

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
2^D 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 \$93,000,000 for fiscal year 2018 and
18 \$130,000,000 for fiscal year 2019 to carry out
19 this paragraph, subject to the availability of ap-
20 propriations. This paragraph shall be carried
21 out using funds otherwise appropriated by law
22 after the date of enactment of this Act.

23 (2) SPALLATION NEUTRON SOURCE PROTON
24 POWER UPGRADE.—

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

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

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

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

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

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

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

4 (D) FUNDING.—Out of funds authorized
5 to be appropriated under section 11 for Basic
6 Energy Sciences, the Secretary of Energy shall
7 devote \$36,000,000 for fiscal year 2018 and
8 \$60,800,000 for fiscal year 2019 to carry out
9 this paragraph, subject to the availability of ap-
10 propriations. This paragraph shall be carried
11 out using funds otherwise appropriated by law
12 after the date of enactment of this Act.

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

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

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

23 (i) the publication of the Office of
24 Science of the Department of Energy titled
25 “Facilities for the Future of Science: A

1 Twenty-Year Outlook”, published Decem-
2 ber 2003;

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

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

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

19 (D) FUNDING.—Out of funds authorized
20 to be appropriated under section 11 for Basic
21 Energy Sciences, the Secretary of Energy shall
22 devote \$5,000,000 for fiscal year 2018 and
23 \$10,000,000 for fiscal year 2019 to carry out
24 this paragraph, subject to the availability of ap-
25 propriations. This paragraph shall be carried

1 out using funds otherwise appropriated by law
2 after the date of enactment of this Act.

3 (4) ADVANCED LIGHT SOURCE UPGRADE.—

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

13 (B) DEFINITIONS.—In this paragraph:

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

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

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, 2026.

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 \$20,000,000 for fiscal year 2018 and
3 \$50,000,000 for fiscal year 2019 to carry out
4 this paragraph, subject to the availability of ap-
5 propriations. This paragraph shall be carried
6 out using funds otherwise appropriated by law
7 after the date of enactment of this Act.

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

10 (A) IN GENERAL.—The Secretary shall
11 provide for the upgrade to the Linac Coherent
12 Light Source II facility described in the publi-
13 cation approved by the Basic Energy Sciences
14 Advisory Committee on June 9, 2016, titled
15 “Report on Facility Upgrades”, including the
16 development of experimental capabilities for
17 high energy x-rays to reveal fundamental sci-
18 entific discoveries. The Secretary shall ensure
19 the upgrade under this paragraph enables the
20 production and use of high energy, ultra-short
21 pulse x-rays delivered at a high repetition rate.

22 (B) DEFINITIONS.—In this paragraph:

23 (i) HIGH ENERGY X-RAY.—The term a
24 “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 one million
6 pulses 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 one hundred 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, the Secretary of Energy shall
19 devote \$20,000,000 for fiscal year 2018 and
20 \$55,000,000 for fiscal year 2019 to carry out
21 this paragraph, subject to the availability of ap-
22 propriations. This paragraph shall be carried
23 out using funds otherwise appropriated by law
24 after the date of enactment of this Act.

1 (e) ACCELERATOR RESEARCH AND DEVELOP-
2 MENT.—The Director shall carry out research and devel-
3 opment on advanced accelerator and storage ring tech-
4 nologies relevant to the development of Basic Energy
5 Sciences user facilities, in consultation with the Office of
6 Science’s High Energy Physics and Nuclear Physics pro-
7 grams.

8 (f) SOLAR FUELS RESEARCH INITIATIVE.—

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

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

13 “(a) INITIATIVE.—

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

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

1 “(A) the Basic Energy Sciences Program
2 and the Biological and Environmental Research
3 Program of the Office of Science; and

4 “(B) the Office of Energy Efficiency and
5 Renewable Energy.

6 “(3) TEAMS.—

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

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

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

22 “(4) ADDITIONAL ACTIVITIES.—The Secretary
23 may organize additional activities under this sub-
24 section through Energy Frontier Research Centers,

1 Energy Innovation Hubs, or other organizational
2 structures.

3 “(b) ARTIFICIAL PHOTOSYNTHESIS.—

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

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

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

15 “(i) photoinduced production of hy-
16 drogen and oxygen from water; and

17 “(ii) the sustainable photoinduced re-
18 duction of carbon dioxide to fuel products
19 including hydrocarbons, alcohols, carbon
20 monoxide, and natural gas; 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.—Out of funds authorized to be
6 appropriated under section 11 of the Department of
7 Energy Science and Innovation Act of 2018, for
8 Basic Energy Sciences, the Secretary of Energy
9 shall devote \$50,000,000 for fiscal year 2018 and
10 \$50,000,000 for fiscal year 2019 to carry out this
11 subsection, subject to the availability of appropria-
12 tions. This subsection shall be carried out using
13 funds otherwise appropriated by law after the date
14 of enactment of the Department of Energy Science
15 and Innovation Act of 2018.

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

18 “(1) IN GENERAL.—The Secretary shall carry
19 out under the Initiative a program to support re-
20 search needed to replicate natural photosynthetic
21 processes by use of artificial photosynthetic compo-
22 nents and materials.

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

1 “(A) the Director of the Office of Basic
2 Energy Sciences shall support basic research to
3 expand fundamental knowledge to replicate nat-
4 ural synthesis processes, including—

5 “(i) the photoinduced reduction of
6 dinitrogen to ammonia;

7 “(ii) the absorption of carbon dioxide
8 from ambient air;

9 “(iii) molecular-based charge separa-
10 tion and storage;

11 “(iv) photoinitiated electron transfer;
12 and

13 “(v) catalysis in biological or bio-
14 mimetic systems;

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

20 “(C) the Assistant Secretary for Energy
21 Efficiency and Renewable Energy shall support
22 translational research, development, and valida-
23 tion of physical concepts developed under the
24 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.—Out of funds authorized to be
6 appropriated under section 11 of the Department of
7 Energy Science and Innovation Act of 2018, for
8 Basic Energy Sciences and Biological and Environ-
9 mental Research, the Secretary of Energy shall de-
10 voted \$50,000,000 for fiscal year 2018 and
11 \$50,000,000 for fiscal year 2019 to carry out this
12 subsection, subject to the availability of appropria-
13 tions. This subsection shall be carried out using
14 funds otherwise appropriated by law after the date
15 of enactment of the Department of Energy Science
16 and Innovation Act of 2018.”.

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

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

21 (g) ELECTRICITY STORAGE RESEARCH INITIA-
22 TIVE.—

23 (1) IN GENERAL.—Section 975 of the Energy
24 Policy Act of 2005 (42 U.S.C. 16315) is amended
25 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.—Out of funds authorized to be
23 appropriated under section 11 of the Department of
24 Energy Science and Innovation Act of 2018, for
25 Basic Energy Sciences and Biological and Environ-

1 mental Research, the Secretary of Energy shall de-
2 vote \$50,000,000 for fiscal year 2018 and
3 \$50,000,000 for fiscal year 2019 to carry out this
4 subsection, subject to the availability of appropria-
5 tions. This subsection shall be carried out using
6 funds otherwise appropriated by law after the date
7 of enactment of the Department of Energy Science
8 and Innovation Act of 2018.

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

11 “(1) IN GENERAL.—The Secretary shall carry
12 out under the Initiative a program to support re-
13 search to model and simulate organic electrolytes,
14 including the static and dynamic electrochemical be-
15 havior and phenomena of organic electrolytes at the
16 molecular and atomic level in monovalent and multi-
17 valent 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, in coordination with the Asso-
22 ciate Director of Advanced Scientific Com-
23 puting Research, shall support the development
24 of high performance computational tools
25 through a joint development process to maxi-

1 mize the effectiveness of current and projected
2 high performance computing systems; 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 and Advanced Scientific
16 Computing Research, the Secretary of Energy shall
17 devote \$30,000,000 for fiscal year 2018 and
18 \$30,000,000 for fiscal year 2019 to carry out this
19 subsection, subject to the availability of appropria-
20 tions. This subsection shall be carried out using
21 funds otherwise appropriated by law after the date
22 of enactment of the Department of Energy Science
23 and Innovation Act of 2018.

24 “(d) MESOSCALE ELECTROCHEMISTRY.—

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

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

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

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

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

20 “(B) the Assistant Secretary for Energy
21 Efficiency and Renewable Energy shall support
22 translational research, development, and valida-
23 tion of physical concepts developed under the
24 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.—Out of funds authorized to be
6 appropriated under section 11 of the Department of
7 Energy Science and Innovation Act of 2018, for
8 Basic Energy Sciences and Biological and Environ-
9 mental Research, the Secretary of Energy shall de-
10 vote 20,000,000 for fiscal year 2018 and
11 \$20,000,000 for fiscal year 2019 to carry out this
12 subsection, subject to the availability of appropria-
13 tions. This subsection shall be carried out using
14 funds otherwise appropriated by law after the date
15 of enactment of the Department of Energy Science
16 and Innovation Act of 2018.”.

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

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

21 (h) ENERGY FRONTIER RESEARCH CENTERS.—

22 (1) IN GENERAL.—The Director shall carry out
23 a program to provide awards, on a competitive,
24 merit-reviewed basis, to multi-institutional collabora-
25 tions or other appropriate entities to conduct funda-

1 mental and use-inspired energy research to accel-
2 erate scientific breakthroughs.

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

6 (3) SELECTION AND DURATION.—

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

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

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

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

25 (i) MATERIALS RESEARCH DATABASE.—

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

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

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

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

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

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

22 (E) drive the development of advanced ma-
23 terials for applications that span the Depart-
24 ment's missions in energy, environment, and
25 national security.

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

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

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

11 (b) AMERICAN SUPER COMPUTING LEADERSHIP.—

12 (1) RENAMING OF ACT.—

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

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

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

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

7 (B) by striking paragraph (1) and insert-
8 ing the following:

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

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

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

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

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

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

7 (C) by striking subsection (d) and insert-
8 ing the following:

9 “(d) EXASCALE COMPUTING PROGRAM.—

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

16 “(2) EXECUTION.—

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

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

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

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

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

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

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

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

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

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

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

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

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

16 “(4) PROJECT REVIEW.—

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

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

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

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

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

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

22 (d) APPLIED MATHEMATICS AND SOFTWARE DEVEL-
23 OPMENT FOR HIGH-END COMPUTING SYSTEMS, COM-
24 PUTATIONAL, AND COMPUTER SCIENCES RESEARCH.—

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

3 (A) mathematics, models, statistics, and al-
4 gorithms for complex systems and programming
5 environments; and

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

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

20 (e) WORKFORCE DEVELOPMENT.—The Director of
21 the Office of Advanced Scientific Computing Research
22 shall support the development of a computational science
23 workforce through a program that—

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

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

7 **SEC. 6. HIGH ENERGY PHYSICS.**

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

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

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

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

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

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

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

18 (e) LONG-BASELINE NEUTRINO FACILITY FOR DEEP
19 UNDERGROUND NEUTRINO EXPERIMENT.—

20 (1) IN GENERAL.—The Secretary shall provide
21 for a Long-Baseline Neutrino Facility to facilitate
22 the international Deep Underground Neutrino Ex-
23 periment to enable a program in neutrino physics to
24 measure the fundamental properties of neutrinos, ex-

1 plore physics beyond the Standard Model, and better
2 clarify the nature of matter and antimatter.

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

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

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

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

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

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

23 (4) FUNDING.—Out of funds authorized to be
24 appropriated under section 11 for High Energy
25 Physics, the Secretary of Energy shall devote

1 \$95,000,000 for fiscal year 2018 and \$175,000,000
2 for fiscal year 2019 to carry out this subsection,
3 subject to the availability of appropriations. This
4 subsection shall be carried out using funds otherwise
5 appropriated by law after the date of enactment of
6 this Act.

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

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

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

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

1 ment of new energy technologies and to support Depart-
2 ment missions in energy, environment, and national secu-
3 rity.

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

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

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

14 (B) bioenergy; and

15 (C) biobased materials;

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

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

24 (c) BIOENERGY RESEARCH CENTERS.—

1 (1) IN GENERAL.—In carrying out activities
2 under subsection (a), the Director shall select and
3 establish up to 4 bioenergy research centers to con-
4 duct basic and fundamental research in plant and
5 microbial systems biology, bio imaging and analysis,
6 and genomics to inform the production of fuels,
7 chemicals from sustainable biomass resources, and
8 to facilitate the translation of basic research results
9 to industry.

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

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

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

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

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

10 (d) LOW DOSE RADIATION RESEARCH PROGRAM.—

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

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

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

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

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

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

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

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

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

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

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

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

21 “(1) support the directives under section 106 of
22 the American Innovation and Competitiveness Act
23 (42 U.S.C. 6601 note);

24 “(2) ensure that the Office of Science of the
25 Department of Energy consults with the National

1 Aeronautics and Space Administration, the National
2 Institutes of Health, the Environmental Protection
3 Agency, the Department of Defense, the Nuclear
4 Regulatory Commission, and the Department of
5 Homeland Security;

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

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

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

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

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

9 “(g) FUNDING.—Out of funds authorized to be ap-
10 propriated under section 11 of the Department of Energy
11 Science and Innovation Act of 2018, for Biological and
12 Environmental Research, the Secretary of Energy shall
13 devote \$20,000,000 for fiscal year 2018 and \$20,000,000
14 for fiscal year 2019 to carry out this section, subject to
15 the availability of appropriations. This section shall be car-
16 ried out using funds otherwise appropriated by law after
17 the date of enactment of the Department of Energy
18 Science and Innovation Act of 2018.”.

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

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

23 (e) MODELING RESEARCH.—As part of the activities
24 described in subsection (a), the Director is authorized to
25 carry out research to develop multiscale computational

1 models that incorporate and examine interactions among
2 human and earth systems.

3 (f) **LIMITATION FOR RESEARCH FUNDS.**—The Direc-
4 tor shall not approve new climate science-related initia-
5 tives without making a determination that such work is
6 well-coordinated with any relevant work carried out by
7 other Federal agencies.

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

9 (a) **PROGRAM.**—The Director shall carry out a fusion
10 energy sciences research program to expand the under-
11 standing of plasmas and matter at very high temperatures
12 and densities and build the science and engineering foun-
13 dation needed to develop a fusion energy source.

14 (b) **INERTIAL FUSION ENERGY RESEARCH AND DE-**
15 **VELOPMENT PROGRAM.**—The Secretary shall carry out a
16 program of research and technology development in iner-
17 tial fusion for energy applications, including ion beam,
18 laser, and pulsed power fusion systems.

19 (c) **TOKAMAK RESEARCH AND DEVELOPMENT.**—

20 (1) **IN GENERAL.**—The Director shall support
21 research and development activities and facility oper-
22 ations to optimize the tokamak approach to fusion
23 energy.

24 (2) **INTERNATIONAL THERMONUCLEAR EXPERI-**
25 **MENTAL REACTOR CONSTRUCTION.**—Section 972 of

1 the Energy Policy Act of 2005 (42 U.S.C. 16312)
2 is amended by adding at the end the following new
3 paragraph:

4 “(7) ITER CONSTRUCTION.—

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

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

17 “(i) A tokamak device with a plasma
18 radius of 6.2 meters and a magnetic field
19 of 5.3 T.

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

23 “(C) FUNDING.—

24 “(i) IN-KIND CONTRIBUTIONS.—Out
25 of funds authorized to be appropriated

1 under section 11 of the Department of En-
2 ergy Science and Innovation Act of 2018,
3 for Fusion Energy Sciences, the Secretary
4 of Energy shall devote \$122,000,000 for
5 fiscal year 2018 and \$163,000,000 for fis-
6 cal year 2019 for in-kind contributions,
7 subject to the availability of appropria-
8 tions.

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

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

23 (d) ALTERNATIVE AND ENABLING CONCEPTS.—

24 (1) IN GENERAL.—As part of the program de-
25 scribed in subsection (a), the Director shall support

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

12 (A) high magnetic field approaches facili-
13 tated by high temperature superconductors;

14 (B) advanced stellarator concepts;

15 (C) non-tokamak confinement configura-
16 tions operating at low magnetic fields;

17 (D) magnetized target fusion energy con-
18 cepts;

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

22 (F) immersion blankets for heat manage-
23 ment and fuel breeding;

24 (G) advanced scientific computing activi-
25 ties; and

1 (H) other promising fusion energy con-
2 cepts identified by the Director.

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

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

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

16 (C) avoid unintentional duplication of ac-
17 tivities.

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

1 (f) IDENTIFICATION OF PRIORITIES.—

2 (1) REPORT.—

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

14 (B) INCLUSIONS.—The report required
15 under subparagraph (A) shall—

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

23 (ii) identify priorities for initiation of
24 facility construction and facility decommis-

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

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

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

22 **SEC. 9. NUCLEAR PHYSICS.**

23 (a) PROGRAM.—The Director shall carry out a pro-
24 gram of experimental and theoretical research, and sup-

1 port associated facilities, to discover, explore, and under-
2 stand all forms of nuclear matter.

3 (b) ISOTOPE DEVELOPMENT AND PRODUCTION FOR
4 RESEARCH APPLICATIONS.—The Director—

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

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

16 (c) RENAMING OF THE RARE ISOTOPE ACCEL-
17 ERATOR.—Section 981 of the Energy Policy Act of 2005
18 (42 U.S.C. 16321) is amended—

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

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

25 (d) FACILITY FOR RARE ISOTOPE BEAMS.—

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

5 (2) FACILITY CAPABILITY.—In carrying out
6 paragraph (1), the Secretary shall provide for, at a
7 minimum, a rare isotope beam facility capable of
8 400 kW of beam power.

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

14 (4) FUNDING.—Out of funds authorized to be
15 appropriated under section 11 of the Department of
16 Energy Science and Innovation Act of 2018, for Nu-
17 clear Physics, the Secretary of Energy shall devote
18 \$101,200,000 for fiscal year 2018 and \$86,000,000
19 for fiscal year 2019 to carry out this subsection,
20 subject to the availability of appropriations. This
21 subsection shall be carried out using funds otherwise
22 appropriated by law after the date of enactment of
23 this Act.

1 **SEC. 10. SCIENCE LABORATORIES INFRASTRUCTURE PRO-**
2 **GRAM.**

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

7 (1) renovate or replace space that does not
8 meet research needs;

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

11 (3) modernize utility systems to prevent failures
12 and ensure efficiency;

13 (4) remove excess facilities to allow safe and ef-
14 ficient operations; and

15 (5) construct modern facilities to conduct ad-
16 vanced research in controlled environmental condi-
17 tions.

18 (b) APPROACH.—In carrying out this section, the Di-
19 rector shall utilize all available approaches and mecha-
20 nisms, including capital line items, minor construction
21 projects, energy savings performance contracts, utility en-
22 ergy service contracts, alternative financing, and expense
23 funding, as appropriate.

1 **SEC. 11. AUTHORIZATION OF APPROPRIATIONS.**

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

5 (1) \$2,090,000,000 shall be for Basic Energy
6 Science;

7 (2) \$908,000,000 shall be for High Energy
8 Physics;

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

11 (4) \$684,000,000 shall be for Nuclear Physics;

12 (5) \$810,000,000 shall be for Advanced Sci-
13 entific Computing Research;

14 (6) \$532,111,000 shall be for Fusion Energy
15 Sciences;

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

18 (8) \$183,000,000 shall be for Science Program
19 Direction;

20 (9) \$103,000,000 shall be for Safeguards and
21 Security; and

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

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

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

3 (2) \$1,004,510,000 shall be for High Energy
4 Physics;

5 (3) \$673,000,000 shall be for Biological and
6 Environmental Research;

7 (4) \$690,000,000 shall be for Nuclear Physics;

8 (5) \$899,010,000 shall be for Advanced Sci-
9 entific Computing Research;

10 (6) \$640,000,000 shall be for Fusion Energy
11 Sciences;

12 (7) \$257,292,000 shall be for Science Labora-
13 tories Infrastructure;

14 (8) \$181,345,000 shall be for Science Program
15 Direction;

16 (9) \$106,110,000 shall be for Safeguards and
17 Security; and

18 (10) \$19,500,000 shall be for Workforce Devel-
19 opment for Teachers and Scientists.