          “(3) DUPLICATION.—The Secretary shall en-  
19          sure the coordination of, and avoid unnecessary du-  
20          plication of, the activities of this program with the  
21          activities of—

22                 “(A) other research entities of the Depart-  
23                 ment, including the National Laboratories, the  
24                 Advanced Research Projects Agency–Energy,

1 the Advanced Scientific Computing Research  
2 program; and

3 “(B) industry.

4 “(4) HIGH-PERFORMANCE COMPUTING FOR FU-  
5 SION INNOVATION CENTER.—In carrying out the  
6 program under paragraph (1), the Secretary shall  
7 establish and operate a national High-Performance  
8 Computing for Fusion Innovation Center (referred  
9 to in this section as the ‘Center’), which shall focus  
10 on the early stage research and development activi-  
11 ties described under paragraph (1).

12 “(5) SELECTION.—The Secretary shall select  
13 the Center under this subsection on a competitive,  
14 merit-reviewed basis. The Secretary shall consider  
15 applications from National Laboratories, institutions  
16 of higher education, multi-institutional collabora-  
17 tions, and other appropriate entities.

18 “(6) 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 “(7) RENEWAL.—Upon the expiration of any  
23 period 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           “(8) TERMINATION.—Consistent with the exist-  
2           ing authorities of the Department, the Secretary  
3           may terminate the Center for cause during the per-  
4           formance period.

5           “(p) MATERIAL PLASMA EXPOSURE EXPERIMENT.—

6           “(1) IN GENERAL.—The Secretary shall con-  
7           struct a Material Plasma Exposure Experiment fa-  
8           cility as described in the 2020 publication approved  
9           by the Fusion Energy Sciences Advisory Committee  
10          titled ‘Powering the Future: Fusion and Plasmas’.  
11          The Secretary shall consult with the private sector,  
12          universities, National Laboratories, and relevant  
13          Federal agencies to ensure that this facility is capa-  
14          ble of meeting Federal research needs for steady  
15          state, high-heat-flux and plasma-material interaction  
16          testing of fusion materials over a range of fusion en-  
17          ergy relevant parameters.

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  
24                  MW/m<sup>2</sup>.

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, to the maximum extent practicable, ensure  
6           that the start of full operations of the facility under  
7           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  
12          out to completion the construction of the facility  
13          under 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 INSTRU-  
19          MENT 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  
23                   described in the 2020 publication approved by the  
24                   Fusion Energy Sciences Advisory Committee titled  
25                   ‘Powering the Future: Fusion and Plasmas’. The

1 Secretary shall consult with the private sector, uni-  
2 versities, National Laboratories, and relevant Fed-  
3 eral agencies to ensure that this facility is capable  
4 of meeting Federal research needs for understanding  
5 physical and chemical changes to plasmas at funda-  
6 mental timescales, and explore new regimes of dense  
7 material physics, astrophysics, planetary physics,  
8 and short-pulse laser-plasma interactions.

9 “(2) START OF OPERATIONS.—The Secretary  
10 shall, to the maximum extent practicable, ensure  
11 that the start of full operations of the facility under  
12 this section occurs before December 31, 2028.”; and

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

16 “(2) \$1,002,900,000 for fiscal year 2022;

17 “(3) \$1,095,707,000 for fiscal year 2023;

18 “(4) \$1,129,368,490 for fiscal year 2024;

19 “(5) \$1,149,042,284 for fiscal year 2025; and

20 “(6) \$1,243,097,244 for fiscal year 2026.”.

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

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

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

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

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

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

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

7                   and

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

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

10          (a) PROGRAM.—Section 305 of the Department of  
11   Energy Research and Innovation Act (42 U.S.C. 18643)  
12   is amended—

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

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

17               “(b) 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  
20   a research program on the fundamental constituents of  
21   matter and energy and the nature of space and time in  
22   order to support theoretical and experimental research in  
23   both elementary particle physics and fundamental accel-  
24   erator science and technology and understand funda-  
25   mental properties of the universe.

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  
4 and advanced detectors, including accelerators and detec-  
5 tors that will function as national user facilities, to create  
6 and study interactions of elementary particles and inves-  
7 tigate fundamental forces.”.

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

12       “(d) INTERNATIONAL COLLABORATION.—The Direc-  
13 tor 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 facili-  
5           ties in the world to United States researchers.”.

6           (c) COSMIC FRONTIER RESEARCH.—Section 305(f)  
7           of the Department of Energy Research and Innovation Act  
8           (42 U.S.C. 18645(f)), as redesignated by subsection (a),  
9           is 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  
13          dark energy and dark matter, which may include collabo-  
14          ration with the National Aeronautics and Space Adminis-  
15          tration or the National Science Foundation, or inter-  
16          national collaboration. These activities shall, to the max-  
17          imum extent practicable, be consistent with the research  
18          priorities identified by the High Energy Physics Advisory  
19          Panel or the National Academy of Sciences, and may in-  
20          clude—

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

1           “(2) the development of space-based, land-  
2           based, water-based, and underground facilities and  
3           experiments.”.

4           (d) SECTION.—Section 305 of the Department of En-  
5           ergy Research and Innovation Act (42 U.S.C. 18645), as  
6           amended, is further amended by adding at the end the  
7           following:

8           “(g) FACILITY CONSTRUCTION AND MAJOR ITEMS  
9           OF EQUIPMENT.—

10           “(1) PROJECTS.—Consistent with the Office of  
11           Science’s project management practices, the Director  
12           shall, to the maximum extent practicable, incor-  
13           porate the findings and recommendations of the  
14           2014 Particle Physics Project Prioritization Panel  
15           (P5) report titled ‘Building for Discovery’, and sup-  
16           port construction or fabrication of—

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

19                   “(B) the Proton Improvement Plan II;

20                   “(C) Second Generation Dark Matter ex-  
21                   periments;

22                   “(D) the Dark Energy Spectroscopic In-  
23                   strument;

24                   “(E) the Vera Rubin Observatory camera;

1           “(F) upgrades to components of the Large  
2 Hadron Collider; and

3           “(G) other high priority projects rec-  
4 ommended in the most recent report of the Par-  
5 ticle Physics Project Prioritization Panel of the  
6 High Energy Physics Advisory Panel.

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

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

16           “(B) FACILITY CAPABILITIES.—The Sec-  
17 retary shall ensure that the facility described in  
18 subparagraph (A) will provide, at a minimum,  
19 the following capabilities:

20           “(i) A neutrino beam with wideband  
21 capability of 1.2 megawatts (MW) of beam  
22 power and upgradable to 2.4 MW of beam  
23 power.

1                   “(ii) Three caverns excavated for a 70  
2                   kiloton fiducial detector mass and sup-  
3                   porting surface buildings and utilities.

4                   “(iii) Cryogenic systems to support  
5                   neutrino detectors.

6                   “(C) START OF OPERATIONS.—The Sec-  
7                   retary shall, to the maximum extent practicable,  
8                   ensure that the start of full operations of the  
9                   facility under this subsection occurs before De-  
10                  cember 31, 2031.

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

16                         “(i) \$200,000,000 for fiscal year  
17                         2022;

18                         “(ii) \$325,000,000 for fiscal year  
19                         2023;

20                         “(iii) \$400,000,000 for fiscal year  
21                         2024;

22                         “(iv) \$375,000,000 for fiscal year  
23                         2025; and

24                         “(v) \$250,000,000 for fiscal year  
25                         2026.

1           “(3) PROTON IMPROVEMENT PLAN—II ACCEL-  
2 ERATOR UPGRADE PROJECT.—

3           “(A) IN GENERAL.—The Secretary of En-  
4 ergy shall support construction of the Proton  
5 Improvement Plan II, an upgrade to the  
6 Fermilab accelerator complex identified in the  
7 2014 Particle Physics Project Prioritization  
8 Panel (P5) report titled ‘Building for Dis-  
9 covery’, to provide the world’s most intense  
10 beam of neutrinos to the international Long  
11 Baseline Neutrino Facility as well as abroad  
12 range of future high energy physics experi-  
13 ments. The Secretary of Energy shall work with  
14 international partners to enable further signifi-  
15 cant contributions to the capabilities of this  
16 project.

17           “(B) FACILITY CAPABILITIES.—The Sec-  
18 retary shall ensure that the facility described in  
19 paragraph (1) will provide, at a minimum, the  
20 following capabilities:

21           “(i) A state-of-the-art 800  
22 megaelectron volt (MeV) superconducting  
23 linear accelerator.

1                   “(ii) Proton beam power of 1.2 MW  
2                   at the start of LBNF/DUNE, upgradeable  
3                   to 2.4 MW of beam power.

4                   “(iii) A flexible design to enable high  
5                   power beam delivery to multiple users si-  
6                   multaneously and customized beams tai-  
7                   lored to specific scientific needs.

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

10                  “(C) START OF OPERATIONS.—The Sec-  
11                  retary shall, to the maximum extent practicable,  
12                  ensure that the start of full operations of the  
13                  facility under this section occurs before Decem-  
14                  ber 31, 2028.

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

20                         “(i) \$191,000,000 for fiscal year  
21                         2022;

22                         “(ii) \$150,000,000 for fiscal year  
23                         2023;

24                         “(iii) \$120,000,000 for fiscal year  
25                         2024;

1                   “(iv) \$120,000,000 for fiscal year  
2                   2025; and

3                   “(v) \$100,000,000 for fiscal year  
4                   2026.

5                   “(4) COSMIC MICROWAVE BACKGROUND STAGE  
6                   4.—

7                   “(A) IN GENERAL.—The Secretary of En-  
8                   ergy, in partnership with the Director of the  
9                   National Science Foundation, shall support con-  
10                  struction of the Cosmic Microwave Background  
11                  Stage 4 project to survey the cosmic microwave  
12                  background to test theories of cosmic inflation  
13                  as described in the 2014 Particle Physics  
14                  Prioritization Panel (P5) report titled ‘Building  
15                  for Discovery: Strategic Plan for U.S. Particle  
16                  Physics in the Global Context.’.

17                  “(B) CONSULTATION.—The Secretary  
18                  shall consult with the private sector, univer-  
19                  sities, National Laboratories, and relevant Fed-  
20                  eral agencies to ensure that this experiment is  
21                  capable of meeting Federal research needs in  
22                  accessing the ultra-high energy physics of infla-  
23                  tion and important neutrino properties.

24                  “(C) EXPERIMENTAL CAPABILITIES.—The  
25                  Secretary shall ensure that the facility de-

1           scribed in subsection (a) will provide at min-  
2           imum, 500,000 superconducting detectors de-  
3           ployed on an array of mm wave telescopes with  
4           the required range in frequency, sensitivity, and  
5           survey speed to enable an order of magnitude  
6           advance in observations of the Cosmic Micro-  
7           wave Background, delivering transformative dis-  
8           coveries in fundamental physics, cosmology, and  
9           astrophysics.

10           “(D) START OF OPERATIONS.—The Sec-  
11           retary shall, to the maximum extent practicable,  
12           ensure that the start of full operations of the  
13           facility under this section occurs before Decem-  
14           ber 31, 2030.

15           “(E) FUNDING.—Out of funds authorized  
16           to be appropriated under subsection (k), there  
17           shall be made available to the Secretary to  
18           carry out construction of the facility under this  
19           subsection—

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

21                   “(ii) \$45,000,000 for fiscal year 2023;

22                   “(iii) \$71,400,000 for fiscal year  
23                   2024;

24                   “(iv) \$49,800,000 for fiscal year  
25                   2025; and

1 “(v) \$84,800,000 for fiscal year 2026.

2 “(h) ACCELERATOR AND DETECTOR UPGRADES.—

3 The Director shall upgrade accelerator facilities and detec-  
4 tors, as necessary and appropriate, to increase beam  
5 power, sustain high reliability, and improve precision  
6 measurement to advance the highest priority particle phys-  
7 ics research programs. In carrying out facility upgrades,  
8 the Director shall continue to work with international  
9 partners, when appropriate and in the United States inter-  
10 est, to leverage investments and expertise in critical tech-  
11 nologies to help build and upgrade accelerator and detec-  
12 tor facilities in the United States.

13 “(i) ACCELERATOR AND DETECTOR RESEARCH AND  
14 DEVELOPMENT.—As part of the program described in  
15 subsection (a), the Director shall carry out research and  
16 development in advanced accelerator and detector concepts  
17 and technologies, including laser technologies, in order to  
18 develop and deploy next generation technologies to support  
19 discovery science in particle physics and to reduce the nec-  
20 essary size and cost for the next generation of particle ac-  
21 celerators, in coordination with the Office of Science’s  
22 Basic Energy Sciences and Nuclear Physics programs as  
23 well as other relevant Federal agencies.

1 “(j) RESEARCH COLLABORATIONS.—In developing  
2 accelerator technologies under the program authorized in  
3 subsection (e), the Director shall—

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

8 “(2) leverage investments in accelerator tech-  
9 nologies and fundamental research in particle phys-  
10 ics by partnering with institutes of higher education,  
11 industry, and other Federal agencies to help com-  
12 mercialize technologies with promising applications.

13 “(k) UNDERGROUND SCIENCE.—The Director  
14 shall—

15 “(1) support an underground science program  
16 consistent with the missions of the Department and  
17 the scientific needs of the High Energy Physics pro-  
18 gram, including those articulated in the most recent  
19 report of the Particle Physics Project Prioritization  
20 Panel of the High Energy Physics Advisory Panel,  
21 that leverages the capabilities of relevant under-  
22 ground science and engineering facilities; and

23 “(2) carry out a competitive grant program to  
24 award scientists and engineers at institutions of  
25 higher education, nonprofit institutions, and national

1 laboratories to conduct research in underground  
2 science and engineering.

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

6 “(1) \$1,355,690,000 for fiscal year 2022;

7 “(2) \$1,512,628,300 for fiscal year 2023;

8 “(3) \$1,653,512,281 for fiscal year 2024;

9 “(4) \$1,681,260,141 for fiscal year 2025; and

10 “(5) \$1,650,812,351 for fiscal year 2026.”.

11 **SEC. 8. NUCLEAR PHYSICS PROGRAM.**

12 (a) PROGRAM.—Section 308 of the Department of  
13 Energy Research and Innovation Act (42 U.S.C. 18646)  
14 is amended—

15 (1) by redesignating subsections (a) and (b) as  
16 subsections (b) and (c), respectively; and

17 (2) by inserting the following before subsection  
18 (b), as so redesignated:

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

24 (b) ISOTOPE DEVELOPMENT AND PRODUCTION FOR  
25 RESEARCH APPLICATIONS.—Section 308(b)(1) of the De-

1 partment of Energy Research and Innovation Act (42  
2 U.S.C. 18646(a)(1)), as redesignated under subsection  
3 (a), is amended to read as follows:

4           “(1) shall carry out a program in coordination  
5           with other relevant programs across the Department  
6           of Energy for the production of isotopes, including  
7           the development of techniques to produce isotopes,  
8           that the Secretary determines are needed for re-  
9           search, medical, industrial, or related purposes, to  
10          the maximum extent practicable, in accordance with  
11          the 2015 NSAC ‘Meeting Isotope Needs and Cap-  
12          turing Opportunities For The Future’ report; and”.

13          (c) PROGRAM ADMINISTRATION.—Section 308 of the  
14 Department of Energy Research and Innovation Act (42  
15 U.S.C. 18646) is amended by adding at the end the fol-  
16 lowing:

17          “(d) USER FACILITIES.—

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

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

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

1 shall be made available to the Secretary to  
2 carry out construction of the facility under this  
3 subsection \$2,000,000 for fiscal year 2022.

4 “(2) ELECTRON-ION COLLIDER.—

5 “(A) IN GENERAL.—The Secretary shall  
6 support construction of an Electron Ion Collider  
7 as described in the 2015 Long Range Plan of  
8 the Nuclear Science Advisory Committee and  
9 the report from the National Academies titled  
10 ‘An Assessment of U.S.-Based Electron-Ion  
11 Collider Science’, in order to measure the inter-  
12 nal structure of the proton and the nucleus and  
13 answer fundamental questions about the nature  
14 of visible matter.

15 “(B) FACILITY CAPABILITY.—The Sec-  
16 retary shall ensure that the facility meets the  
17 requirements in the 2015 Long Range Plan, in-  
18 cluding—

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

21 “(ii) ion beams from deuterium to the  
22 heaviest stable nuclei;

23 “(iii) variable center of mass energy  
24 from 20 to 140 GeV;

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

3                   “(v) the possibility of more than one  
4                   interaction region.

5                   “(C) START OF OPERATIONS.—The Sec-  
6                   retary shall, to the maximum extent practicable,  
7                   ensure that the start of full operations of the  
8                   facility under this section occurs before Decem-  
9                   ber 31, 2030.

10                   “(D) FUNDING.—Out of funds authorized  
11                   to be appropriated under subsection (e), there  
12                   shall be made available to the Secretary to  
13                   carry out construction of the facility under this  
14                   subsection—

15                   “(i) \$101,000,000 for fiscal year  
16                   2022;

17                   “(ii) \$155,000,000 for fiscal year  
18                   2023;

19                   “(iii) \$250,000,000 for fiscal year  
20                   2024;

21                   “(iv) \$300,000,000 for fiscal year  
22                   2025; and

23                   “(v) \$305,000,000 for fiscal year  
24                   2026.

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

4           “(1) \$861,000,000 for fiscal year 2022;

5           “(2) \$960,390,000 for fiscal year 2023;

6           “(3) \$1,106,097,300 for fiscal year 2024;

7           “(4) \$1,210,354,111 for fiscal year 2025; and

8           “(5) \$1,273,408,899 for fiscal year 2026.”.

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

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

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

20           “(d) ALTERNATIVE FINANCING OF RESEARCH FA-  
21 CILITIES AND INFRASTRUCTURE.—

22           “(1) IN GENERAL.—Consistent with section  
23 161(g) of the Atomic Energy Act of 1954 (42  
24 U.S.C. 2201(g)), the Management and Operating  
25 contractors of the Department may enter into the

1 lease-purchase of research facilities and infrastruc-  
2 ture under the scope of their contract with the De-  
3 partment with the approval of the Secretary or their  
4 designee.

5 “(2) LIMITATIONS.—To carry out lease-pur-  
6 chases approved by the Secretary under subsection  
7 (a), the Department shall only be required to have  
8 budget authority in an amount sufficient to cover  
9 the minimum required lease payments through the  
10 period required to exercise a termination provision in  
11 the lease agreement, plus any associated lease termi-  
12 nation penalties, regardless of whether such leased  
13 facility and infrastructure is on or off Government  
14 land, and if—

15 “(A) the Department has established a  
16 mission need for the facility or infrastructure to  
17 be leased;

18 “(B) the facility or infrastructure is gen-  
19 eral purpose, including offices, laboratories,  
20 cafeterias, utilities, and data centers;

21 “(C) the Department is not a party to and  
22 has no financial obligations under the lease-pur-  
23 chase transaction entered into by the Manage-  
24 ment and Operating contractor, other than al-

1 lowability of the lease cost and conveyance of  
2 Government land, if needed;

3 “(D) the lease-purchase has an advance  
4 notice termination provision with reasonable  
5 pre-defined penalties that the Management and  
6 Operating contractor may exercise, at the direc-  
7 tion of the Department, if funding for the lease  
8 is no longer available or the mission need ceases  
9 to exist;

10 “(E) there is an option for a no cost trans-  
11 fer of ownership to the Government once the  
12 underlying financing is retired, but neither the  
13 Management and Operating contractor nor the  
14 Department are obligated to purchase the facil-  
15 ity or infrastructure at any time during or after  
16 the lease term;

17 “(F) the lease-purchase transaction, as-  
18 suming exercise of the ownership option, is  
19 demonstrated to be the lowest lifecycle cost al-  
20 ternative for the Government; and

21 “(G) the cumulative annual base rent for  
22 all lease-purchases of facilities and infrastruc-  
23 ture, inclusive of any transactions under consid-  
24 eration, does not exceed 2 percent of the Man-  
25 agement and Operating contract operating

1 budget for the year the commitment is made for  
2 the lease.

3 “(3) REPORTING.—Not later than one year  
4 after the date of the enactment of the Department  
5 of Energy Science for the Future Act, and biennially  
6 thereafter, the Department shall submit to the Com-  
7 mittee on Science, Space, and Technology and the  
8 Committee on Appropriations of the House of Rep-  
9 resentatives, and the Committee on Energy and Nat-  
10 ural Resources and the Committee on Appropria-  
11 tions of the Senate, a report on the lease-purchase  
12 transactions that the Management and Operating  
13 contractors of the Department entered into under  
14 subsection (a) that includes—

15 “(A) a list of the lease-purchase trans-  
16 actions entered into by each Management and  
17 Operating contractor and their respective costs;

18 “(B) the annual percentage of each Man-  
19 agement and Operating contract operating  
20 budget that is used for lease-purchase trans-  
21 actions for the year the commitments were  
22 made; and

23 “(C) any other information the Secretary  
24 finds appropriate.

1           “(d) MID-SCALE INSTRUMENTATION PROGRAM.—  
2 The Director, in coordination with each of the programs  
3 carried out by the Office of Science, shall establish a mid-  
4 scale instrumentation program to enable the development  
5 and acquisition of novel, state-of-the-art instruments rang-  
6 ing in cost from \$1 million to \$20 million each that would  
7 significantly accelerate scientific breakthroughs at user fa-  
8 cilities.

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

13 **SEC. 10. INCREASED COLLABORATION WITH TEACHERS**  
14 **AND SCIENTISTS.**

15           (a) IN GENERAL.—The Department of Energy Re-  
16 search and Innovation Act (42 U.S.C. 18601 note) is  
17 amended by adding at the end the following:

18 **“SEC. 310. INCREASED COLLABORATION WITH TEACHERS**  
19 **AND SCIENTISTS.**

20           “(a) IN GENERAL.—The Director shall support the  
21 development of a scientific workforce through programs  
22 that facilitate collaboration between K–12, university stu-  
23 dents, early-career researchers, faculty, and the National  
24 Laboratories, including through the use of proven tech-  
25 niques to expand the number of individuals from under-

1 represented groups pursuing and attaining skills or under-  
2 graduate and graduate degrees relevant to the Office’s  
3 mission.

4 “(b) AUTHORIZATION OF APPROPRIATIONS.—Section  
5 3169 of the Department of Energy Science Education En-  
6 hancement Act (42 U.S.C. 7381e) is amended—

7 “(1) by striking, ‘programs’, and inserting ‘pro-  
8 grams, including the NSF INCLUDES National  
9 Network,’; and

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

12 (b) BROADENING PARTICIPATION IN WORKFORCE  
13 DEVELOPMENT FOR TEACHERS AND SCIENTISTS.—The  
14 Department of Energy Science Education Enhancement  
15 Act (42 U.S.C. 7381 note) is amended by inserting the  
16 following sections after section 3167 (42 U.S.C. 7381c–  
17 1):

18 **“SEC. 3167A. BROADENING PARTICIPATION FOR TEACHERS  
19 AND SCIENTISTS.**

20 “(a) IN GENERAL.—The Secretary, in collaboration  
21 with the Director of the National Science Foundation,  
22 shall support and leverage the National Science Founda-  
23 tion Inclusion across the Nation of Communities of Learn-  
24 ers of Underrepresented Discoverers in Engineering and  
25 Science National Network, hereafter referred to as the

1 NSF INCLUDES National Network, to expand the num-  
2 ber of students, early-career researchers, and faculty from  
3 underrepresented groups pursuing and attaining skills or  
4 undergraduate and graduate degrees in science, tech-  
5 nology, engineering, and mathematics fields relevant to  
6 the Department's mission.

7 “(b) PLAN.—Not later than 1 year after the date of  
8 enactment of the Department of Energy Science for the  
9 Future Act, the Secretary shall submit to the Committee  
10 on Science, Space, and Technology of the House of Rep-  
11 resentatives and the Committee on Energy and Natural  
12 Resources and the Committee on Commerce, Science, and  
13 Transportation of the Senate and make available to the  
14 public a plan for broadening participation of underrep-  
15 resented groups in science, technology, engineering, and  
16 mathematics in programs supported by the Department  
17 programs, including—

18 “(1) a plan for supporting and leveraging the  
19 National Science Foundation INCLUDES National  
20 Network;

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

23 “(3) experienced and potential barriers to  
24 broadening participation of underrepresented groups

1 in Department programs, including recommended  
2 solutions; and

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

5 “(c) AUTHORIZATION OF APPROPRIATIONS.—Of the  
6 amounts authorized to be appropriated in section 3169  
7 (42 U.S.C. 7381e), at least \$2,000,000 shall be made  
8 available each fiscal year for the activities described under  
9 this subsection.

10 **“SEC. 3167B. EXPANDING OPPORTUNITIES TO INCREASE**  
11 **THE DIVERSITY, EQUITY, AND INCLUSION OF**  
12 **HIGHLY SKILLED SCIENCE, TECHNOLOGY,**  
13 **ENGINEERING, AND MATHEMATICS (STEM)**  
14 **PROFESSIONALS.**

15 “(a) IN GENERAL.—The Secretary shall expand op-  
16 portunities to increase the number and the diversity, eq-  
17 uity, and inclusion of highly skilled science, technology, en-  
18 gineering, and mathematics (STEM) professionals work-  
19 ing in Department of Energy mission-relevant disciplines  
20 and broaden the recruitment pool to increase diversity, in-  
21 cluding expanded partnerships with minority-serving insti-  
22 tutions, non-Research I universities, and scientific soci-  
23 eties.

24 “(b) PLAN AND OUTREACH STRATEGY.—

1           “(1) IN GENERAL.—Not later than 6 months  
2 after the date of enactment of the Department of  
3 Energy Science for the Future Act, the Secretary  
4 shall submit to the Committee on Science, Space,  
5 and Technology of the House of Representatives and  
6 the Committee on Energy and Natural Resources of  
7 the Senate a 10-year educational plan in accordance  
8 with paragraph (2) and an outreach strategy in ac-  
9 cordance with paragraph (3).

10           “(2) PLAN.—The plan under paragraph (1)  
11 shall fund and expand new or existing programs ad-  
12 ministered by the Office of Science and sited at the  
13 National Laboratories and Department of Energy  
14 user facilities to expand educational and workforce  
15 opportunities for underrepresented high school, un-  
16 dergraduate, and graduate students as well as recent  
17 graduates, teachers and faculty in STEM fields.  
18 Such programs may include paid internships, fellow-  
19 ships, temporary employment, training programs,  
20 visiting student and faculty programs, sabbaticals,  
21 and research support.

22           “(3) OUTREACH STRATEGY.—The outreach  
23 strategy under paragraph (1) shall include a plan to  
24 improve the advertising, recruitment, and promotion  
25 of educational and workforce programs to commu-

1           nity colleges, minority-serving institutions, and non-  
2           Research I universities.

3           “(c) BUILDING RESEARCH CAPACITY.—The Sec-  
4           retary shall develop programs that strengthen the research  
5           capacity relevant to Office of Science disciplines at emerg-  
6           ing research institutions, including minority-serving insti-  
7           tutions, colleges, and universities. This may include ena-  
8           bling meaningful partnerships between research-intensive  
9           institutions and emerging research institutions, and solici-  
10          iting research proposals, fellowships, training programs,  
11          and research support directly from emerging research in-  
12          stitutions.

13          “(d) TRAINEESHIPS.—The Secretary shall establish  
14          a university-led Traineeship Program to address workforce  
15          training needs in DOE-relevant STEM fields. The focus  
16          should be on supporting training and research experiences  
17          for underrepresented undergraduate and graduate stu-  
18          dents and increasing participation from underrepresented  
19          populations. The traineeships should include opportunities  
20          to build the next-generation workforce in research areas  
21          critical to maintaining core competencies across the Office  
22          of Science’s programs.

23          “(e) EVALUATION.—The Secretary shall establish key  
24          performance indicators to measure and monitor progress

1 of education and workforce programs and expand Depart-  
2 mental activities for data collection and analysis.

3 “(f) REPORT.—The Secretary shall submit a report  
4 every 2 years to the Committee on Science, Space, and  
5 Technology of the House of Representatives and the Com-  
6 mittee on Energy and Natural Resources of the Senate  
7 summarizing progress toward meeting key performance  
8 indicators under subsection (e).

9 “(g) MINORITY-SERVING INSTITUTION DEFINED.—  
10 The term ‘minority-serving institution’ includes the enti-  
11 ties described in any of paragraphs (1) through (7) of sec-  
12 tion 371(a) of the Higher Education Act of 1965 (20  
13 U.S.C. 1067q(a));”.

14 **SEC. 11. HIGH INTENSITY LASER RESEARCH INITIATIVE;**  
15 **HELIUM CONSERVATION PROGRAM; AUTHOR-**  
16 **IZATION OF APPROPRIATIONS.**

17 (a) IN GENERAL.—The Department of Energy Re-  
18 search and Innovation Act (42 U.S.C. 18601 note) is  
19 amended by adding at the end the following:

20 **“SEC. 311. HIGH INTENSITY LASER RESEARCH INITIATIVE.**

21 “(a) IN GENERAL.—The Director shall establish a  
22 high intensity laser research initiative consistent with the  
23 recommendations of the National Academies report, ‘Op-  
24 portunities in Intense Ultrafast Lasers: Reaching for the  
25 Brightest Light’, and the report from the Brightest Light

1 Initiative workshop on ‘The Future of Intense Ultrafast  
2 Lasers in the U.S.’. This initiative should include research  
3 and development of petawatt-scale and of high average  
4 power laser technologies necessary for future facility needs  
5 in discovery science and to advance energy technologies,  
6 as well as support for a user network of academic and  
7 national laboratory high intensity laser facilities.

8 “(b) LEVERAGE.—The Director shall also leverage  
9 new laser technologies for more compact, less complex,  
10 and low-cost accelerator systems needed for science appli-  
11 cations.

12 “(c) COORDINATION.—The Director shall coordinate  
13 this initiative among all relevant programs within the Of-  
14 fice of Science, and the Under Secretary for Science shall  
15 coordinate this initiative with other relevant programs  
16 within the Department as well as within other Federal  
17 agencies.

18 “(d) AUTHORIZATION OF APPROPRIATIONS.—Out of  
19 funds authorized to be appropriated for the Office of  
20 Science there are authorized to be appropriated to the Sec-  
21 retary to carry out the activities described in this sub-  
22 section—

23 “(1) \$50,000,000 for fiscal year 2022;

24 “(2) \$100,000,000 for fiscal year 2023;

25 “(3) \$150,000,000 for fiscal year 2024;

1           “(4) \$200,000,000 for fiscal year 2025; and

2           “(5) \$250,000,000 for fiscal year 2026.

3   **“SEC. 312. HELIUM CONSERVATION PROGRAM.**

4           “(a) IN GENERAL.—The Secretary shall establish a  
5 program to reduce the consumption of helium for Depart-  
6 ment grant recipients and facilities and encourage helium  
7 recycling and reuse. The program shall competitively  
8 award grants for—

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

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

14          “(3) helium alternatives research and develop-  
15        ment activities.

16          “(b) REPORT.—In carrying out the program under  
17 this section, the Director shall submit to the Committee  
18 on Science, Space, and Technology of House of Represent-  
19 atives and the Committee on Energy and Natural Re-  
20 sources of the Senate a report, not later than two years  
21 after the date of enactment of the Department of Energy  
22 Science for the Future Act, and every 3 years thereafter,  
23 on the purchase of helium as part of research projects and  
24 facilities supported by the Department. The report shall  
25 include—

1           “(1) the quantity of helium purchased for  
2 projects and facilities supported by Department  
3 grants;

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

5           “(3) the predominant production sources for  
6 such helium;

7           “(4) expected or experienced impacts of helium  
8 supply shortages or prices on the research projects  
9 and facilities supported by the Department; and

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

12           “(c) COORDINATION.—In carrying out the program  
13 under this section, the Director shall coordinate with the  
14 National Science Foundation and other relevant Federal  
15 agencies on helium conversation activities.

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

19           “(e) RENEWAL.—Upon expiration of any period of  
20 support of the program under this section, the Director  
21 may renew support for the program for a period of not  
22 more than 5 years.

23 **“SEC. 313. AUTHORIZATION OF APPROPRIATIONS.**

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

- 1           “(1) \$8,728,615,000 for fiscal year 2022;
- 2           “(2) \$9,344,434,300 for fiscal year 2023;
- 3           “(3) \$10,031,656,951 for fiscal year 2024;
- 4           “(4) \$10,503,567,938 for fiscal year 2025; and
- 5           “(5) \$10,960,667,486 for fiscal year 2026.”.

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

- “Sec. 310. Increased collaboration with teachers and scientists.
- “Sec. 311. High intensity laser research initiative.
- “Sec. 312. Helium conservation program.
- “Sec. 313. Authorization of appropriations.”.