

115TH CONGRESS
2D SESSION

H. R. 5905

AN ACT

To authorize basic research programs in the Department of Energy Office of Science for fiscal years 2018 and 2019.

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

1 **SECTION 1. SHORT TITLE; TABLE OF CONTENTS.**

2 (a) SHORT TITLE.—This Act may be cited as the
3 “Department of Energy Science and Innovation Act of
4 2018”.

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

- Sec. 1. Short title; table of contents.
- Sec. 2. Definitions.
- Sec. 3. Mission.
- Sec. 4. Basic energy sciences.
- Sec. 5. Advanced scientific computing research.
- Sec. 6. High energy physics.
- Sec. 7. Biological and environmental research.
- Sec. 8. Fusion energy.
- Sec. 9. Nuclear physics.
- Sec. 10. Science laboratories infrastructure program.
- Sec. 11. Authorization of appropriations.

7 **SEC. 2. DEFINITIONS.**

8 In this Act:

9 (1) DEPARTMENT.—The term “Department”
10 means the Department of Energy.

11 (2) DIRECTOR.—The term “Director” means
12 the Director of the Office of Science of the Depart-
13 ment.

14 (3) NATIONAL LABORATORY.—The term “Na-
15 tional Laboratory” has the meaning given that term
16 in section 2 of the Energy Policy Act of 2005 (42
17 U.S.C. 15801).

18 (4) SECRETARY.—The term “Secretary” means
19 the Secretary of Energy.

1 **SEC. 3. MISSION.**

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 “(c) MISSION.—The mission of the Office of Science
6 shall be the delivery of scientific discoveries, capabilities,
7 and major scientific tools to transform the understanding
8 of nature and to advance the energy, economic, and na-
9 tional security of the United States.”.

10 **SEC. 4. BASIC ENERGY SCIENCES.**

11 (a) PROGRAM.—The Director shall carry out a pro-
12 gram in basic energy sciences, including materials sciences
13 and engineering, chemical sciences, physical biosciences,
14 and geosciences, for the purpose of providing the scientific
15 foundations for new energy technologies.

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

23 (c) BASIC ENERGY SCIENCES USER FACILITIES.—

24 (1) IN GENERAL.—The Director shall carry out
25 a program for the development, construction, oper-
26 ation, and maintenance of national user facilities.

1 (2) REQUIREMENTS.—To the maximum extent
2 practicable, the national user facilities developed,
3 constructed, operated, or maintained under para-
4 graph (1) shall serve the needs of the Department,
5 industry, the academic community, and other rel-
6 evant entities to create and examine materials and
7 chemical processes for the purpose of improving the
8 competitiveness of the United States.

9 (3) INCLUDED FACILITIES.—The national user
10 facilities developed, constructed, operated, or main-
11 tained under paragraph (1) shall include—

12 (A) x-ray light sources;

13 (B) neutron sources;

14 (C) nanoscale science research centers; and

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

19 (d) BASIC ENERGY SCIENCES RESEARCH INFRA-
20 STRUCTURE.—

21 (1) ADVANCED PHOTON SOURCE UPGRADE.—

22 (A) IN GENERAL.—The Secretary shall
23 provide for the upgrade to the Advanced Pho-
24 ton Source described in the publication ap-
25 proved by the Basic Energy Sciences Advisory

1 Committee on June 9, 2016, titled “Report on
2 Facility Upgrades”, including the development
3 of a multi-bend achromat lattice to produce a
4 high flux of coherent x-rays within the hard x-
5 ray energy region and a suite of beamlines opti-
6 mized for this source.

7 (B) DEFINITIONS.—In this paragraph:

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

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

13 (C) START OF OPERATIONS.—The Sec-
14 retary shall, to the maximum extent practicable,
15 ensure that the start of full operations of the
16 upgrade under this paragraph occurs before De-
17 cember 31, 2025.

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

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

24 and

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

1 (2) SPALLATION NEUTRON SOURCE PROTON
2 POWER UPGRADE.—

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

6 (B) DEFINITION OF PROTON POWER UP-
7 GRADE.—For the purposes of this paragraph,
8 the term “proton power upgrade” means the
9 Spallation Neutron Source power upgrade de-
10 scribed in—

11 (i) the publication of the Office of
12 Science of the Department of Energy titled
13 “Facilities for the Future of Science: A
14 Twenty-Year Outlook”, published Decem-
15 ber 2003;

16 (ii) the publication of the Office of
17 Science of the Department of Energy titled
18 “Four Years Later: An Interim Report on
19 Facilities for the Future of Science: A
20 Twenty-Year Outlook”, published August
21 2007; and

22 (iii) the publication approved by the
23 Basic Energy Sciences Advisory Committee
24 on June 9, 2016, titled “Report on Facil-
25 ity Upgrades”.

1 (C) START OF OPERATIONS.—The Sec-
2 retary shall, to the maximum extent practicable,
3 ensure that the start of full operations of the
4 upgrade under this paragraph occurs before De-
5 cember 31, 2025.

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

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

12 and

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

14 (3) SPALLATION NEUTRON SOURCE SECOND
15 TARGET STATION.—

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

19 (B) DEFINITION OF SECOND TARGET STA-
20 TION.—For the purposes of this paragraph, the
21 term “second target station” means the Spall-
22 ation Neutron Source second target station de-
23 scribed in—

24 (i) the publication of the Office of
25 Science of the Department of Energy titled

1 “Facilities for the Future of Science: A
2 Twenty-Year Outlook”, published Decem-
3 ber 2003;

4 (ii) the publication of the Office of
5 Science of the Department of Energy titled
6 “Four Years Later: An Interim Report on
7 Facilities for the Future of Science: A
8 Twenty-Year Outlook”, published August
9 2007; and

10 (iii) the publication approved by the
11 Basic Energy Sciences Advisory Committee
12 on June 9, 2016, titled “Report on Facil-
13 ity Upgrades”.

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 second target station under this paragraph oc-
18 curs before December 31, 2030, with the option
19 for early operation in 2028.

20 (D) FUNDING.—Out of funds authorized
21 to be appropriated under section 11 for Basic
22 Energy Sciences, there shall be made available
23 to the Secretary to carry out activities, includ-
24 ing construction, under this paragraph—

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

2 and

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

4 (4) ADVANCED LIGHT SOURCE UPGRADE.—

5 (A) IN GENERAL.—The Secretary shall
6 provide for the upgrade to the Advanced Light
7 Source described in the publication approved by
8 the Basic Energy Sciences Advisory Committee
9 on June 9, 2016, titled “Report on Facility Up-
10 grades”, including the development of a multi-
11 bend achromat lattice to produce a high flux of
12 coherent x-rays within the soft x-ray energy re-
13 gion.

14 (B) DEFINITIONS.—In this paragraph:

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

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

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

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

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

and

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

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

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

(B) DEFINITIONS.—In this paragraph:

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

1 an energy at or exceeding 12 kiloelectron
2 volts.

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

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

11 (C) START OF OPERATIONS.—The Sec-
12 retary shall, to the maximum extent practicable,
13 ensure that the start of full operations of the
14 upgrade under this paragraph occurs before De-
15 cember 31, 2025.

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

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

22 and

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

24 (e) ACCELERATOR RESEARCH AND DEVELOP-
25 MENT.—The Director shall carry out research and devel-

1 opment on advanced accelerator and storage ring tech-
2 nologies relevant to the development of Basic Energy
3 Sciences user facilities, in consultation with the Office of
4 Science’s High Energy Physics and Nuclear Physics pro-
5 grams.

6 (f) SOLAR FUELS RESEARCH INITIATIVE.—

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

10 **“SEC. 973. SOLAR FUELS RESEARCH INITIATIVE.**

11 **“(a) INITIATIVE.—**

12 **“(1) IN GENERAL.—**The Secretary shall carry
13 out a research initiative, to be known as the ‘Solar
14 Fuels Research Initiative’ (referred to in this section
15 as the ‘Initiative’) to expand theoretical and funda-
16 mental knowledge of photochemistry, electro-
17 chemistry, biochemistry, and materials science useful
18 for the practical development of experimental sys-
19 tems to convert solar energy to chemical energy.

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

23 **“(A) the Basic Energy Sciences Program**
24 **and the Biological and Environmental Research**
25 **Program of the Office of Science; and**

1 “(B) the Office of Energy Efficiency and
2 Renewable Energy.

3 “(3) TEAMS.—

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

10 “(B) GOALS.—The multidisciplinary teams
11 described in subparagraph (A) shall pursue ag-
12 gressive, milestone-driven, basic research goals.

13 “(C) RESOURCES.—The Secretary shall
14 provide sufficient resources to the multidisci-
15 plinary teams described in subparagraph (A) to
16 achieve the goals described in subparagraph (B)
17 over a period of time to be determined by the
18 Secretary.

19 “(4) ADDITIONAL ACTIVITIES.—The Secretary
20 may organize additional activities under this sub-
21 section through Energy Frontier Research Centers,
22 Energy Innovation Hubs, or other organizational
23 structures.

24 “(b) ARTIFICIAL PHOTOSYNTHESIS.—

1 “(1) IN GENERAL.—The Secretary shall carry
2 out under the Initiative a program to support re-
3 search needed to bridge scientific barriers to, and
4 discover knowledge relevant to, artificial photosyn-
5 thetic systems.

6 “(2) ACTIVITIES.—As part of the program de-
7 scribed in paragraph (1)—

8 “(A) the Director of the Office of Basic
9 Energy Sciences shall support basic research to
10 pursue distinct lines of scientific inquiry, in-
11 cluding—

12 “(i) photoinduced production of hy-
13 drogen and oxygen from water; and

14 “(ii) the sustainable photoinduced re-
15 duction of carbon dioxide to fuel products
16 including hydrocarbons, alcohols, carbon
17 monoxide, and natural gas; and

18 “(B) the Assistant Secretary for Energy
19 Efficiency and Renewable Energy shall support
20 translational research, development, and valida-
21 tion of physical concepts developed under the
22 program.

23 “(3) STANDARD OF REVIEW.—The Secretary
24 shall review activities carried out under the program

described in paragraph (1) to determine the achievement of technical milestones.

“(4) FUNDING.—

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

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

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

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

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

“(A) the Director of the Office of Basic Energy Sciences shall support basic research to

1 expand fundamental knowledge to replicate nat-
2 ural synthesis processes, including—

3 “(i) the photoinduced reduction of
4 dinitrogen to ammonia;

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

7 “(iii) molecular-based charge separa-
8 tion and storage;

9 “(iv) photoinitiated electron transfer;
10 and

11 “(v) catalysis in biological or bio-
12 mimetic systems;

13 “(B) the Associate Director of Biological
14 and Environmental Research shall support sys-
15 tems biology and genomics approaches to un-
16 derstand genetic and physiological pathways
17 connected to photosynthetic mechanisms; and

18 “(C) the Assistant Secretary for Energy
19 Efficiency and Renewable Energy shall support
20 translational research, development, and valida-
21 tion of physical concepts developed under the
22 program.

23 “(3) STANDARD OF REVIEW.—The Secretary
24 shall review activities carried out under the program

described in paragraph (1) to determine the achievement of technical milestones.

“(4) FUNDING.—

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

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

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

“Sec. 973. Solar fuels research initiative.”.

(g) ELECTRICITY STORAGE RESEARCH INITIATIVE.—

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

1 **“SEC. 975. ELECTRICITY STORAGE RESEARCH INITIATIVE.**

2 “(a) INITIATIVE.—

3 “(1) IN GENERAL.—The Secretary shall carry
4 out a research initiative, to be known as the ‘Elec-
5 tricity Storage Research Initiative’ (referred to in
6 this section as the ‘Initiative’)—

7 “(A) to expand theoretical and funda-
8 mental knowledge to control, store, and con-
9 vert—

10 “(i) electrical energy to chemical en-
11 ergy; and

12 “(ii) chemical energy to electrical en-
13 ergy; and

14 “(B) to support scientific inquiry into the
15 practical understanding of chemical and phys-
16 ical processes that occur within systems involv-
17 ing crystalline and amorphous solids, polymers,
18 and organic and aqueous liquids.

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

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

1 “(B) the Office of Energy Efficiency and
2 Renewable Energy.

3 “(3) TEAMS.—

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

10 “(B) GOALS.—The multidisciplinary teams
11 described in subparagraph (A) shall pursue ag-
12 gressive, milestone-driven, basic research goals.

13 “(C) RESOURCES.—The Secretary shall
14 provide sufficient resources to the multidisci-
15 plinary teams described in subparagraph (A) to
16 achieve the goals described in subparagraph (B)
17 over a period of time to be determined by the
18 Secretary.

19 “(4) ADDITIONAL ACTIVITIES.—The Secretary
20 may organize additional activities under this sub-
21 section through Energy Frontier Research Centers,
22 Energy Innovation Hubs, or other organizational
23 structures.

24 “(b) MULTIVALENT SYSTEMS.—

1 “(1) IN GENERAL.—The Secretary shall carry
2 out under the Initiative a program to support re-
3 search needed to bridge scientific barriers to, and
4 discover knowledge relevant to, multivalent ion mate-
5 rials in electric energy storage systems.

6 “(2) ACTIVITIES.—As part of the program de-
7 scribed in paragraph (1)—

8 “(A) the Director of the Office of Basic
9 Energy Sciences shall investigate electro-
10 chemical properties and the dynamics of mate-
11 rials, including charge transfer phenomena and
12 mass transport in materials; and

13 “(B) the Assistant Secretary for Energy
14 Efficiency and Renewable Energy shall support
15 translational research, development, and valida-
16 tion of physical concepts developed under the
17 program.

18 “(3) STANDARD OF REVIEW.—The Secretary
19 shall review activities carried out under the program
20 described in paragraph (1) to determine the achieve-
21 ment of technical milestones.

22 “(4) FUNDING.—

23 “(A) IN GENERAL.—From within funds
24 authorized to be appropriated under section 11
25 of the Department of Energy Science and Inno-

1 vation Act of 2018, for Basic Energy Sciences
2 and Biological and Environmental Research,
3 the Secretary shall make available for carrying
4 out activities under this subsection \$50,000,000
5 for each of the fiscal years 2018 through 2019.

6 “(B) PROHIBITION.—No funds allocated to
7 the program described in paragraph (1) may be
8 obligated or expended for commercial applica-
9 tion of energy technology.

10 “(c) ELECTROCHEMISTRY MODELING AND SIMULA-
11 TION.—

12 “(1) IN GENERAL.—The Secretary shall carry
13 out under the Initiative a program to support re-
14 search to model and simulate organic electrolytes,
15 including the static and dynamic electrochemical be-
16 havior and phenomena of organic electrolytes at the
17 molecular and atomic level in monovalent and multi-
18 valent systems.

19 “(2) ACTIVITIES.—As part of the program de-
20 scribed in paragraph (1)—

21 “(A) the Director of the Office of Basic
22 Energy Sciences, in coordination with the Asso-
23 ciate Director of Advanced Scientific Com-
24 puting Research, shall support the development
25 of high performance computational tools

1 through a joint development process to maxi-
2 mize the effectiveness of current and projected
3 high performance computing systems; and

4 “(B) the Assistant Secretary for Energy
5 Efficiency and Renewable Energy shall support
6 translational research, development, and valida-
7 tion of physical concepts developed under the
8 program.

9 “(3) STANDARD OF REVIEW.—The Secretary
10 shall review activities carried out under the program
11 described in paragraph (1) to determine the achieve-
12 ment of technical milestones.

13 “(4) FUNDING.—

14 “(A) IN GENERAL.—From within funds
15 authorized to be appropriated under section 11
16 of the Department of Energy Science and Inno-
17 vation Act of 2018, for Basic Energy Sciences
18 and Advanced Scientific Computing Research,
19 the Secretary shall make available for carrying
20 out activities under this subsection \$30,000,000
21 for each of the fiscal years 2018 through 2019.

22 “(B) PROHIBITION.—No funds allocated to
23 the program described in paragraph (1) may be
24 obligated or expended for commercial applica-
25 tion of energy technology.

1 “(d) MESOSCALE ELECTROCHEMISTRY.—

2 “(1) IN GENERAL.—The Secretary shall carry
3 out under the Initiative a program to support re-
4 search needed to reveal electrochemistry in confined
5 mesoscale spaces, including scientific discoveries rel-
6 evant to—

7 “(A) bio-electrochemistry and electro-
8 chemical energy conversion and storage in con-
9 fined spaces; and

10 “(B) the dynamics of the phenomena de-
11 scribed in subparagraph (A).

12 “(2) ACTIVITIES.—As part of the program de-
13 scribed in paragraph (1)—

14 “(A) the Director of the Office of Basic
15 Energy Sciences and the Associate Director of
16 Biological and Environmental Research shall in-
17 vestigate phenomena of mesoscale electro-
18 chemical confinement for the purpose of repli-
19 cating and controlling new electrochemical be-
20 havior; and

21 “(B) the Assistant Secretary for Energy
22 Efficiency and Renewable Energy shall support
23 translational research, development, and valida-
24 tion of physical concepts developed under the
25 program.

1 “(3) STANDARD OF REVIEW.—The Secretary
2 shall review activities carried out under the program
3 described in paragraph (1) to determine the achieve-
4 ment of technical milestones.

5 “(4) FUNDING.—

6 “(A) IN GENERAL.—From within funds
7 authorized to be appropriated under section 11
8 of the Department of Energy Science and Inno-
9 vation Act of 2018, for Basic Energy Sciences
10 and Biological and Environmental Research,
11 the Secretary shall make available for carrying
12 out activities under this subsection \$20,000,000
13 for each of fiscal years 2018 through 2019.

14 “(B) PROHIBITION.—No funds allocated to
15 the program described in paragraph (1) may be
16 obligated or expended for commercial applica-
17 tion of energy technology.”.

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

“Sec. 975. Electricity storage research initiative.”.

22 (h) ENERGY FRONTIER RESEARCH CENTERS.—

23 (1) IN GENERAL.—The Director shall carry out
24 a program to provide awards, on a competitive,
25 merit-reviewed basis, to multi-institutional collabora-

1 tions or other appropriate entities to conduct funda-
2 mental and use-inspired energy research to accel-
3 erate scientific breakthroughs.

4 (2) COLLABORATIONS.—A collaboration receiv-
5 ing an award under this subsection may include mul-
6 tiple types of institutions and private sector entities.

7 (3) SELECTION AND DURATION.—

8 (A) IN GENERAL.—A collaboration under
9 this subsection shall be selected for a period of
10 4 years.

11 (B) EXISTING CENTERS.—An Energy
12 Frontier Research Center in existence and sup-
13 ported by the Director on the date of enactment
14 of this Act may continue to receive support for
15 a period of 4 years beginning on the date of es-
16 tablishment of that center.

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

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

1 (i) MATERIALS RESEARCH DATABASE.—

2 (1) IN GENERAL.—As part of the program in
3 materials sciences and engineering, the Director
4 shall support the development of a web-based plat-
5 form to provide access to a database of computed in-
6 formation on known and predicted materials prop-
7 erties and computational tools to accelerate break-
8 throughs in materials discovery and design.

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

11 (A) conduct cooperative research with in-
12 dustry, academia, and other research institu-
13 tions to facilitate the design of novel materials;

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

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

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

23 (E) drive the development of advanced ma-
24 terials for applications that span the Depart-

1 ment’s missions in energy, environment, and
2 national security.

3 (3) In carrying out this section, the Director
4 shall leverage programs and activities across the De-
5 partment.

6 **SEC. 5. ADVANCED SCIENTIFIC COMPUTING RESEARCH.**

7 (a) PROGRAM.—The Director shall carry out a re-
8 search, development, and demonstration program to ad-
9 vance computational and networking capabilities to ana-
10 lyze, model, simulate, and predict complex phenomena rel-
11 evant to the development of new energy technologies and
12 the competitiveness of the United States.

13 (b) AMERICAN SUPER COMPUTING LEADERSHIP.—

14 (1) RENAMING OF ACT.—

15 (A) IN GENERAL.—Section 1 of the De-
16 partment of Energy High-End Computing Revi-
17 talization Act of 2004 (15 U.S.C. 5501 note;
18 Public Law 108–423) is amended by striking
19 “Department of Energy High-End Computing
20 Revitalization Act of 2004” and inserting
21 “American Super Computing Leadership Act”.

22 (B) CONFORMING AMENDMENT.—Section
23 976(a)(1) of the Energy Policy Act of 2005 (42
24 U.S.C. 16316(1)) is amended by striking “De-
25 partment of Energy High-End Computing Revi-

1 talization Act of 2004” and inserting “Amer-
2 ican Super Computing Leadership Act”.

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

6 (A) by redesignating paragraphs (2)
7 through (5) as paragraphs (3) through (6), re-
8 spectively;

9 (B) by striking paragraph (1) and insert-
10 ing the following:

11 “(1) DEPARTMENT.—The term ‘Department’
12 means the Department of Energy.

13 “(2) EXASCALE COMPUTING.—The term
14 ‘exascale computing’ means computing through the
15 use of a computing machine that performs near or
16 above 10 to the 18th power operations per second.”;
17 and

18 (C) in paragraph (6) (as redesignated by
19 subparagraph (A)), by striking “, acting
20 through the Director of the Office of Science of
21 the Department of Energy”.

22 (3) DEPARTMENT OF ENERGY HIGH-END COM-
23 PUTING RESEARCH AND DEVELOPMENT PROGRAM.—
24 Section 3 of the American Super Computing Leader-

1 ship Act (15 U.S.C. 5542), as renamed by para-
2 graph (1), is amended—

3 (A) in subsection (a)(1), by striking “pro-
4 gram” and inserting “coordinated program
5 across the Department”;

6 (B) in subsection (b)(2), by striking “,
7 which may” and all that follows through
8 “multithreading architectures”; and

9 (C) by striking subsection (d) and insert-
10 ing the following:

11 “(d) EXASCALE COMPUTING PROGRAM.—

12 “(1) IN GENERAL.—The Secretary shall con-
13 duct a research program (referred to in this sub-
14 section as the ‘Program’) for exascale computing, in-
15 cluding the development of two or more exascale
16 computing machine architectures, to promote the
17 missions of the Department.

18 “(2) EXECUTION.—

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

21 “(i) establish a National Laboratory
22 partnership for industry partners and in-
23 stitutions of higher education for codesign
24 of exascale hardware, technology, software,

1 and applications across all applicable orga-
2 nizations of the Department;

3 “(ii) acquire multiple exascale com-
4 puting systems at the existing Depart-
5 mental facilities that represent at least two
6 distinct technology options developed under
7 clause (i);

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

17 “(iv) explore the use of exascale com-
18 puting technologies to advance a broad
19 range of science and engineering; and

20 “(v) provide, as appropriate, on a
21 competitive, merit-reviewed basis, access
22 for researchers in industries in the United
23 States, institutions of higher education,
24 National Laboratories, and other Federal

1 agencies to the exascale computing systems
2 developed pursuant to clause (i).

3 “(B) SELECTION OF PARTNERS.—The Sec-
4 retary shall select the partnerships with the
5 computing facilities of the Department under
6 subparagraph (A) through a competitive, peer-
7 review process.

8 “(3) CODESIGN AND APPLICATION DEVELOP-
9 MENT.—

10 “(A) IN GENERAL.—The Secretary shall—

11 “(i) carry out the Program through
12 an integration of applications, computer
13 science, applied mathematics, and com-
14 puter hardware architecture using the
15 partnerships established pursuant to para-
16 graph (2) to ensure that, to the maximum
17 extent practicable, two or more exascale
18 computing machine architectures are capa-
19 ble of solving Department target applica-
20 tions and broader scientific problems, in-
21 cluding predictive modeling and simulation,
22 large scale data analytics and manage-
23 ment, and artificial intelligence; and

24 “(ii) conduct outreach programs to in-
25 crease the readiness for the use of such

1 platforms by domestic industries, including
2 manufacturers.

3 “(B) REPORT.—(i) The Secretary shall
4 submit to Congress a report describing how the
5 integration under subparagraph (A) is fur-
6 thering application science data and computa-
7 tional workloads across application interests, in-
8 cluding national security, material science,
9 physical science, cybersecurity, biological
10 science, the Materials Genome and BRAIN Ini-
11 tiatives of the President, advanced manufac-
12 turing, and the national electric grid.

13 “(ii) The roles and responsibilities of Na-
14 tional Laboratories and industry, including the
15 definition of the roles and responsibilities within
16 the Department to ensure an integrated pro-
17 gram across the Department.

18 “(4) PROJECT REVIEW.—

19 “(A) IN GENERAL.—The exascale architec-
20 tures developed pursuant to partnerships estab-
21 lished pursuant to paragraph (2) shall be re-
22 viewed through a project review process.

23 “(B) REPORT.—Not later than 90 days
24 after the date of enactment of this subsection,

1 the Secretary shall submit to Congress a report
2 on—

3 “(i) the results of the review con-
4 ducted under subparagraph (A); and

5 “(ii) the coordination and manage-
6 ment of the Program to ensure an inte-
7 grated research program across the De-
8 partment.

9 “(5) ANNUAL REPORTS.—At the time of the
10 budget submission of the Department for each fiscal
11 year, the Secretary, in consultation with the mem-
12 bers of the partnerships established pursuant to
13 paragraph (2), shall submit to Congress a report
14 that describes funding for the Program as a whole
15 by functional element of the Department and critical
16 milestones.”.

17 (c) HIGH-PERFORMANCE COMPUTING AND NET-
18 WORKING RESEARCH.—The Director shall support re-
19 search in high-performance computing and networking rel-
20 evant to energy applications, including modeling, simula-
21 tion, machine learning, and advanced data analytics for
22 basic and applied energy research programs carried out
23 by the Secretary.

1 (d) APPLIED MATHEMATICS AND SOFTWARE DEVEL-
2 OPMENT FOR HIGH-END COMPUTING SYSTEMS, COM-
3 PUTATIONAL, AND COMPUTER SCIENCES RESEARCH.—

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

6 (A) mathematics, models, statistics, and al-
7 gorithms for complex systems and programming
8 environments; and

9 (B) tools, languages, and operations for
10 high-end computing systems (as defined in sec-
11 tion 2 of the American Super Computing Lead-
12 ership Act (15 U.S.C. 5541), as renamed by
13 this section).

14 (2) PORTFOLIO BALANCE.—The Director shall
15 maintain a balanced portfolio within the advanced
16 scientific computing research and development pro-
17 gram established under section 976 of the Energy
18 Policy Act of 2005 (42 U.S.C. 16316) that supports
19 robust investment in applied mathematical, com-
20 putational, and computer sciences research while ac-
21 commodating necessary investments in high-perform-
22 ance computing hardware and facilities.

23 (e) WORKFORCE DEVELOPMENT.—The Director of
24 the Office of Advanced Scientific Computing Research

1 shall support the development of a computational science
2 workforce through a program that—

3 (1) facilitates collaboration between university
4 students and researchers at the National Labora-
5 tories; and

6 (2) endeavors to advance science in areas rel-
7 evant to the mission of the Department through the
8 application of computational science.

9 **SEC. 6. HIGH ENERGY PHYSICS.**

10 (a) PROGRAM.—The Director shall carry out a re-
11 search program on the fundamental constituents of matter
12 and energy and the nature of space and time.

13 (b) MISSION.—The mission of the program described
14 in subsection (a) shall be to support theoretical and experi-
15 mental research in both elementary particle physics and
16 fundamental accelerator science and technology to under-
17 stand fundamental properties of the universe.

18 (c) SENSE OF CONGRESS.—It is the sense of the Con-
19 gress that—

20 (1) the Director should incorporate the findings
21 and recommendations of the Particle Physics Project
22 Prioritization Panel’s report entitled “Building for
23 Discovery: Strategic Plan for U.S. Particle Physics
24 in the Global Context”, into the Department’s plan-

1 ning process as part of the program described in
2 subsection (a);

3 (2) the Director should prioritize domestically
4 hosted research projects that will maintain the
5 United States position as a global leader in particle
6 physics and attract the world's most talented physi-
7 cists and foreign investment for international col-
8 laboration; and

9 (3) the nations that lead in particle physics by
10 hosting international teams dedicated to a common
11 scientific goal attract the world's best talent and in-
12 spire future generations of physicists and tech-
13 nologists.

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

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

22 (1) IN GENERAL.—The Secretary shall provide
23 for a Long-Baseline Neutrino Facility to facilitate
24 the international Deep Underground Neutrino Ex-
25 periment to enable a program in neutrino physics to

1 measure the fundamental properties of neutrinos, ex-
2 plore physics beyond the Standard Model, and better
3 clarify the nature of matter and antimatter.

4 (2) FACILITY CAPABILITIES.—The Secretary
5 shall ensure that the facility described in paragraph
6 (1) will provide, at a minimum, the following capa-
7 bilities:

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

11 (B) Four caverns excavated for a 40 kil-
12 oton fiducial detector mass and supporting sur-
13 face buildings and utilities.

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

18 (D) Cryogenic systems to support neutrino
19 detectors.

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

24 (4) FUNDING.—Out of funds authorized to be
25 appropriated under section 11 for High Energy

1 Physics, there shall be made available to the Sec-
 2 retary to carry out activities, including construction
 3 of the facility, under this subsection—

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

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

6 (5) DARK ENERGY AND DARK MATTER RE-
 7 SEARCH.—As part of the program described in para-
 8 graph (1), the Director shall carry out research ac-
 9 tivities on the nature of dark energy and dark mat-
 10 ter, which may include collaborations with the Na-
 11 tional Aeronautics and Space Administration or the
 12 National Science Foundation, or international col-
 13 laborations.

14 (6) INTERNATIONAL COLLABORATION.—The
 15 Director, as practicable and in coordination with
 16 other appropriate Federal agencies as necessary,
 17 shall ensure the access of United States researchers
 18 to the most advanced accelerator facilities and re-
 19 search capabilities in the world, including the Large
 20 Hadron Collider.

21 **SEC. 7. BIOLOGICAL AND ENVIRONMENTAL RESEARCH.**

22 (a) PROGRAM.—The Director shall carry out a pro-
 23 gram of basic research in the areas of biological systems
 24 science and environmental science relevant to the develop-
 25 ment of new energy technologies and to support Depart-

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

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

8 (1) to accelerate breakthroughs and new knowl-
9 edge that would enable the cost-effective, sustainable
10 production of—

11 (A) biomass-based liquid transportation
12 fuels;

13 (B) bioenergy; and

14 (C) biobased materials;

15 (2) to improve understanding of the global car-
16 bon cycle, including processes for removing carbon
17 dioxide from the atmosphere, through photosynthesis
18 and other biological processes, for sequestration and
19 storage; and

20 (3) to understand the biological mechanisms
21 used to transform, immobilize, or remove contami-
22 nants from subsurface environments.

23 (c) BIOENERGY RESEARCH CENTERS.—

24 (1) IN GENERAL.—In carrying out activities
25 under subsection (a), the Director shall select and

1 establish up to four bioenergy research centers to
2 conduct basic and fundamental research in plant
3 and microbial systems biology, bio imaging and anal-
4 ysis, and genomics to inform the production of fuels,
5 chemicals from sustainable biomass resources, and
6 to facilitate the translation of basic research results
7 to industry.

8 (2) SELECTION.—The Director shall select cen-
9 ters under paragraph (1) on a competitive, merit-re-
10 viewed basis. The Director shall consider applica-
11 tions from National Laboratories, multi-institutional
12 collaborations, and other appropriate entities.

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

17 (4) EXISTING CENTERS.—The Director may se-
18 lect a center for participation under this subsection
19 that is in existence, or undergoing a renewal process,
20 on the date of enactment of this Act. Such center
21 shall be eligible to receive support for the duration
22 the 5-year period beginning on the date of establish-
23 ment of such center.

24 (5) RENEWAL.—Upon the expiration of any pe-
25 riod of support of a center under this subsection, the

1 Director may renew support for the center, on a
2 merit-reviewed basis, for a period of not more than
3 5 years.

4 (6) TERMINATION.—Consistent with the exist-
5 ing authorities of the Department, the Director may
6 terminate an underperforming center for cause dur-
7 ing the performance period.

8 (d) LOW DOSE RADIATION RESEARCH PROGRAM.—

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

13 **“SEC. 977A. LOW-DOSE RADIATION RESEARCH PROGRAM.**

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

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

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

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

24 “(1) formulate scientific goals for low-dose radi-
25 ation basic research in the United States;

1 “(2) identify ongoing scientific challenges for
2 understanding the long-term effects of ionizing radi-
3 ation on biological systems;

4 “(3) develop a long-term strategic and
5 prioritized basic research agenda to address such
6 scientific challenges in coordination with other re-
7 search efforts;

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

10 “(5) engage with other Federal agencies, re-
11 search communities, and potential users of informa-
12 tion produced under this section, including institu-
13 tions concerning radiation research, medical physics,
14 radiology, health physics, and emergency response.

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

19 “(1) support the directives under section 106 of
20 the American Innovation and Competitiveness Act
21 (42 U.S.C. 6601 note);

22 “(2) ensure that the Office of Science of the
23 Department of Energy consults with the National
24 Aeronautics and Space Administration, the National
25 Institutes of Health, the Environmental Protection

1 Agency, the Department of Defense, the Nuclear
2 Regulatory Commission, and the Department of
3 Homeland Security;

4 “(3) advise and assist the National Science and
5 Technology Council on policies and initiatives in ra-
6 diation biology, including enhancing scientific knowl-
7 edge of the effects of low-dose radiation on biological
8 systems to improve radiation risk-assessment and
9 risk-management methods; and

10 “(4) identify opportunities to stimulate inter-
11 national cooperation relating to low-dose radiation
12 and leverage research and knowledge from sources
13 outside of the United States.

14 “(d) RESEARCH PLAN.—Not later than 180 days
15 after the date of enactment of this Act, the Secretary shall
16 transmit to the Committee on Science, Space, and Tech-
17 nology of the House of Representatives and the Committee
18 on Energy and Natural Resources of the Senate a 4-year
19 research plan that identifies and prioritizes basic research
20 needs relating to low-dose radiation. In developing such
21 plan, the Secretary shall incorporate the components de-
22 scribed in subsection (b).

23 “(e) DEFINITION OF LOW-DOSE RADIATION.—In
24 this section, the term ‘low-dose radiation’ means a radi-
25 ation dose of less than 100 millisieverts.

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

6 “(g) FUNDING.—From within funds authorized to be
 7 appropriated under section 11 of the Department of En-
 8 ergy Science and Innovation Act of 2018, for Biological
 9 and Environmental Research, the Secretary make avail-
 10 able to carry out this section—

11 “(1) \$20,000,000 for fiscal year 2018; and

12 “(2) \$20,000,000 for fiscal year 2019.”.

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

“977A. Low-dose radiation research program.”.

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

22 (f) LIMITATION FOR RESEARCH FUNDS.—The Direc-
 23 tor shall not approve new climate science-related initia-
 24 tives without making a determination that such work is

1 well-coordinated with any relevant work carried out by
2 other Federal agencies.

3 **SEC. 8. FUSION ENERGY.**

4 (a) PROGRAM.—The Director shall carry out a fusion
5 energy sciences research program to expand the under-
6 standing of plasmas and matter at very high temperatures
7 and densities and build the science and engineering foun-
8 dation needed to develop a fusion energy source.

9 (b) INERTIAL FUSION ENERGY RESEARCH AND DE-
10 VELOPMENT PROGRAM.—The Secretary shall carry out a
11 program of research and technology development in iner-
12 tial fusion for energy applications, including ion beam,
13 laser, and pulsed power fusion systems.

14 (c) TOKAMAK RESEARCH AND DEVELOPMENT.—

15 (1) IN GENERAL.—The Director shall support
16 research and development activities and facility oper-
17 ations to optimize the tokamak approach to fusion
18 energy.

19 (2) INTERNATIONAL THERMONUCLEAR EXPERI-
20 MENTAL REACTOR CONSTRUCTION.—Section 972 of
21 the Energy Policy Act of 2005 (42 U.S.C. 16312)
22 is amended by adding at the end the following new
23 paragraph:

24 “(7) ITER CONSTRUCTION.—

1 “(A) IN GENERAL.—There is authorized
2 United States participation in the construction
3 and operations of the ITER project, as agreed
4 to under the April 25, 2007 ‘Agreement on the
5 Establishment of the ITER International Fu-
6 sion Energy Organization for the Joint Imple-
7 mentation of the ITER Project.’.

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

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

16 “(ii) Capable of creating and sus-
17 taining a 15-million-Ampere plasma cur-
18 rent for greater than 300 seconds.

19 “(C) AUTHORIZATION OF APPROPRIA-
20 TIONS.—From within funds authorized to be
21 appropriated under section 11 of the Depart-
22 ment of Energy Science and Innovation Act of
23 2018, for Fusion Energy Sciences, there is au-
24 thorized for in-kind contributions under this
25 paragraph—

1 “(i) \$122,000,000 for fiscal year
2 2018; and

3 “(ii) \$163,000,000 for fiscal year
4 2019.

5 “(D) AUTHORIZATION OF APPROPRIA-
6 TIONS.—From within funds authorized to be
7 appropriated under section 11 of the Depart-
8 ment of Energy Science and Innovation Act of
9 2018, for Fusion Energy Sciences, there is au-
10 thorized for cash contributions under this para-
11 graph—

12 “(i) \$50,000,000 for fiscal year 2018;
13 and

14 “(ii) \$50,000,000 for fiscal year
15 2019.”.

16 (d) ALTERNATIVE AND ENABLING CONCEPTS.—

17 (1) IN GENERAL.—As part of the program de-
18 scribed in subsection (a), the Director shall support
19 research and development activities and facility oper-
20 ations at United States universities, national labora-
21 tories, and private facilities for a portfolio of alter-
22 native and enabling fusion energy concepts that may
23 provide solutions to significant challenges to the es-
24 tablishment of a commercial magnetic fusion power
25 plant, prioritized based on the ability of the United

1 States to play a leadership role in the international
2 fusion research community. Fusion energy concepts
3 and activities explored under this paragraph may in-
4 clude—

5 (A) high magnetic field approaches facili-
6 tated by high temperature superconductors;

7 (B) advanced stellarator concepts;

8 (C) non-tokamak confinement configura-
9 tions operating at low magnetic fields;

10 (D) magnetized target fusion energy con-
11 cepts;

12 (E) liquid metals to address issues associ-
13 ated with fusion plasma interactions with the
14 inner wall of the encasing device;

15 (F) immersion blankets for heat manage-
16 ment and fuel breeding;

17 (G) advanced scientific computing activi-
18 ties; and

19 (H) other promising fusion energy con-
20 cepts identified by the Director.

21 (2) COORDINATION WITH ARPA-E.—The Under
22 Secretary and the Director shall coordinate with the
23 Director of the Advanced Research Projects Agency–
24 Energy (in this paragraph referred to as “ARPA–
25 E”) to—

1 (A) assess the potential for any fusion en-
2 ergy project supported by ARPA-E to rep-
3 resent a promising approach to a commercially
4 viable fusion power plant;

5 (B) determine whether the results of any
6 fusion energy project supported by ARPA-E
7 merit the support of follow-on research activi-
8 ties carried out by the Office of Science; and

9 (C) avoid unintentional duplication of ac-
10 tivities.

11 (e) FAIRNESS IN COMPETITION FOR SOLICITATIONS
12 FOR INTERNATIONAL PROJECT ACTIVITIES.—Section 33
13 of the Atomic Energy Act of 1954 (42 U.S.C. 2053) is
14 amended by inserting before the first sentence the fol-
15 lowing: “In this section, with respect to international re-
16 search projects, the term ‘private facilities or laboratories’
17 means facilities or laboratories located in the United
18 States.”.

19 (f) IDENTIFICATION OF PRIORITIES.—

20 (1) REPORT.—

21 (A) IN GENERAL.—Not later than 2 years
22 after the date of enactment of this Act, the Sec-
23 retary shall submit to Congress a report on the
24 fusion energy research and development activi-
25 ties that the Department proposes to carry out

1 over the 10-year period following the date of
2 the report under not fewer than three realistic
3 budget scenarios, including a scenario based on
4 3-percent annual growth in the non-ITER por-
5 tion of the budget for fusion energy research
6 and development activities.

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

9 (i) identify specific areas of fusion en-
10 ergy research and enabling technology de-
11 velopment, including activities to advance
12 inertial and alternative fusion energy con-
13 cepts, in which the United States can and
14 should establish or solidify a lead in the
15 global fusion energy development effort;

16 (ii) identify priorities for initiation of
17 facility construction and facility decommis-
18 sioning under each of the three budget sce-
19 narios described in subparagraph (A); and

20 (iii) assess the ability of the fusion
21 workforce of the United States to carry out
22 the activities identified under clauses (i)
23 and (ii), including the adequacy of pro-
24 grams at institutions of higher education
25 in the United States to train the leaders

1 and workers of the next generation of fu-
2 sion energy researchers.

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

9 (3) REQUIREMENT.—No member of the Fusion
10 Energy Sciences Advisory Committee shall be ex-
11 cluded from participating in developing or voting on
12 final approval of the report required under para-
13 graph (1)(A).

14 **SEC. 9. NUCLEAR PHYSICS.**

15 (a) PROGRAM.—The Director shall carry out a pro-
16 gram of experimental and theoretical research, and sup-
17 port associated facilities, to discover, explore, and under-
18 stand all forms of nuclear matter.

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

21 (1) may carry out a program for the production
22 of isotopes, including the development of techniques
23 to produce isotopes, that the Secretary determines
24 are needed for research, medical, industrial, or re-
25 lated purposes; and

1 (2) shall ensure that isotope production activi-
 2 ties carried out under the program under this para-
 3 graph do not compete with private industry unless
 4 the Director determines that critical national inter-
 5 ests require the involvement of the Federal Govern-
 6 ment.

7 (c) RENAMING OF THE RARE ISOTOPE ACCEL-
 8 ERATOR.—Section 981 of the Energy Policy Act of 2005
 9 (42 U.S.C. 16321) is amended—

10 (1) in the section heading, by striking “**RARE**
 11 **ISOTOPE ACCELERATOR**” and inserting “**FACIL-**
 12 **ITY FOR RARE ISOTOPE BEAMS**”; and

13 (2) by striking “Rare Isotope Accelerator” each
 14 place it appears and inserting “Facility for Rare Iso-
 15 tope Beams”.

16 (d) FACILITY FOR RARE ISOTOPE BEAMS.—

17 (1) IN GENERAL.—The Secretary shall provide
 18 for a Facility for Rare Isotope Beams to advance the
 19 understanding of rare nuclear isotopes and the evo-
 20 lution of the cosmos.

21 (2) FACILITY CAPABILITY.—In carrying out
 22 paragraph (1), the Secretary shall provide for, at a
 23 minimum, a rare isotope beam facility capable of
 24 400 kW of beam power.

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

6 (4) FUNDING.—Out of funds authorized to be
 7 appropriated under section 11 for Nuclear Physics,
 8 there shall be made available to the Secretary to
 9 carry out activities, including construction of the fa-
 10 cility, under this subsection—

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

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

13 **SEC. 10. SCIENCE LABORATORIES INFRASTRUCTURE PRO-**
 14 **GRAM.**

15 (a) IN GENERAL.—The Director shall carry out a
 16 program to improve the safety, efficiency, and mission
 17 readiness of infrastructure at Office of Science labora-
 18 tories. The program shall include projects to—

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

21 (2) replace facilities that are no longer cost ef-
 22 fective to renovate or operate;

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

1 (4) remove excess facilities to allow safe and ef-
2 ficient operations; and

3 (5) construct modern facilities to conduct ad-
4 vanced research in controlled environmental condi-
5 tions.

6 (b) APPROACH.—In carrying out this section, the Di-
7 rector shall utilize all available approaches and mecha-
8 nisms, including capital line items, minor construction
9 projects, energy savings performance contracts, utility en-
10 ergy service contracts, alternative financing, and expense
11 funding, as appropriate.

12 **SEC. 11. AUTHORIZATION OF APPROPRIATIONS.**

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

16 (1) \$2,090,000,000 shall be for Basic Energy
17 Science;

18 (2) \$908,000,000 shall be for High Energy
19 Physics;

20 (3) \$673,000,000 shall be for Biological and
21 Environmental Research;

22 (4) \$684,000,000 shall be for Nuclear Physics;

23 (5) \$810,000,000 shall be for Advanced Sci-
24 entific Computing Research;

1 (6) \$532,111,000 shall be for Fusion Energy
2 Sciences;

3 (7) \$257,292,000 shall be for Science Labora-
4 tories Infrastructure;

5 (8) \$183,000,000 shall be for Science Program
6 Direction;

7 (9) \$103,000,000 shall be for Safeguards and
8 Security; and

9 (10) \$19,500,000 shall be for Workforce Devel-
10 opment for Teachers and Scientists.

11 (b) FISCAL YEAR 2019.—There are authorized to be
12 appropriated to the Secretary for the Office of Science for
13 fiscal year 2019 \$6,600,000,000, of which—

14 (1) \$2,129,233,000 shall be for Basic Energy
15 Science;

16 (2) \$1,004,510,000 shall be for High Energy
17 Physics;

18 (3) \$673,000,000 shall be for Biological and
19 Environmental Research;

20 (4) \$690,000,000 shall be for Nuclear Physics;

21 (5) \$899,010,000 shall be for Advanced Sci-
22 entific Computing Research;

23 (6) \$640,000,000 shall be for Fusion Energy
24 Sciences;

1 (7) \$257,292,000 shall be for Science Labora-
2 tories Infrastructure;

3 (8) \$181,345,000 shall be for Science Program
4 Direction;

5 (9) \$106,110,000 shall be for Safeguards and
6 Security; and

7 (10) \$19,500,000 shall be for Workforce Devel-
8 opment for Teachers and Scientists.

Passed the House of Representatives June 27, 2018.

Attest:

Clerk.

115TH CONGRESS
2^D SESSION

H. R. 5905

AN ACT

To authorize basic research programs in the Department of Energy Office of Science for fiscal years 2018 and 2019.