

Suspend the Rules and Pass the Bill, H.R. 5905, With an Amendment

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

115TH CONGRESS
2D SESSION

H. R. 5905

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

IN THE HOUSE OF REPRESENTATIVES

MAY 22, 2018

Mr. WEBER of Texas (for himself, Ms. LOFGREN, Mr. SMITH of Texas, Mr. LUCAS, Mr. KNIGHT, Mr. HULTGREN, Mr. DUNN, Mr. NORMAN, Mr. BABIN, Mr. MARSHALL, Mr. HIGGINS of Louisiana, and Mrs. LESKO) introduced the following bill; which was referred to the Committee on Science, Space, and Technology

A BILL

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,*

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

4 (a) SHORT TITLE.—This Act may be cited as the
5 “Department of Energy Science and Innovation Act of
6 2018”.

1 (b) TABLE OF CONTENTS.—The table of contents for
2 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.

3 **SEC. 2. DEFINITIONS.**

4 In this Act:

5 (1) DEPARTMENT.—The term “Department”
6 means the Department of Energy.

7 (2) DIRECTOR.—The term “Director” means the Direc-
8 tor of the Office of Science of the Department.

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

13 (4) SECRETARY.—The term “Secretary” means
14 the Secretary of Energy.

15 **SEC. 3. MISSION.**

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

19 “(c) MISSION.—The mission of the Office of Science
20 shall be the delivery of scientific discoveries, capabilities,

1 and major scientific tools to transform the understanding
2 of nature and to advance the energy, economic, and na-
3 tional security of the United States.”.

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

5 (a) PROGRAM.—The Director shall carry out a pro-
6 gram in basic energy sciences, including materials sciences
7 and engineering, chemical sciences, physical biosciences,
8 and geosciences, for the purpose of providing the scientific
9 foundations for new energy technologies.

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

17 (c) BASIC ENERGY SCIENCES USER FACILITIES.—

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

21 (2) REQUIREMENTS.—To the maximum extent
22 practicable, the national user facilities developed,
23 constructed, operated, or maintained under para-
24 graph (1) shall serve the needs of the Department,
25 industry, the academic community, and other rel-

1 evant entities to create and examine materials and
2 chemical processes for the purpose of improving the
3 competitiveness of the United States.

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

7 (A) x-ray light sources;

8 (B) neutron sources;

9 (C) nanoscale science research centers; and

10 (D) such other facilities as the Director
11 considers appropriate, consistent with section
12 209 of the Department of Energy Organization
13 Act (42 U.S.C. 7139).

14 (d) BASIC ENERGY SCIENCES RESEARCH INFRA-
15 STRUCTURE.—

16 (1) ADVANCED PHOTON SOURCE UPGRADE.—

17 (A) IN GENERAL.—The Secretary shall
18 provide for the upgrade to the Advanced Pho-
19 ton Source described in the publication ap-
20 proved by the Basic Energy Sciences Advisory
21 Committee on June 9, 2016, titled “Report on
22 Facility Upgrades”, including the development
23 of a multi-bend achromat lattice to produce a
24 high flux of coherent x-rays within the hard x-

1 ray energy region and a suite of beamlines opti-
2 mized for this source.

3 (B) DEFINITIONS.—In this paragraph:

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

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

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 upgrade under this paragraph occurs before De-
13 cember 31, 2025.

14 (D) FUNDING.—Out of funds authorized
15 to be appropriated under section 11 for Basic
16 Energy Sciences, the Secretary of Energy shall
17 devote \$223,000,000 to carry out this para-
18 graph, which shall include \$93,000,000 for fis-
19 cal year 2018 and \$130,000,000 for fiscal year
20 2019, subject to the availability of appropria-
21 tions, to come from amounts made available for
22 the Office of Science. This paragraph shall be
23 carried out using funds otherwise appropriated
24 by law after the date of enactment of this Act.

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, the Secretary of Energy shall
9 devote \$96,800,000 to carry out this para-
10 graph, which shall include \$36,000,000 for fis-
11 cal year 2018 and \$60,800,000 for fiscal year
12 2019, subject to the availability of appropria-
13 tions, to come from amounts made available for
14 the Office of Science. This paragraph shall be
15 carried out using funds otherwise appropriated
16 by law after the date of enactment of this Act.

17 (3) SPALLATION NEUTRON SOURCE SECOND
18 TARGET STATION.—

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

22 (B) DEFINITION OF SECOND TARGET STA-
23 TION.—For the purposes of this paragraph, the
24 term “second target station” means the Spall-

1 ation Neutron Source second target station de-
2 scribed in—

3 (i) the publication of the Office of
4 Science of the Department of Energy titled
5 “Facilities for the Future of Science: A
6 Twenty-Year Outlook”, published Decem-
7 ber 2003;

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

14 (iii) the publication approved by the
15 Basic Energy Sciences Advisory Committee
16 on June 9, 2016, titled “Report on Facil-
17 ity Upgrades”.

18 (C) START OF OPERATIONS.—The Sec-
19 retary shall, to the maximum extent practicable,
20 ensure that the start of full operations of the
21 second target station under this paragraph oc-
22 curs before December 31, 2030, with the option
23 for early operation in 2028.

24 (D) FUNDING.—Out of funds authorized
25 to be appropriated under section 11 for Basic

1 Energy Sciences, the Secretary of Energy shall
2 devote \$15,000,000 to carry out this para-
3 graph, which shall include \$5,000,000 for fiscal
4 year 2018 and \$10,000,000 for fiscal year
5 2019, subject to the availability of appropria-
6 tions, to come from amounts made available for
7 the Office of Science. This paragraph shall be
8 carried out using funds otherwise appropriated
9 by law after the date of enactment of this Act.

10 (4) ADVANCED LIGHT SOURCE UPGRADE.—

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

20 (B) DEFINITIONS.—In this paragraph:

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

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

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, 2026.

6 (D) FUNDING.—Out of funds authorized
7 to be appropriated under section 11 for Basic
8 Energy Sciences, the Secretary of Energy shall
9 devote \$70,000,000 to carry out this para-
10 graph, which shall include \$20,000,000 for fis-
11 cal year 2018 and \$50,000,000 for fiscal year
12 2019, subject to the availability of appropria-
13 tions, to come from amounts made available for
14 the Office of Science. This paragraph shall be
15 carried out using funds otherwise appropriated
16 by law after the date of enactment of this Act.

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

19 (A) IN GENERAL.—The Secretary shall
20 provide for the upgrade to the Linac Coherent
21 Light Source II facility described in the publi-
22 cation approved by the Basic Energy Sciences
23 Advisory Committee on June 9, 2016, titled
24 “Report on Facility Upgrades”, including the
25 development of experimental capabilities for

1 high energy x-rays to reveal fundamental sci-
2 entific discoveries. The Secretary shall ensure
3 the upgrade under this paragraph enables the
4 production and use of high energy, ultra-short
5 pulse x-rays delivered at a high repetition rate.

6 (B) DEFINITIONS.—In this paragraph:

7 (i) HIGH ENERGY X-RAY.—The term a
8 “high energy x-ray” means a photon with
9 an energy at or exceeding 12 kiloelectron
10 volts.

11 (ii) HIGH REPETITION RATE.—The
12 term “high repetition rate” means the de-
13 livery of x-ray pulses up to one million
14 pulses per second.

15 (iii) ULTRA-SHORT PULSE X-RAYS.—
16 The term “ultra-short pulse x-rays” means
17 x-ray bursts capable of durations of less
18 than one hundred femtoseconds.

19 (C) START OF OPERATIONS.—The Sec-
20 retary shall, to the maximum extent practicable,
21 ensure that the start of full operations of the
22 upgrade under this paragraph occurs before De-
23 cember 31, 2025.

24 (D) FUNDING.—Out of funds authorized
25 to be appropriated under section 11 for Basic

1 Energy Sciences, the Secretary of Energy shall
2 devote \$75,000,000 to carry out this para-
3 graph, which shall include \$20,000,000 for fis-
4 cal year 2018 and \$55,000,000 for fiscal year
5 2019, subject to the availability of appropria-
6 tions, to come from amounts made available for
7 the Office of Science. This paragraph shall be
8 carried out using funds otherwise appropriated
9 by law after the date of enactment of this Act.

10 (e) ACCELERATOR RESEARCH AND DEVELOP-
11 MENT.—The Director shall carry out research and devel-
12 opment on advanced accelerator and storage ring tech-
13 nologies relevant to the development of Basic Energy
14 Sciences user facilities, in consultation with the Office of
15 Science’s High Energy Physics and Nuclear Physics pro-
16 grams.

17 (f) SOLAR FUELS RESEARCH INITIATIVE.—

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

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

22 **“(a) INITIATIVE.—**

23 **“(1) IN GENERAL.—**The Secretary shall carry
24 out a research initiative, to be known as the ‘Solar
25 Fuels Research Initiative’ (referred to in this section

1 as the ‘Initiative’) to expand theoretical and funda-
2 mental knowledge of photochemistry, electro-
3 chemistry, biochemistry, and materials science useful
4 for the practical development of experimental sys-
5 tems to convert solar energy to chemical energy.

6 “(2) LEVERAGING.—In carrying out programs
7 and activities under the Initiative, the Secretary
8 shall leverage expertise and resources from—

9 “(A) the Basic Energy Sciences Program
10 and the Biological and Environmental Research
11 Program of the Office of Science; and

12 “(B) the Office of Energy Efficiency and
13 Renewable Energy.

14 “(3) TEAMS.—

15 “(A) IN GENERAL.—In carrying out the
16 Initiative, the Secretary shall organize activities
17 among multidisciplinary teams to leverage, to
18 the maximum extent practicable, expertise from
19 the National Laboratories, institutions of higher
20 education, and the private sector.

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

24 “(C) RESOURCES.—The Secretary shall
25 provide sufficient resources to the multidisci-

1 plinary teams described in subparagraph (A) to
2 achieve the goals described in subparagraph (B)
3 over a period of time to be determined by the
4 Secretary.

5 “(4) ADDITIONAL ACTIVITIES.—The Secretary
6 may organize additional activities under this sub-
7 section through Energy Frontier Research Centers,
8 Energy Innovation Hubs, or other organizational
9 structures.

10 “(b) ARTIFICIAL PHOTOSYNTHESIS.—

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

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

18 “(A) the Director of the Office of Basic
19 Energy Sciences shall support basic research to
20 pursue distinct lines of scientific inquiry, in-
21 cluding—

22 “(i) photoinduced production of hy-
23 drogen and oxygen from water; and

24 “(ii) the sustainable photoinduced re-
25 duction of carbon dioxide to fuel products

1 including hydrocarbons, alcohols, carbon
2 monoxide, and natural gas; and

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

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

12 “(4) FUNDING.—Out of funds authorized to be
13 appropriated under section 11 of the Department of
14 Energy Science and Innovation Act of 2018, for
15 Basic Energy Sciences, the Secretary of Energy
16 shall devote \$100,000,000 to carry out this sub-
17 section, which shall include \$50,000,000 for fiscal
18 year 2018 and \$50,000,000 for fiscal year 2019,
19 subject to the availability of appropriations, to come
20 from amounts made available for the Office of
21 Science. This subsection shall be carried out using
22 funds otherwise appropriated by law after the date
23 of enactment of the Department of Energy Science
24 and Innovation Act of 2018.

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

3 “(1) IN GENERAL.—The Secretary shall carry
4 out under the Initiative a program to support re-
5 search needed to replicate natural photosynthetic
6 processes by use of artificial photosynthetic compo-
7 nents and materials.

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

10 “(A) the Director of the Office of Basic
11 Energy Sciences shall support basic research to
12 expand fundamental knowledge to replicate nat-
13 ural synthesis processes, including—

14 “(i) the photoinduced reduction of
15 dinitrogen to ammonia;

16 “(ii) the absorption of carbon dioxide
17 from ambient air;

18 “(iii) molecular-based charge separa-
19 tion and storage;

20 “(iv) photoinitiated electron transfer;
21 and

22 “(v) catalysis in biological or bio-
23 mimetic systems;

24 “(B) the Associate Director of Biological
25 and Environmental Research shall support sys-

1 tems biology and genomics approaches to un-
2 derstand genetic and physiological pathways
3 connected to photosynthetic mechanisms; and

4 “(C) 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.—Out of funds authorized to be
14 appropriated under section 11 of the Department of
15 Energy Science and Innovation Act of 2018, for
16 Basic Energy Sciences and Biological and Environ-
17 mental Research, the Secretary of Energy shall de-
18 vote \$100,000,000 to carry out this subsection,
19 which shall include \$50,000,000 for fiscal year 2018
20 and \$50,000,000 for fiscal year 2019, subject to the
21 availability of appropriations, to come from amounts
22 made available for the Office of Science. This sub-
23 section shall be carried out using funds otherwise
24 appropriated by law after the date of enactment of

1 the Department of Energy Science and Innovation
2 Act of 2018.”.

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

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

7 (g) ELECTRICITY STORAGE RESEARCH INITIA-
8 TIVE.—

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

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

13 **“(a) INITIATIVE.—**

14 **“(1) IN GENERAL.—**The Secretary shall carry
15 out a research initiative, to be known as the ‘Elec-
16 tricity Storage Research Initiative’ (referred to in
17 this section as the ‘Initiative’)—

18 **“(A) to expand theoretical and funda-**
19 **mental knowledge to control, store, and con-**
20 **vert—**

21 **“(i) electrical energy to chemical en-**
22 **ergy; and**

23 **“(ii) chemical energy to electrical en-**
24 **ergy; and**

1 “(B) to support scientific inquiry into the
2 practical understanding of chemical and phys-
3 ical processes that occur within systems involv-
4 ing crystalline and amorphous solids, polymers,
5 and organic and aqueous liquids.

6 “(2) LEVERAGING.—In carrying out programs
7 and activities under the Initiative, the Secretary
8 shall leverage expertise and resources from—

9 “(A) the Basic Energy Sciences Program,
10 the Advanced Scientific Computing Research
11 Program, and the Biological and Environmental
12 Research Program of the Office of Science; and

13 “(B) the Office of Energy Efficiency and
14 Renewable Energy.

15 “(3) TEAMS.—

16 “(A) IN GENERAL.—In carrying out the
17 Initiative, the Secretary shall organize activities
18 among multidisciplinary teams to leverage, to
19 the maximum extent practicable, expertise from
20 the National Laboratories, institutions of higher
21 education, and the private sector.

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

1 “(C) RESOURCES.—The Secretary shall
2 provide sufficient resources to the multidisci-
3 plinary teams described in subparagraph (A) to
4 achieve the goals described in subparagraph (B)
5 over a period of time to be determined by the
6 Secretary.

7 “(4) ADDITIONAL ACTIVITIES.—The Secretary
8 may organize additional activities under this sub-
9 section through Energy Frontier Research Centers,
10 Energy Innovation Hubs, or other organizational
11 structures.

12 “(b) MULTIVALENT SYSTEMS.—

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

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

20 “(A) the Director of the Office of Basic
21 Energy Sciences shall investigate electro-
22 chemical properties and the dynamics of mate-
23 rials, including charge transfer phenomena and
24 mass transport in materials; and

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

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

10 “(4) FUNDING.—Out of funds authorized to be
11 appropriated under section 11 of the Department of
12 Energy Science and Innovation Act of 2018, for
13 Basic Energy Sciences and Biological and Environ-
14 mental Research, the Secretary of Energy shall de-
15 vote \$100,000,000 to carry out this subsection,
16 which shall include \$50,000,000 for fiscal year 2018
17 and \$50,000,000 for fiscal year 2019, subject to the
18 availability of appropriations, to come from amounts
19 made available for the Office of Science. This sub-
20 section shall be carried out using funds otherwise
21 appropriated by law after the date of enactment of
22 the Department of Energy Science and Innovation
23 Act of 2018.

24 “(c) ELECTROCHEMISTRY MODELING AND SIMULA-
25 TION.—

1 “(1) IN GENERAL.—The Secretary shall carry
2 out under the Initiative a program to support re-
3 search to model and simulate organic electrolytes,
4 including the static and dynamic electrochemical be-
5 havior and phenomena of organic electrolytes at the
6 molecular and atomic level in monovalent and multi-
7 valent systems.

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

10 “(A) the Director of the Office of Basic
11 Energy Sciences, in coordination with the Asso-
12 ciate Director of Advanced Scientific Com-
13 puting Research, shall support the development
14 of high performance computational tools
15 through a joint development process to maxi-
16 mize the effectiveness of current and projected
17 high performance computing systems; 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

1 described in paragraph (1) to determine the achieve-
2 ment of technical milestones.

3 “(4) FUNDING.—Out of funds authorized to be
4 appropriated under section 11 of the Department of
5 Energy Science and Innovation Act of 2018, for
6 Basic Energy Sciences and Advanced Scientific
7 Computing Research, the Secretary of Energy shall
8 devote \$60,000,000 to carry out this subsection,
9 which shall include \$30,000,000 for fiscal year 2018
10 and \$30,000,000 for fiscal year 2019, subject to the
11 availability of appropriations, to come from amounts
12 made available for the Office of Science. This sub-
13 section shall be carried out using funds otherwise
14 appropriated by law after the date of enactment of
15 the Department of Energy Science and Innovation
16 Act of 2018.

17 “(d) MESOSCALE ELECTROCHEMISTRY.—

18 “(1) IN GENERAL.—The Secretary shall carry
19 out under the Initiative a program to support re-
20 search needed to reveal electrochemistry in confined
21 mesoscale spaces, including scientific discoveries rel-
22 evant to—

23 “(A) bio-electrochemistry and electro-
24 chemical energy conversion and storage in con-
25 fined spaces; and

1 “(B) the dynamics of the phenomena de-
2 scribed in subparagraph (A).

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

5 “(A) the Director of the Office of Basic
6 Energy Sciences and the Associate Director of
7 Biological and Environmental Research shall in-
8 vestigate phenomena of mesoscale electro-
9 chemical confinement for the purpose of repli-
10 cating and controlling new electrochemical be-
11 havior; and

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

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

21 “(4) FUNDING.—Out of funds authorized to be
22 appropriated under section 11 of the Department of
23 Energy Science and Innovation Act of 2018, for
24 Basic Energy Sciences and Biological and Environ-
25 mental Research, the Secretary of Energy shall de-

1 vote \$40,000,000 to carry out this subsection, which
2 shall include \$20,000,000 for fiscal year 2018 and
3 \$20,000,000 for fiscal year 2019, subject to the
4 availability of appropriations, to come from amounts
5 made available for the Office of Science. This sub-
6 section shall be carried out using funds otherwise
7 appropriated by law after the date of enactment of
8 the Department of Energy Science and Innovation
9 Act of 2018.”.

10 (2) CONFORMING AMENDMENT.—The table of
11 contents for the Energy Policy Act of 2005 is
12 amended by striking the item relating to section 975
13 and inserting the following:

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

14 (h) ENERGY FRONTIER RESEARCH CENTERS.—

15 (1) IN GENERAL.—The Director shall carry out
16 a program to provide awards, on a competitive,
17 merit-reviewed basis, to multi-institutional collabora-
18 tions or other appropriate entities to conduct funda-
19 mental and use-inspired energy research to accel-
20 erate scientific breakthroughs.

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

24 (3) SELECTION AND DURATION.—

1 (A) IN GENERAL.—A collaboration under
2 this subsection shall be selected for a period of
3 4 years.

4 (B) EXISTING CENTERS.—An Energy
5 Frontier Research Center in existence and sup-
6 ported by the Director on the date of enactment
7 of this Act may continue to receive support for
8 a period of 4 years beginning on the date of es-
9 tablishment of that center.

10 (C) REAPPLICATION.—After the end of the
11 period described in subparagraph (A) or (B), as
12 applicable, a recipient of an award may reapply
13 for selection on a competitive, merit-reviewed
14 basis.

15 (D) TERMINATION.—Consistent with the
16 existing authorities of the Department, the Di-
17 rector may terminate an underperforming cen-
18 ter for cause during the performance period.

19 (i) MATERIALS RESEARCH DATABASE.—

20 (1) IN GENERAL.—As part of the program in
21 materials sciences and engineering, the Director
22 shall support the development of a web-based plat-
23 form to provide access to a database of computed in-
24 formation on known and predicted materials prop-

1 erties and computational tools to accelerate break-
2 throughs in materials discovery and design.

3 (2) In carrying out this section, the Director
4 shall—

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

8 (B) leverage existing high performance
9 computing systems to conduct high-throughput
10 calculations, and develop computational and
11 data mining algorithms for the prediction of
12 material properties;

13 (C) advance understanding, prediction, and
14 manipulation of materials;

15 (D) strengthen the foundation for new
16 technologies and advanced manufacturing; and

17 (E) drive the development of advanced ma-
18 terials for applications that span the Depart-
19 ment's missions in energy, environment, and
20 national security.

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

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

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

8 (b) AMERICAN SUPER COMPUTING LEADERSHIP.—

9 (1) RENAMING OF ACT.—

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

17 (B) CONFORMING AMENDMENT.—Section
18 976(a)(1) of the Energy Policy Act of 2005 (42
19 U.S.C. 16316(1)) is amended by striking “De-
20 partment of Energy High-End Computing Revi-
21 talization Act of 2004” and inserting “Amer-
22 ican Super Computing Leadership Act”.

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

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

4 (B) by striking paragraph (1) and insert-
5 ing the following:

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

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

13 (C) in paragraph (6) (as redesignated by
14 subparagraph (A)), by striking “, acting
15 through the Director of the Office of Science of
16 the Department of Energy”.

17 (3) DEPARTMENT OF ENERGY HIGH-END COM-
18 PUTING RESEARCH AND DEVELOPMENT PROGRAM.—
19 Section 3 of the American Super Computing Leader-
20 ship Act (15 U.S.C. 5542), as renamed by para-
21 graph (1), is amended—

22 (A) in subsection (a)(1), by striking “pro-
23 gram” and inserting “coordinated program
24 across the Department”;

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

4 (C) by striking subsection (d) and insert-
5 ing the following:

6 “(d) EXASCALE COMPUTING PROGRAM.—

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

13 “(2) EXECUTION.—

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

16 “(i) establish a National Laboratory
17 partnership for industry partners and in-
18 stitutions of higher education for codesign
19 of exascale hardware, technology, software,
20 and applications across all applicable orga-
21 nizations of the Department;

22 “(ii) acquire multiple exascale com-
23 puting systems at the existing Depart-
24 mental facilities that represent at least two

1 distinct technology options developed under
2 clause (i);

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

12 “(iv) explore the use of exascale com-
13 puting technologies to advance a broad
14 range of science and engineering; and

15 “(v) provide, as appropriate, on a
16 competitive, merit-reviewed basis, access
17 for researchers in industries in the United
18 States, institutions of higher education,
19 National Laboratories, and other Federal
20 agencies to the exascale computing systems
21 developed pursuant to clause (i).

22 “(B) SELECTION OF PARTNERS.—The Sec-
23 retary shall select the partnerships with the
24 computing facilities of the Department under

1 subparagraph (A) through a competitive, peer-
2 review process.

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

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

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

19 “(ii) conduct outreach programs to in-
20 crease the readiness for the use of such
21 platforms by domestic industries, including
22 manufacturers.

23 “(B) REPORT.—(i) The Secretary shall
24 submit to Congress a report describing how the
25 integration under subparagraph (A) is fur-

1 thering application science data and computa-
2 tional workloads across application interests, in-
3 cluding national security, material science,
4 physical science, cybersecurity, biological
5 science, the Materials Genome and BRAIN Ini-
6 tiatives of the President, advanced manufac-
7 turing, and the national electric grid.

8 “(ii) The roles and responsibilities of Na-
9 tional Laboratories and industry, including the
10 definition of the roles and responsibilities within
11 the Department to ensure an integrated pro-
12 gram across the Department.

13 “(4) PROJECT REVIEW.—

14 “(A) IN GENERAL.—The exascale architec-
15 tures developed pursuant to partnerships estab-
16 lished pursuant to paragraph (2) shall be re-
17 viewed through a project review process.

18 “(B) REPORT.—Not later than 90 days
19 after the date of enactment of this subsection,
20 the Secretary shall submit to Congress a report
21 on—

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

24 “(ii) the coordination and manage-
25 ment of the Program to ensure an inte-

1 grated research program across the De-
2 partment.

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

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

18 (d) APPLIED MATHEMATICS AND SOFTWARE DEVEL-
19 OPMENT FOR HIGH-END COMPUTING SYSTEMS, COM-
20 PUTATIONAL, AND COMPUTER SCIENCES RESEARCH.—

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

23 (A) mathematics, models, statistics, and al-
24 gorithms for complex systems and programming
25 environments; and

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

6 (2) PORTFOLIO BALANCE.—The Director shall
7 maintain a balanced portfolio within the advanced
8 scientific computing research and development pro-
9 gram established under section 976 of the Energy
10 Policy Act of 2005 (42 U.S.C. 16316) that supports
11 robust investment in applied mathematical, com-
12 putational, and computer sciences research while ac-
13 commodating necessary investments in high-perform-
14 ance computing hardware and facilities.

15 (e) WORKFORCE DEVELOPMENT.—The Director of
16 the Office of Advanced Scientific Computing Research
17 shall support the development of a computational science
18 workforce through a program that—

19 (1) facilitates collaboration between university
20 students and researchers at the National Labora-
21 tories; and

22 (2) endeavors to advance science in areas rel-
23 evant to the mission of the Department through the
24 application of computational science.

1 **SEC. 6. HIGH ENERGY PHYSICS.**

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

5 (b) MISSION.—The mission of the program described
6 in subsection (a) shall be to support theoretical and experi-
7 mental research in both elementary particle physics and
8 fundamental accelerator science and technology to under-
9 stand fundamental properties of the universe.

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

12 (1) the Director should incorporate the findings
13 and recommendations of the Particle Physics Project
14 Prioritization Panel’s report entitled “Building for
15 Discovery: Strategic Plan for U.S. Particle Physics
16 in the Global Context”, into the Department’s plan-
17 ning process as part of the program described in
18 subsection (a);

19 (2) the Director should prioritize domestically
20 hosted research projects that will maintain the
21 United States position as a global leader in particle
22 physics and attract the world’s most talented physi-
23 cists and foreign investment for international col-
24 laboration; and

25 (3) the nations that lead in particle physics by
26 hosting international teams dedicated to a common

1 scientific goal attract the world's best talent and in-
2 spire future generations of physicists and tech-
3 nologists.

4 (d) NEUTRINO RESEARCH.—As part of the program
5 described in subsection (a), the Director shall carry out
6 research activities on rare decay processes and the nature
7 of the neutrino, which may include collaborations with the
8 National Science Foundation or international collabora-
9 tions.

10 (e) LONG-BASELINE NEUTRINO FACILITY FOR DEEP
11 UNDERGROUND NEUTRINO EXPERIMENT.—

12 (1) IN GENERAL.—The Secretary shall provide
13 for a Long-Baseline Neutrino Facility to facilitate
14 the international Deep Underground Neutrino Ex-
15 periment to enable a program in neutrino physics to
16 measure the fundamental properties of neutrinos, ex-
17 plore physics beyond the Standard Model, and better
18 clarify the nature of matter and antimatter.

19 (2) FACILITY CAPABILITIES.—The Secretary
20 shall ensure that the facility described in paragraph
21 (1) will provide, at a minimum, the following capa-
22 bilities:

23 (A) A broad-band neutrino beam capable
24 of 1.2 megawatts (MW) of beam power and
25 upgradable to 2.4 MW of beam power.

1 (B) Four caverns excavated for a forty kil-
2 on fiducial detector mass and supporting sur-
3 face buildings and utilities.

4 (C) Neutrino detector facilities at both the
5 Far Site in South Dakota and the Near Site in
6 Illinois to categorize and study neutrinos on
7 their 800-mile journey between the two sites.

8 (D) Cryogenic systems to support neutrino
9 detectors.

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

14 (4) FUNDING.—Out of funds authorized to be
15 appropriated under section 11 for High Energy
16 Physics, the Secretary of Energy shall devote
17 \$270,000,000 to carry out this subsection, which
18 shall include \$95,000,000 for fiscal year 2018 and
19 \$175,000,000 for fiscal year 2019, subject to the
20 availability of appropriations, to come from amounts
21 made available for the Office of Science. This sub-
22 section shall be carried out using funds otherwise
23 appropriated by law after the date of enactment of
24 this Act.

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

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

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

17 (a) PROGRAM.—The Director shall carry out a pro-
18 gram of basic research in the areas of biological systems
19 science and environmental science relevant to the develop-
20 ment of new energy technologies and to support Depart-
21 ment missions in energy, environment, and national secu-
22 rity.

23 (b) BIOLOGICAL SYSTEMS.—The Director shall carry
24 out research and development activities in fundamental,
25 structural, computational, and systems biology to increase

1 systems-level understanding of the complex biological sys-
2 tems, which may include activities—

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

6 (A) biomass-based liquid transportation
7 fuels;

8 (B) bioenergy; and

9 (C) biobased materials;

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

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

18 (c) BIOENERGY RESEARCH CENTERS.—

19 (1) IN GENERAL.—In carrying out activities
20 under subsection (a), the Director shall select and
21 establish up to 4 bioenergy research centers to con-
22 duct basic and fundamental research in plant and
23 microbial systems biology, bio imaging and analysis,
24 and genomics to inform the production of fuels,
25 chemicals from sustainable biomass resources, and

1 to facilitate the translation of basic research results
2 to industry.

3 (2) SELECTION.—The Director shall select cen-
4 ters under paragraph (1) on a competitive, merit-re-
5 viewed basis. The Director shall consider applica-
6 tions from National Laboratories, multi-institutional
7 collaborations, and other appropriate entities.

8 (3) DURATION.—A center established under
9 this subsection shall receive support for a period of
10 not more than 5 years, subject to the availability of
11 appropriations.

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

19 (5) RENEWAL.—Upon the expiration of any pe-
20 riod of support of a center under this subsection, the
21 Director may renew support for the center, on a
22 merit-reviewed basis, for a period of not more than
23 5 years.

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

1 terminate an underperforming center for cause dur-
2 ing the performance period.

3 (d) LOW DOSE RADIATION RESEARCH PROGRAM.—

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

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

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

11 “(1) enhance the scientific understanding of,
12 and reduce uncertainties associated with, the effects
13 of exposure to low-dose radiation; and

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

16 “(b) PROGRAM COMPONENTS.—In carrying out the
17 program required under subsection (a), the Secretary
18 shall—

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

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

24 “(3) develop a long-term strategic and
25 prioritized basic research agenda to address such

1 scientific challenges in coordination with other re-
2 search efforts;

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

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

10 “(c) COORDINATION.—In carrying out the program,
11 the Secretary, in coordination with the Physical Science
12 Subcommittee of the National Science and Technology
13 Council, shall—

14 “(1) support the directives under section 106 of
15 the American Innovation and Competitiveness Act
16 (42 U.S.C. 6601 note);

17 “(2) ensure that the Office of Science of the
18 Department of Energy consults with the National
19 Aeronautics and Space Administration, the National
20 Institutes of Health, the Environmental Protection
21 Agency, the Department of Defense, the Nuclear
22 Regulatory Commission, and the Department of
23 Homeland Security;

24 “(3) advise and assist the National Science and
25 Technology Council on policies and initiatives in ra-

1 diation biology, including enhancing scientific knowl-
2 edge of the effects of low-dose radiation on biological
3 systems to improve radiation risk-assessment and
4 risk-management methods; and

5 “(4) identify opportunities to stimulate inter-
6 national cooperation relating to low-dose radiation
7 and leverage research and knowledge from sources
8 outside of the United States.

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

18 “(e) DEFINITION OF LOW-DOSE RADIATION.—In this
19 section, the term ‘low-dose radiation’ means a radiation
20 dose of less than 100 millisieverts.

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

1 “(g) FUNDING.—Out of funds authorized to be ap-
2 propriated under section 11 of the Department of Energy
3 Science and Innovation Act of 2018, for Biological and
4 Environmental Research, the Secretary of Energy shall
5 devote \$40,000,000 to carry out this section, which shall
6 include \$20,000,000 for fiscal year 2018 and \$20,000,000
7 for fiscal year 2019, subject to the availability of appro-
8 priations, to come from amounts made available for the
9 Office of Science. This section shall be carried out using
10 funds otherwise appropriated by law after the date of en-
11 actment of the Department of Energy Science and Innova-
12 tion Act of 2018.”.

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) FUNDING.—

20 “(i) IN-KIND CONTRIBUTIONS.—Out
21 of funds authorized to be appropriated
22 under section 11 of the Department of En-
23 ergy Science and Innovation Act of 2018,
24 for Fusion Energy Sciences, the Secretary
25 of Energy shall devote \$285,000,000 for

1 in-kind contributions, which shall include
2 \$122,000,000 for fiscal year 2018 and
3 \$163,000,000 for fiscal year 2019, subject
4 to the availability of appropriations, to
5 come from amounts made available for the
6 Office of Science.

7 “(ii) CASH CONTRIBUTIONS.—Out of
8 funds authorized to be appropriated under
9 section 11 of the Department of Energy
10 Science and Innovation Act of 2018, for
11 Fusion Energy Sciences, the Secretary of
12 Energy shall devote \$100,000,000 for cash
13 contributions, which shall include
14 \$50,000,000 for fiscal year 2018 and
15 \$50,000,000 for fiscal year 2019, subject
16 to the availability of appropriations, to
17 come from amounts made available for the
18 Office of Science.

19 “(iii) LIMITATION.—This paragraph
20 shall be carried out using funds otherwise
21 appropriated by law after the date of en-
22 actment of the Department of Energy
23 Science and Innovation Act of 2018.”.

24 (d) ALTERNATIVE AND ENABLING CONCEPTS.—

1 (1) IN GENERAL.—As part of the program de-
2 scribed in subsection (a), the Director shall support
3 research and development activities and facility oper-
4 ations at United States universities, national labora-
5 tories, and private facilities for a portfolio of alter-
6 native and enabling fusion energy concepts that may
7 provide solutions to significant challenges to the es-
8 tablishment of a commercial magnetic fusion power
9 plant, prioritized based on the ability of the United
10 States to play a leadership role in the international
11 fusion research community. Fusion energy concepts
12 and activities explored under this paragraph may in-
13 clude—

14 (A) high magnetic field approaches facili-
15 tated by high temperature superconductors;

16 (B) advanced stellarator concepts;

17 (C) non-tokamak confinement configura-
18 tions operating at low magnetic fields;

19 (D) magnetized target fusion energy con-
20 cepts;

21 (E) liquid metals to address issues associ-
22 ated with fusion plasma interactions with the
23 inner wall of the encasing device;

24 (F) immersion blankets for heat manage-
25 ment and fuel breeding;

1 (G) advanced scientific computing activi-
2 ties; and

3 (H) other promising fusion energy con-
4 cepts identified by the Director.

5 (2) COORDINATION WITH ARPA-E.—The Under
6 Secretary and the Director shall coordinate with the
7 Director of the Advanced Research Projects Agency–
8 Energy (in this paragraph referred to as “ARPA–
9 E”) to—

10 (A) assess the potential for any fusion en-
11 ergy project supported by ARPA-E to rep-
12 resent a promising approach to a commercially
13 viable fusion power plant;

14 (B) determine whether the results of any
15 fusion energy project supported by ARPA-E
16 merit the support of follow-on research activi-
17 ties carried out by the Office of Science; and

18 (C) avoid unintentional duplication of ac-
19 tivities.

20 (e) FAIRNESS IN COMPETITION FOR SOLICITATIONS
21 FOR INTERNATIONAL PROJECT ACTIVITIES.—Section 33
22 of the Atomic Energy Act of 1954 (42 U.S.C. 2053) is
23 amended by inserting before the first sentence the fol-
24 lowing: “In this section, with respect to international re-
25 search projects, the term ‘private facilities or laboratories’

1 means facilities or laboratories located in the United
2 States.”.

3 (f) IDENTIFICATION OF PRIORITIES.—

4 (1) REPORT.—

5 (A) IN GENERAL.—Not later than 2 years
6 after the date of enactment of this Act, the Sec-
7 retary shall submit to Congress a report on the
8 fusion energy research and development activi-
9 ties that the Department proposes to carry out
10 over the 10-year period following the date of
11 the report under not fewer than 3 realistic
12 budget scenarios, including a scenario based on
13 3-percent annual growth in the non-ITER por-
14 tion of the budget for fusion energy research
15 and development activities.

16 (B) INCLUSIONS.—The report required
17 under subparagraph (A) shall—

18 (i) identify specific areas of fusion en-
19 ergy research and enabling technology de-
20 velopment, including activities to advance
21 inertial and alternative fusion energy con-
22 cepts, in which the United States can and
23 should establish or solidify a lead in the
24 global fusion energy development effort;

1 (ii) identify priorities for initiation of
2 facility construction and facility decommis-
3 sioning under each of the three budget sce-
4 narios described in subparagraph (A); and
5 (iii) assess the ability of the fusion
6 workforce of the United States to carry out
7 the activities identified under clauses (i)
8 and (ii), including the adequacy of pro-
9 grams at institutions of higher education
10 in the United States to train the leaders
11 and workers of the next generation of fu-
12 sion energy researchers.

13 (2) PROCESS.—In order to develop the report
14 required under paragraph (1)(A), the Secretary shall
15 leverage best practices and lessons learned from the
16 process used to develop the most recent report of the
17 Particle Physics Project Prioritization Panel of the
18 High Energy Physics Advisory Panel.

19 (3) REQUIREMENT.—No member of the Fusion
20 Energy Sciences Advisory Committee shall be ex-
21 cluded from participating in developing or voting on
22 final approval of the report required under para-
23 graph (1)(A).

1 **SEC. 9. NUCLEAR PHYSICS.**

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

6 (b) ISOTOPE DEVELOPMENT AND PRODUCTION FOR
7 RESEARCH APPLICATIONS.—The Director—

8 (1) may carry out a program for the production
9 of isotopes, including the development of techniques
10 to produce isotopes, that the Secretary determines
11 are needed for research, medical, industrial, or re-
12 lated purposes; and

13 (2) shall ensure that isotope production activi-
14 ties carried out under the program under this para-
15 graph do not compete with private industry unless
16 the Director determines that critical national inter-
17 ests require the involvement of the Federal Govern-
18 ment.

19 (c) RENAMING OF THE RARE ISOTOPE ACCEL-
20 ERATOR.—Section 981 of the Energy Policy Act of 2005
21 (42 U.S.C. 16321) is amended—

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

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

4 (d) FACILITY FOR RARE ISOTOPE BEAMS.—

5 (1) IN GENERAL.—The Secretary shall provide
6 for a Facility for Rare Isotope Beams to advance the
7 understanding of rare nuclear isotopes and the evo-
8 lution of the cosmos.

9 (2) FACILITY CAPABILITY.—In carrying out
10 paragraph (1), the Secretary shall provide for, at a
11 minimum, a rare isotope beam facility capable of
12 400 kW of beam power.

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

18 (4) FUNDING.—Out of funds authorized to be
19 appropriated under section 11 of the Department of
20 Energy Science and Innovation Act of 2018, for Nu-
21 clear Physics, the Secretary of Energy shall devote
22 \$187,200,000 to carry out this subsection, which
23 shall include \$101,200,000 for fiscal year 2018 and
24 \$86,000,000 for fiscal year 2019, subject to the
25 availability of appropriations, to come from amounts

1 made available for the Office of Science. This sub-
2 section shall be carried out using funds otherwise
3 appropriated by law after the date of enactment of
4 this Act.

5 **SEC. 10. SCIENCE LABORATORIES INFRASTRUCTURE PRO-**
6 **GRAM.**

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

11 (1) renovate or replace space that does not
12 meet research needs;

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

15 (3) modernize utility systems to prevent failures
16 and ensure efficiency;

17 (4) remove excess facilities to allow safe and ef-
18 ficient operations; and

19 (5) construct modern facilities to conduct ad-
20 vanced research in controlled environmental condi-
21 tions.

22 (b) APPROACH.—In carrying out this section, the Di-
23 rector shall utilize all available approaches and mecha-
24 nisms, including capital line items, minor construction
25 projects, energy savings performance contracts, utility en-

1 ergy service contracts, alternative financing, and expense
2 funding, as appropriate.

3 **SEC. 11. AUTHORIZATION OF APPROPRIATIONS.**

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

7 (1) \$2,090,000,000 shall be for Basic Energy
8 Science;

9 (2) \$908,000,000 shall be for High Energy
10 Physics;

11 (3) \$673,000,000 shall be for Biological and
12 Environmental Research;

13 (4) \$684,000,000 shall be for Nuclear Physics;

14 (5) \$810,000,000 shall be for Advanced Sci-
15 entific Computing Research;

16 (6) \$532,111,000 shall be for Fusion Energy
17 Sciences;

18 (7) \$257,292,000 shall be for Science Labora-
19 tories Infrastructure;

20 (8) \$183,000,000 shall be for Science Program
21 Direction;

22 (9) \$103,000,000 shall be for Safeguards and
23 Security; and

24 (10) \$19,500,000 shall be for Workforce Devel-
25 opment for Teachers and Scientists.

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

4 (1) \$2,129,233,000 shall be for Basic Energy
5 Science;

6 (2) \$1,004,510,000 shall be for High Energy
7 Physics;

8 (3) \$673,000,000 shall be for Biological and
9 Environmental Research;

10 (4) \$690,000,000 shall be for Nuclear Physics;

11 (5) \$899,010,000 shall be for Advanced Sci-
12 entific Computing Research;

13 (6) \$640,000,000 shall be for Fusion Energy
14 Sciences;

15 (7) \$257,292,000 shall be for Science Labora-
16 tories Infrastructure;

17 (8) \$181,345,000 shall be for Science Program
18 Direction;

19 (9) \$106,110,000 shall be for Safeguards and
20 Security; and

21 (10) \$19,500,000 shall be for Workforce Devel-
22 opment for Teachers and Scientists.