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(Original Signature of Member)

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.

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## IN THE HOUSE OF REPRESENTATIVES

Mr. WEBER of Texas introduced the following bill; which was referred to the Committee on \_\_\_\_\_

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# 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”.

7 (b) TABLE OF CONTENTS.—The table of contents for  
8 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.

1 **SEC. 2. DEFINITIONS.**

2 In this Act:

3 (1) DEPARTMENT.—The term “Department”  
4 means the Department of Energy.

5 (2) DIRECTOR.—The term “Director” means  
6 the Director of the Office of Science of the Depart-  
7 ment.

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

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

14 **SEC. 3. MISSION.**

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

18 “(c) MISSION.—The mission of the Office of Science  
19 shall be the delivery of scientific discoveries, capabilities,  
20 and major scientific tools to transform the understanding

1 of nature and to advance the energy, economic, and na-  
2 tional security of the United States.”.

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

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

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

16 (c) BASIC ENERGY SCIENCES USER FACILITIES.—

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

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

1 chemical processes for the purpose of improving the  
2 competitiveness of the United States.

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

6 (A) x-ray light sources;

7 (B) neutron sources;

8 (C) nanoscale science research centers; and

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

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

15 (1) ADVANCED PHOTON SOURCE UPGRADE.—

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

1 (B) DEFINITIONS.—In this paragraph:

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

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

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

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

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

18 and

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

20 (2) SPALLATION NEUTRON SOURCE PROTON  
21 POWER UPGRADE.—

22 (A) IN GENERAL.—The Secretary shall  
23 provide for a proton power upgrade to the  
24 Spallation Neutron Source.

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

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

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

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

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

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

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

7 and

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

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

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

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

19 (i) the publication of the Office of  
20 Science of the Department of Energy titled  
21 “Facilities for the Future of Science: A  
22 Twenty-Year Outlook”, published Decem-  
23 ber 2003;

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

1           “Four Years Later: An Interim Report on  
2           Facilities for the Future of Science: A  
3           Twenty-Year Outlook”, published August  
4           2007; and

5                   (iii) the publication approved by the  
6           Basic Energy Sciences Advisory Committee  
7           on June 9, 2016, titled “Report on Facil-  
8           ity Upgrades”.

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

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

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

21                   and

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

23          (4) ADVANCED LIGHT SOURCE UPGRADE.—

24                  (A) IN GENERAL.—The Secretary shall  
25          provide for the upgrade to the Advanced Light



1 Source described in the publication approved by  
2 the Basic Energy Sciences Advisory Committee  
3 on June 9, 2016, titled “Report on Facility Up-  
4 grades”, including the development of a multi-  
5 bend achromat lattice to produce a high flux of  
6 coherent x-rays within the soft x-ray energy re-  
7 gion.

8 (B) DEFINITIONS.—In this paragraph:

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

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

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

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

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

25 and

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

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

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

16 (B) DEFINITIONS.—In this paragraph:

17 (i) HIGH ENERGY X-RAY.—The term a  
18 “high energy x-ray” means a photon with  
19 an energy at or exceeding 12 kiloelectron  
20 volts.

21 (ii) HIGH REPETITION RATE.—The  
22 term “high repetition rate” means the de-  
23 livery of x-ray pulses up to one million  
24 pulses per second.

1 (iii) ULTRA-SHORT PULSE X-RAYS.—

2 The term “ultra-short pulse x-rays” means  
3 x-ray bursts capable of durations of less  
4 than one hundred femtoseconds.

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

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

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

16 and

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

18 (e) ACCELERATOR RESEARCH AND DEVELOP-  
19 MENT.—The Director shall carry out research and devel-  
20 opment on advanced accelerator and storage ring tech-  
21 nologies relevant to the development of Basic Energy  
22 Sciences user facilities, in consultation with the Office of  
23 Science’s High Energy Physics and Nuclear Physics pro-  
24 grams.

25 (f) SOLAR FUELS RESEARCH INITIATIVE.—

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

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

5           “(a) INITIATIVE.—

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

14          “(2) LEVERAGING.—In carrying out programs  
15          and activities under the Initiative, the Secretary  
16          shall leverage expertise and resources from—

17                  “(A) the Basic Energy Sciences Program  
18                  and the Biological and Environmental Research  
19                  Program of the Office of Science; and

20                  “(B) the Office of Energy Efficiency and  
21                  Renewable Energy.

22          “(3) TEAMS.—

23                  “(A) IN GENERAL.—In carrying out the  
24                  Initiative, the Secretary shall organize activities  
25                  among multidisciplinary teams to leverage, to

1 the maximum extent practicable, expertise from  
2 the National Laboratories, institutions of higher  
3 education, and the private sector.

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

7 “(C) RESOURCES.—The Secretary shall  
8 provide sufficient resources to the multidisci-  
9 plinary teams described in subparagraph (A) to  
10 achieve the goals described in subparagraph (B)  
11 over a period of time to be determined by the  
12 Secretary.

13 “(4) ADDITIONAL ACTIVITIES.—The Secretary  
14 may organize additional activities under this sub-  
15 section through Energy Frontier Research Centers,  
16 Energy Innovation Hubs, or other organizational  
17 structures.

18 “(b) ARTIFICIAL PHOTOSYNTHESIS.—

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

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

1           “(A) the Director of the Office of Basic  
2           Energy Sciences shall support basic research to  
3           pursue distinct lines of scientific inquiry, in-  
4           cluding—

5                   “(i) photoinduced production of hy-  
6                   drogen and oxygen from water; and

7                   “(ii) the sustainable photoinduced re-  
8                   duction of carbon dioxide to fuel products  
9                   including hydrocarbons, alcohols, carbon  
10                  monoxide, and natural gas; and

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

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

20           “(4) FUNDING.—

21                   “(A) IN GENERAL.—From within funds  
22                   authorized to be appropriated under section 11  
23                   of the Department of Energy Science and Inno-  
24                   vation Act of 2018, for Basic Energy Sciences,  
25                   the Secretary shall make available for carrying

1 out activities under this subsection \$50,000,000  
2 for each of fiscal years 2018 through 2019.

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

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

9 “(1) IN GENERAL.—The Secretary shall carry  
10 out under the Initiative a program to support re-  
11 search needed to replicate natural photosynthetic  
12 processes by use of artificial photosynthetic compo-  
13 nents and materials.

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

16 “(A) the Director of the Office of Basic  
17 Energy Sciences shall support basic research to  
18 expand fundamental knowledge to replicate nat-  
19 ural synthesis processes, including—

20 “(i) the photoinduced reduction of  
21 dinitrogen to ammonia;

22 “(ii) the absorption of carbon dioxide  
23 from ambient air;

24 “(iii) molecular-based charge separa-  
25 tion and storage;

1 “(iv) photoinitiated electron transfer;

2 and

3 “(v) catalysis in biological or bio-  
4 mimetic systems;

5 “(B) the Associate Director of Biological  
6 and Environmental Research shall support sys-  
7 tems biology and genomics approaches to un-  
8 derstand genetic and physiological pathways  
9 connected to photosynthetic mechanisms; and

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

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

19 “(4) FUNDING.—

20 “(A) IN GENERAL.—From within funds  
21 authorized to be appropriated under section 11  
22 of the Department of Energy Science and Inno-  
23 vation Act of 2018, for Basic Energy Sciences  
24 and Biological and Environmental Research,  
25 the Secretary shall make available for carrying



1 out activities under this subsection \$50,000,000  
2 for each of fiscal years 2018 through 2019.

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

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

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

11 (g) ELECTRICITY STORAGE RESEARCH INITIA-  
12 TIVE.—

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

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

17 “(a) INITIATIVE.—

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

22 “(A) to expand theoretical and funda-  
23 mental knowledge to control, store, and con-  
24 vert—

1                   “(i) electrical energy to chemical en-  
2                   ergy; and

3                   “(ii) chemical energy to electrical en-  
4                   ergy; and

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

10                  “(2) LEVERAGING.—In carrying out programs  
11                  and activities under the Initiative, the Secretary  
12                  shall leverage expertise and resources from—

13                         “(A) the Basic Energy Sciences Program,  
14                         the Advanced Scientific Computing Research  
15                         Program, and the Biological and Environmental  
16                         Research Program of the Office of Science; and

17                         “(B) the Office of Energy Efficiency and  
18                         Renewable Energy.

19                  “(3) TEAMS.—

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

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

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

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

15          “(b) MULTIVALENT SYSTEMS.—

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

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

23                       “(A) the Director of the Office of Basic  
24                       Energy Sciences shall investigate electro-  
25                       chemical properties and the dynamics of mate-

1           rials, including charge transfer phenomena and  
2           mass transport in materials; 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.—

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

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

1           “(c) ELECTROCHEMISTRY MODELING AND SIMULA-  
2 TION.—

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

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

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

6           “(A) IN GENERAL.—From within funds  
7 authorized to be appropriated under section 11  
8 of the Department of Energy Science and Inno-  
9 vation Act of 2018, for Basic Energy Sciences  
10 and Advanced Scientific Computing Research,  
11 the Secretary shall make available for carrying  
12 out activities under this subsection \$30,000,000  
13 for each of the fiscal years 2018 through 2019.

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

18           “(d) MESOSCALE ELECTROCHEMISTRY.—

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

1           “(A) bio-electrochemistry and electro-  
2           chemical energy conversion and storage in con-  
3           fined spaces; and

4           “(B) the dynamics of the phenomena de-  
5           scribed in subparagraph (A).

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 and the Associate Director of  
10          Biological and Environmental Research shall in-  
11          vestigate phenomena of mesoscale electro-  
12          chemical confinement for the purpose of repli-  
13          cating and controlling new electrochemical be-  
14          havior; and

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

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

24          “(4) FUNDING.—

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

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

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

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

17          (h) ENERGY FRONTIER RESEARCH CENTERS.—

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



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

4           (3) SELECTION AND DURATION.—

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

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

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

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

23          (i) MATERIALS RESEARCH DATABASE.—

24                (1) IN GENERAL.—As part of the program in  
25                materials sciences and engineering, the Director

1 shall support the development of a web-based plat-  
2 form to provide access to a database of computed in-  
3 formation on known and predicted materials prop-  
4 erties and computational tools to accelerate break-  
5 throughs in materials discovery and design.

6 (2) In carrying out this section, the Director  
7 shall—

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

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

16 (C) advance understanding, prediction, and  
17 manipulation of materials;

18 (D) strengthen the foundation for new  
19 technologies and advanced manufacturing; and

20 (E) drive the development of advanced ma-  
21 terials for applications that span the Depart-  
22 ment's missions in energy, environment, and  
23 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, there shall be made available to the Sec-

1       retary to carry out activities, including construction  
2       of the facility, under this subsection—

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

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

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

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

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

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

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

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

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

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

13 (B) bioenergy; and

14 (C) biobased materials;

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

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

23 (c) BIOENERGY RESEARCH CENTERS.—

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

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

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

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

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

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



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

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

8 (d) LOW DOSE RADIATION RESEARCH PROGRAM.—

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

17       (e) **LIMITATION FOR RESEARCH FUNDS.**—The Direc-  
18 tor shall not approve new climate science-related initia-  
19 tives without making a determination that such work is  
20 well-coordinated with any relevant work carried out by  
21 other Federal agencies.

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

23       (a) **PROGRAM.**—The Director shall carry out a fusion  
24 energy sciences research program to expand the under-  
25 standing of plasmas and matter at very high temperatures

1 and densities and build the science and engineering foun-  
2 dation needed to develop a fusion energy source.

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

8 (c) TOKAMAK RESEARCH AND DEVELOPMENT.—

9 (1) IN GENERAL.—The Director shall support  
10 research and development activities and facility oper-  
11 ations to optimize the tokamak approach to fusion  
12 energy.

13 (2) INTERNATIONAL THERMONUCLEAR EXPERI-  
14 MENTAL REACTOR CONSTRUCTION.—Section 972 of  
15 the Energy Policy Act of 2005 (42 U.S.C. 16312)  
16 is amended by adding section the following new  
17 paragraph:

18 “(6) ITER CONSTRUCTION.—

19 “(A) IN GENERAL.—There is authorized  
20 United States participation in the construction  
21 and operations of the ITER project, as agreed  
22 to under the April 25, 2007 ‘Agreement on the  
23 Establishment of the ITER International Fu-  
24 sion Energy Organization for the Joint Imple-  
25 mentation of the ITER Project.’.

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

6                   “(i) A tokamak device with a plasma  
7                   radius of 6.2 meters and a magnetic field  
8                   of 5.3 T.

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

12          “(c) AUTHORIZATION OF APPROPRIATIONS.—From  
13          within funds authorized to be appropriated under section  
14          11 of the Department of Energy Science and Innovation  
15          Act of 2018, for Fusion Energy Sciences, there is author-  
16          ized for in-kind contributions under this section—

17                  “(1) \$122,000,000 for fiscal year 2018; and

18                  “(2) \$163,000,000 for fiscal year 2019.

19          “(d) AUTHORIZATION OF APPROPRIATIONS.—From  
20          within funds authorized to be appropriated under section  
21          11 of the Department of Energy Science and Innovation  
22          Act of 2018, for Fusion Energy Sciences, there is author-  
23          ized for cash contributions under this section—

24                  “(1) \$50,000,000 for fiscal year 2018; and

25                  “(2) \$50,000,000 for fiscal year 2019.”.

1 (d) INERTIAL FUSION ENERGY RESEARCH AND DE-  
2 VELOPMENT.—The Director shall support research and  
3 development activities for inertial fusion for energy appli-  
4 cations.

5 (e) ALTERNATIVE AND ENABLING CONCEPTS.—

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

19 (A) high magnetic field approaches facili-  
20 tated by high temperature superconductors;

21 (B) advanced stellarator concepts;

22 (C) non-tokamak confinement configura-  
23 tions operating at low magnetic fields;

24 (D) magnetized target fusion energy con-  
25 cepts;

1           (E) liquid metals to address issues associ-  
2           ated with fusion plasma interactions with the  
3           inner wall of the encasing device;

4           (F) immersion blankets for heat manage-  
5           ment and fuel breeding;

6           (G) advanced scientific computing activi-  
7           ties; and

8           (H) other promising fusion energy con-  
9           cepts identified by the Director.

10           (2) COORDINATION WITH ARPA-E.—The Under  
11           Secretary and the Director shall coordinate with the  
12           Director of the Advanced Research Projects Agency-  
13           Energy (in this paragraph referred to as “ARPA-  
14           E”) to—

15           (A) assess the potential for any fusion en-  
16           ergy project supported by ARPA-E to rep-  
17           resent a promising approach to a commercially  
18           viable fusion power plant;

19           (B) determine whether the results of any  
20           fusion energy project supported by ARPA-E  
21           merit the support of follow-on research activi-  
22           ties carried out by the Office of Science; and

23           (C) avoid unintentional duplication of ac-  
24           tivities.



1 (f) COORDINATION WITH ARPA-E.—The Director  
2 shall coordinate with the Director of the Advanced Re-  
3 search Projects Agency-Energy (referred to in this sub-  
4 section as “ARPA-E”) to—

5 (1) assess the potential for any fusion energy  
6 project supported by ARPA-E to represent a prom-  
7 ising approach to a commercially viable fusion power  
8 plant;

9 (2) determine whether the results of any fusion  
10 energy project supported by ARPA-E merit the sup-  
11 port of follow-on research activities carried out by  
12 the Office of Science; and

13 (3) avoid the unintentional duplication of activi-  
14 ties.

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

23 (h) IDENTIFICATION OF PRIORITIES.—

24 (1) REPORT.—

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

12          (B) INCLUSIONS.—The report required  
13          under subparagraph (A) shall—

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

21               (ii) identify priorities for initiation of  
22               facility construction and facility decommis-  
23               sioning under each of the three budget sce-  
24               narios described in subparagraph (A); and

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

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

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

20 **SEC. 9. NUCLEAR PHYSICS.**

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

1 (b) ISOTOPE DEVELOPMENT AND PRODUCTION FOR  
2 RESEARCH APPLICATIONS.—The Director—

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

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

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

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

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

23 (d) FACILITY FOR RARE ISOTOPE BEAMS.—

24 (1) IN GENERAL.—The Secretary shall provide  
25 for a Facility for Rare Isotope Beams to advance the

1 understanding of rare nuclear isotopes and the evo-  
2 lution of the cosmos.

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

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

12 (4) FUNDING.—Out of funds authorized to be  
13 appropriated under section 11 for Nuclear Physics,  
14 there shall be made available to the Secretary to  
15 carry out activities, including construction of the fa-  
16 cility, under this subsection—

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

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

19 **SEC. 10. SCIENCE LABORATORIES INFRASTRUCTURE PRO-**  
20 **GRAM.**

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

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

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

5           (3) modernize utility systems to prevent failures  
6 and ensure efficiency;

7           (4) remove excess facilities to allow safe and ef-  
8 ficient operations; and

9           (5) construct modern facilities to conduct ad-  
10 vanced research in controlled environmental condi-  
11 tions.

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

18 **SEC. 11. AUTHORIZATION OF APPROPRIATIONS.**

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

22           (1) \$2,090,000,000 shall be for Basic Energy  
23 Science;

24           (2) \$908,000,000 shall be for High Energy  
25 Physics;

1           (3) \$673,000,000 shall be for Biological and  
2     Environmental Research;

3           (4) \$684,000,000 shall be for Nuclear Physics;

4           (5) \$810,000,000 shall be for Advanced Sci-  
5     entific Computing Research;

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

8           (7) \$257,292,000 shall be for Science Labora-  
9     tories Infrastructure;

10          (8) \$183,000,000 shall be for Science Program  
11     Direction;

12          (9) \$103,000,000 shall be for Safeguards and  
13     Security; and

14          (10) \$19,500,000 shall be for Workforce Devel-  
15     opment for Teachers and Scientists.

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

19          (1) \$2,129,233,000 shall be for Basic Energy  
20     Science;

21          (2) \$1,004,510,000 shall be for High Energy  
22     Physics;

23          (3) \$673,000,000 shall be for Biological and  
24     Environmental Research;

25          (4) \$690,000,000 shall be for Nuclear Physics;

1           (5) \$899,010,000 shall be for Advanced Sci-  
2           entific Computing Research;

3           (6) \$640,000,000 shall be for Fusion Energy  
4           Sciences;

5           (7) \$257,292,000 shall be for Science Labora-  
6           tories Infrastructure;

7           (8) \$181,345,000 shall be for Science Program  
8           Direction;

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

11          (10) \$19,500,000 shall be for Workforce Devel-  
12          opment for Teachers and Scientists.