

Union Calendar No. 609

115TH CONGRESS
2^D SESSION

H. R. 5905

[Report No. 115-787]

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

JUNE 27, 2018

Additional sponsor: Mr. ABRAHAM

JUNE 27, 2018

Reported with an amendment, committed to the Committee of the Whole House on the State of the Union, and ordered to be printed

[Strike out all after the enacting clause and insert the part printed in *italic*]

[For text of introduced bill, see copy of bill as introduced on May 22, 2018]

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 “De-*
 5 *partment of Energy Science and Innovation Act of 2018”.*

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

8 **SEC. 2. DEFINITIONS.**

9 *In this Act:*

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

12 (2) *DIRECTOR.*—*The term “*¥ *means the Director*
 13 *of the Office of Science of the Department.*

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

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

1 **SEC. 3. MISSION.**

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

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

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

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

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

23 (c) **BASIC ENERGY SCIENCES USER FACILITIES.—**

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

1 (2) *REQUIREMENTS.*—*To the maximum extent*
2 *practicable, the national user facilities developed, con-*
3 *structed, operated, or maintained under paragraph*
4 *(1) shall serve the needs of the Department, industry,*
5 *the academic community, and other relevant entities*
6 *to create and examine materials and chemical proc-*
7 *esses for the purpose of improving the competitiveness*
8 *of the United States.*

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

12 (A) *x-ray light sources;*

13 (B) *neutron sources;*

14 (C) *nanoscale science research centers; and*

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

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

21 (1) *ADVANCED PHOTON SOURCE UPGRADE.*—

22 (A) *IN GENERAL.*—*The Secretary shall pro-*
23 *vide for the upgrade to the Advanced Photon*
24 *Source described in the publication approved by*
25 *the Basic Energy Sciences Advisory Committee*

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

7 (B) *DEFINITIONS.*—In this paragraph:

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

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

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

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

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

24 and

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

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

3 (A) *IN GENERAL.—The Secretary shall pro-*
4 *vide for a proton power upgrade to the Spall-*
5 *ation Neutron Source.*

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

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

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

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

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

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

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

12 *and*

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

14 (3) *SPALLATION NEUTRON SOURCE SECOND TAR-*
15 *GET STATION.*—

16 (A) *IN GENERAL.*—*The Secretary shall pro-*
17 *vide for a second target station for the Spall-*
18 *ation Neutron Source.*

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

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

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

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

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

14 (C) *START OF OPERATIONS.*—*The Secretary*
15 *shall, to the maximum extent practicable, ensure*
16 *that the start of full operations of the second tar-*
17 *get station under this paragraph occurs before*
18 *December 31, 2030, with the option for early op-*
19 *eration in 2028.*

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

25 (i) *\$5,000,000 for fiscal year 2018; and*

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

2 (4) *ADVANCED LIGHT SOURCE UPGRADE.*—

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

12 (B) *DEFINITIONS.*—*In this paragraph:*

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

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

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

23 (D) *FUNDING.*—*Out of funds authorized to*
24 *be appropriated under section 11 for Basic En-*
25 *ergy Sciences, there shall be made available to*

1 the Secretary to carry out the upgrade under
2 this paragraph—

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

4 and

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

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

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

20 (B) *DEFINITIONS.*—*In this paragraph:*

21 (i) *HIGH ENERGY X-RAY.*—*The term a*
22 *“high energy x-ray” means a photon with*
23 *an energy at or exceeding 12 kiloelectron*
24 *volts.*

1 (ii) *HIGH REPETITION RATE.*—The
2 term “high repetition rate” means the deliv-
3 ery of x-ray pulses up to one million pulses
4 per second.

5 (iii) *ULTRA-SHORT PULSE X-RAYS.*—
6 The term “ultra-short pulse x-rays” means
7 x-ray bursts capable of durations of less
8 than one hundred femtoseconds.

9 (C) *START OF OPERATIONS.*—The Secretary
10 shall, to the maximum extent practicable, ensure
11 that the start of full operations of the upgrade
12 under this paragraph occurs before December 31,
13 2025.

14 (D) *FUNDING.*—Out of funds authorized to
15 be appropriated under section 11 for Basic En-
16 ergy Sciences, there shall be made available to
17 the Secretary to carry out the upgrade under
18 this paragraph—

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

20 and

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

22 (e) *ACCELERATOR RESEARCH AND DEVELOPMENT.*—
23 The Director shall carry out research and development on
24 advanced accelerator and storage ring technologies relevant
25 to the development of Basic Energy Sciences user facilities,

1 *in consultation with the Office of Science’s High Energy*
2 *Physics and Nuclear Physics programs.*

3 (f) *SOLAR FUELS RESEARCH INITIATIVE.*—

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

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

8 **“(a) INITIATIVE.**—

9 (1) *IN GENERAL.*—*The Secretary shall carry*
10 *out a research initiative, to be known as the ‘Solar*
11 *Fuels Research Initiative’ (referred to in this section*
12 *as the ‘Initiative’) to expand theoretical and funda-*
13 *mental knowledge of photochemistry, electrochemistry,*
14 *biochemistry, and materials science useful for the*
15 *practical development of experimental systems to con-*
16 *vert solar energy to chemical energy.*

17 (2) *LEVERAGING.*—*In carrying out programs*
18 *and activities under the Initiative, the Secretary shall*
19 *leverage expertise and resources from—*

20 (A) *the Basic Energy Sciences Program*
21 *and the Biological and Environmental Research*
22 *Program of the Office of Science; and*

23 (B) *the Office of Energy Efficiency and*
24 *Renewable Energy.*

25 (3) *TEAMS.*—

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

7 “(B) *GOALS.*—*The multidisciplinary teams*
8 *described in subparagraph (A) shall pursue ag-*
9 *gressive, milestone-driven, basic research goals.*

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

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

21 “(b) *ARTIFICIAL PHOTOSYNTHESIS.*—

22 “(1) *IN GENERAL.*—*The Secretary shall carry*
23 *out under the Initiative a program to support re-*
24 *search needed to bridge scientific barriers to, and dis-*

1 *cover knowledge relevant to, artificial photosynthetic*
2 *systems.*

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

5 “(A) *the Director of the Office of Basic En-*
6 *ergy Sciences shall support basic research to pur-*
7 *sue distinct lines of scientific inquiry, includ-*
8 *ing—*

9 “(i) *photoinduced production of hydro-*
10 *gen and oxygen from water; and*

11 “(ii) *the sustainable photoinduced re-*
12 *duction of carbon dioxide to fuel products*
13 *including hydrocarbons, alcohols, carbon*
14 *monoxide, and natural gas; and*

15 “(B) *the Assistant Secretary for Energy Ef-*
16 *iciency 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 au-*
2 *thorized to be appropriated under section 11 of*
3 *the Department of Energy Science and Innova-*
4 *tion Act of 2018, for Basic Energy Sciences, the*
5 *Secretary shall make available for carrying out*
6 *activities under this subsection \$50,000,000 for*
7 *each of fiscal years 2018 through 2019.*

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

12 “(c) *BIOCHEMISTRY, REPLICATION OF NATURAL PHO-*
13 *TOSYNTHESIS, AND RELATED PROCESSES.*—

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

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

21 “(A) *the Director of the Office of Basic En-*
22 *ergy Sciences shall support basic research to ex-*
23 *pand fundamental knowledge to replicate nat-*
24 *ural synthesis processes, including—*

1 “(i) the photoinduced reduction of
2 dinitrogen to ammonia;

3 “(ii) the absorption of carbon dioxide
4 from ambient air;

5 “(iii) molecular-based charge separa-
6 tion and storage;

7 “(iv) photoinitiated electron transfer;
8 and

9 “(v) catalysis in biological or bio-
10 mimetic systems;

11 “(B) the Associate Director of Biological
12 and Environmental Research shall support sys-
13 tems biology and genomics approaches to under-
14 stand genetic and physiological pathways con-
15 nected to photosynthetic mechanisms; and

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

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

25 “(4) FUNDING.—

1 “(A) *IN GENERAL.*—*From within funds au-*
2 *thorized to be appropriated under section 11 of*
3 *the Department of Energy Science and Innova-*
4 *tion Act of 2018, for Basic Energy Sciences and*
5 *Biological and Environmental Research, the Sec-*
6 *retary shall make available for carrying out ac-*
7 *tivities under this subsection \$50,000,000 for*
8 *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 application*
12 *of energy technology.*”

13 (2) *CONFORMING AMENDMENT.*—*The table of*
14 *contents for the Energy Policy Act of 2005 is amend-*
15 *ed by striking the item relating to section 973 and in-*
16 *serting the following:*

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

17 (g) *ELECTRICITY STORAGE RESEARCH INITIATIVE.*—

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

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

22 “(a) *INITIATIVE.*—

23 “(1) *IN GENERAL.*—*The Secretary shall carry*
24 *out a research initiative, to be known as the ‘Elec-*

1 *tricity Storage Research Initiative*’ (referred to in
2 *this section as the ‘Initiative’*)—

3 “(A) *to expand theoretical and fundamental*
4 *knowledge to control, store, and convert—*

5 “(i) *electrical energy to chemical en-*
6 *ergy; and*

7 “(ii) *chemical energy to electrical en-*
8 *ergy; and*

9 “(B) *to support scientific inquiry into the*
10 *practical understanding of chemical and phys-*
11 *ical processes that occur within systems involv-*
12 *ing crystalline and amorphous solids, polymers,*
13 *and organic and aqueous liquids.*

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

17 “(A) *the Basic Energy Sciences Program,*
18 *the Advanced Scientific Computing Research*
19 *Program, and the Biological and Environmental*
20 *Research Program of the Office of Science; and*

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

23 “(3) *TEAMS.—*

24 “(A) *IN GENERAL.—In carrying out the*
25 *Initiative, the Secretary shall organize activities*

1 *among multidisciplinary teams to leverage, to*
2 *the maximum extent practicable, expertise from*
3 *the National Laboratories, institutions of higher*
4 *education, and the private sector.*

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

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

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

19 “(b) *MULTIVALENT SYSTEMS.*—

20 “(1) *IN GENERAL.*—*The Secretary shall carry*
21 *out under the Initiative a program to support re-*
22 *search needed to bridge scientific barriers to, and dis-*
23 *cover knowledge relevant to, multivalent ion materials*
24 *in electric energy storage systems.*

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

3 “(A) *the Director of the Office of Basic En-*
4 *ergy Sciences shall investigate electrochemical*
5 *properties and the dynamics of materials, in-*
6 *cluding charge transfer phenomena and mass*
7 *transport in materials; and*

8 “(B) *the Assistant Secretary for Energy Ef-*
9 *iciency and Renewable Energy shall support*
10 *translational research, development, and valida-*
11 *tion of physical concepts developed under the*
12 *program.*

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

17 “(4) *FUNDING.*—

18 “(A) *IN GENERAL.*—*From within funds au-*
19 *thorized to be appropriated under section 11 of*
20 *the Department of Energy Science and Innova-*
21 *tion Act of 2018, for Basic Energy Sciences and*
22 *Biological and Environmental Research, the Sec-*
23 *retary shall make available for carrying out ac-*
24 *tivities under this subsection \$50,000,000 for*
25 *each of the fiscal years 2018 through 2019.*

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

5 “(c) *ELECTROCHEMISTRY MODELING AND SIMULA-*
6 *TION.*—

7 “(1) *IN GENERAL.*—The Secretary shall carry
8 out under the Initiative a program to support re-
9 search to model and simulate organic electrolytes, in-
10 cluding the static and dynamic electrochemical behav-
11 ior and phenomena of organic electrolytes at the mo-
12 lecular and atomic level in monovalent and multi-
13 valent systems.

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

16 “(A) the Director of the Office of Basic En-
17 ergy Sciences, in coordination with the Associate
18 Director of Advanced Scientific Computing Re-
19 search, shall support the development of high
20 performance computational tools through a joint
21 development process to maximize the effectiveness
22 of current and projected high performance com-
23 puting systems; and

24 “(B) the Assistant Secretary for Energy Ef-
25 ficiency and Renewable Energy shall support

1 *translational research, development, and valida-*
2 *tion of physical concepts developed under the*
3 *program.*

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

8 “(4) *FUNDING.—*

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

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

21 “(d) *MESOSCALE ELECTROCHEMISTRY.—*

22 “(1) *IN GENERAL.—The Secretary shall carry*
23 *out under the Initiative a program to support re-*
24 *search needed to reveal electrochemistry in confined*

1 *mesoscale spaces, including scientific discoveries rel-*
2 *evant to—*

3 “(A) *bio-electrochemistry and electro-*
4 *chemical energy conversion and storage in con-*
5 *finned spaces; and*

6 “(B) *the dynamics of the phenomena de-*
7 *scribed in subparagraph (A).*

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

10 “(A) *the Director of the Office of Basic En-*
11 *ergy Sciences and the Associate Director of Bio-*
12 *logical and Environmental Research shall inves-*
13 *tigate phenomena of mesoscale electrochemical*
14 *confinement for the purpose of replicating and*
15 *controlling new electrochemical behavior; and*

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

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

25 “(4) *FUNDING.—*

1 “(A) *IN GENERAL.*—*From within funds au-*
2 *thorized to be appropriated under section 11 of*
3 *the Department of Energy Science and Innova-*
4 *tion Act of 2018, for Basic Energy Sciences and*
5 *Biological and Environmental Research, the Sec-*
6 *retary shall make available for carrying out ac-*
7 *tivities under this subsection \$20,000,000 for*
8 *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 application*
12 *of energy technology.*”

13 (2) *CONFORMING AMENDMENT.*—*The table of*
14 *contents for the Energy Policy Act of 2005 is amend-*
15 *ed by striking the item relating to section 975 and in-*
16 *serting 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 accelerate*
23 *scientific breakthroughs.*

1 (2) *COLLABORATIONS.*—*A collaboration receiving*
2 *an award under this subsection may include multiple*
3 *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 4*
7 *years.*

8 (B) *EXISTING CENTERS.*—*An Energy Fron-*
9 *tier Research Center in existence and supported*
10 *by the Director on the date of enactment of this*
11 *Act may continue to receive support for a period*
12 *of 4 years beginning on the date of establishment*
13 *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 ex-*
20 *isting authorities of the Department, the Direc-*
21 *tor may terminate an underperforming center*
22 *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 shall*

1 *support the development of a web-based platform to*
2 *provide access to a database of computed information*
3 *on known and predicted materials properties and*
4 *computational tools to accelerate breakthroughs in*
5 *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 institutions*
10 *to facilitate the design of novel materials;*

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

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

18 *(D) strengthen the foundation for new tech-*
19 *nologies 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 na-*
23 *tional 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 Depart-*
14 *ment of Energy High-End Computing Revital-*
15 *ization Act of 2004 (15 U.S.C. 5501 note; Public*
16 *Law 108–423) is amended by striking “Depart-*
17 *ment of Energy High-End Computing Revital-*
18 *ization Act of 2004” and inserting “American*
19 *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 “American*
25 *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 inserting*
8 *the following:*

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

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

15 (C) *in paragraph (6) (as redesignated by*
16 *subparagraph (A)), by striking “, acting through*
17 *the Director of the Office of Science of the De-*
18 *partment of Energy”.*

19 (3) *DEPARTMENT OF ENERGY HIGH-END COM-*
20 *PUTING RESEARCH AND DEVELOPMENT PROGRAM.*—
21 *Section 3 of the American Super Computing Leader-*
22 *ship Act (15 U.S.C. 5542), as renamed by paragraph*
23 *(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 “multi-
6 threading architectures”; and

7 (C) by striking subsection (d) and inserting
8 the following:

9 “(d) *EXASCALE COMPUTING PROGRAM.*—

10 “(1) *IN GENERAL.*—The Secretary shall conduct
11 a research program (referred to in this subsection as
12 the ‘Program’) for exascale computing, including the
13 development of two or more exascale computing ma-
14 chine architectures, to promote the missions of the De-
15 partment.

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 insti-
21 tutions of higher education for codesign of
22 exascale hardware, technology, software, and
23 applications across all applicable organiza-
24 tions of the Department;

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

6 “(iii) develop such advancements in
7 hardware and software technology as are re-
8 quired 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 for
20 researchers in industries in the United
21 States, institutions of higher education, Na-
22 tional Laboratories, and other Federal agen-
23 cies to the exascale computing systems de-
24 veloped pursuant to clause (i).

1 “(B) *SELECTION OF PARTNERS.*—*The Sec-*
2 *retary shall select the partnerships with the com-*
3 *puting facilities of the Department under sub-*
4 *paragraph (A) through a competitive, peer-re-*
5 *view process.*

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

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

9 “*(i) carry out the Program through an*
10 *integration of applications, computer*
11 *science, applied mathematics, and computer*
12 *hardware architecture using the partner-*
13 *ships established pursuant to paragraph (2)*
14 *to ensure that, to the maximum extent prac-*
15 *ticable, two or more exascale computing*
16 *machine architectures are capable of solving*
17 *Department target applications and broader*
18 *scientific problems, including predictive*
19 *modeling and simulation, large scale data*
20 *analytics and management, and artificial*
21 *intelligence; and*

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

1 “(B) REPORT.—(i) *The Secretary shall submit to Congress a report describing how the integration under subparagraph (A) is furthering application science data and computational workloads across application interests, including national security, material science, physical science, cybersecurity, biological science, the Materials Genome and BRAIN Initiatives of the President, advanced manufacturing, and the national electric grid.*

11 “(ii) *The roles and responsibilities of National Laboratories and industry, including the definition of the roles and responsibilities within the Department to ensure an integrated program across the Department.*

16 “(4) PROJECT REVIEW.—

17 “(A) IN GENERAL.—*The exascale architectures developed pursuant to partnerships established pursuant to paragraph (2) shall be reviewed through a project review process.*

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

24 “(i) *the results of the review conducted*
25 *under subparagraph (A); and*

1 “(ii) *the coordination and manage-*
2 *ment of the Program to ensure an inte-*
3 *grated research program across the Depart-*
4 *ment.*”

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

12 “(c) *HIGH-PERFORMANCE COMPUTING AND NET-*
13 *WORKING RESEARCH.—The Director shall support research*
14 *in high-performance computing and networking relevant to*
15 *energy applications, including modeling, simulation, ma-*
16 *chine learning, and advanced data analytics for basic and*
17 *applied energy research programs carried out by the Sec-*
18 *retary.*”

19 “(d) *APPLIED MATHEMATICS AND SOFTWARE DEVEL-*
20 *OPMENT FOR HIGH-END COMPUTING SYSTEMS, COMPUTA-*
21 *TIONAL, AND COMPUTER SCIENCES RESEARCH.—*

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

1 (A) *mathematics, models, statistics, and al-*
2 *gorithms for complex systems and programming*
3 *environments; and*

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

9 (2) *PORTFOLIO BALANCE.—The Director shall*
10 *maintain a balanced portfolio within the advanced*
11 *scientific computing research and development pro-*
12 *gram established under section 976 of the Energy Pol-*
13 *icy Act of 2005 (42 U.S.C. 16316) that supports ro-*
14 *bust investment in applied mathematical, computa-*
15 *tional, and computer sciences research while accom-*
16 *modating necessary investments in high-performance*
17 *computing hardware and facilities.*

18 (e) *WORKFORCE DEVELOPMENT.—The Director of the*
19 *Office of Advanced Scientific Computing Research shall*
20 *support the development of a computational science work-*
21 *force through a program that—*

22 (1) *facilitates collaboration between university*
23 *students and researchers at the National Laboratories;*
24 *and*

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

4 **SEC. 6. HIGH ENERGY PHYSICS.**

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

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

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

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

22 (2) the Director should prioritize domestically
23 hosted research projects that will maintain the United
24 States position as a global leader in particle physics
25 and attract the world’s most talented physicists and

1 *foreign investment for international collaboration;*
2 *and*

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

8 (d) *NEUTRINO RESEARCH.*—*As part of the program*
9 *described in subsection (a), the Director shall carry out re-*
10 *search activities on rare decay processes and the nature of*
11 *the neutrino, which may include collaborations with the*
12 *National Science Foundation or international collabora-*
13 *tions.*

14 (e) *LONG-BASELINE NEUTRINO FACILITY FOR DEEP*
15 *UNDERGROUND NEUTRINO EXPERIMENT.*—

16 (1) *IN GENERAL.*—*The Secretary shall provide*
17 *for a Long-Baseline Neutrino Facility to facilitate the*
18 *international Deep Underground Neutrino Experi-*
19 *ment to enable a program in neutrino physics to*
20 *measure the fundamental properties of neutrinos, ex-*
21 *plore physics beyond the Standard Model, and better*
22 *clarify the nature of matter and antimatter.*

23 (2) *FACILITY CAPABILITIES.*—*The Secretary*
24 *shall ensure that the facility described in paragraph*

1 (1) will provide, at a minimum, the following capa-
2 bilities:

3 (A) A broad-band neutrino beam capable of
4 1.2 megawatts (MW) of beam power and
5 upgradable to 2.4 MW of beam power.

6 (B) Four caverns excavated for a forty kil-
7 oton fiducial detector mass and supporting sur-
8 face buildings and utilities.

9 (C) Neutrino detector facilities at both the
10 Far Site in South Dakota and the Near Site in
11 Illinois to categorize and study neutrinos on
12 their 800-mile journey between the two sites.

13 (D) Cryogenic systems to support neutrino
14 detectors.

15 (3) *START OF OPERATIONS.*—The Secretary
16 shall, to the maximum extent practicable, ensure that
17 the start of full operations of the facility under this
18 subsection occurs before December 31, 2026.

19 (4) *FUNDING.*—Out of funds authorized to be ap-
20 propriated under section 11 for High Energy Physics,
21 there shall be made available to the Secretary to carry
22 out activities, including construction of the facility,
23 under this subsection—

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

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

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

9 (6) *INTERNATIONAL COLLABORATION.*—*The Di-*
10 *rector, as practicable and in coordination with other*
11 *appropriate Federal agencies as necessary, shall en-*
12 *sure the access of United States researchers to the*
13 *most advanced accelerator facilities and research ca-*
14 *pabilities in the world, including the Large Hadron*
15 *Collider.*

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

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

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

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

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

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

8 *(B) bioenergy; and*

9 *(C) biobased materials;*

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

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

18 *(c) BIOENERGY RESEARCH CENTERS.—*

19 *(1) IN GENERAL.—In carrying out activities*
20 *under subsection (a), the Director shall select and es-*
21 *tablish up to 4 bioenergy research centers to conduct*
22 *basic and fundamental research in plant and micro-*
23 *bial systems biology, bio imaging and analysis, and*
24 *genomics to inform the production of fuels, chemicals*

1 *from sustainable biomass resources, and to facilitate*
2 *the translation of basic research results to industry.*

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

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

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

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

24 (6) *TERMINATION.*—*Consistent with the existing*
25 *authorities of the Department, the Director may ter-*

1 *minate an underperforming center for cause during*
2 *the performance period.*

3 *(d) LOW DOSE RADIATION RESEARCH PROGRAM.—*

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

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

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

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

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

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

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

21 *“(2) identify ongoing scientific challenges for un-*
22 *derstanding the long-term effects of ionizing radiation*
23 *on biological systems;*

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

1 *entific challenges in coordination with other research*
2 *efforts;*

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

5 *“(5) engage with other Federal agencies, research*
6 *communities, and potential users of information pro-*
7 *duced under this section, including institutions con-*
8 *cerning radiation research, medical physics, radi-*
9 *ology, health physics, and emergency response.*

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

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

17 *“(2) ensure that the Office of Science of the De-*
18 *partment of Energy consults with the National Aero-*
19 *nautics and Space Administration, the National In-*
20 *stitutes of Health, the Environmental Protection*
21 *Agency, the Department of Defense, the Nuclear Regu-*
22 *latory Commission, and the Department of Homeland*
23 *Security;*

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

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

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

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

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

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

1 “(g) *FUNDING.*—*From within funds authorized to be*
2 *appropriated under section 11 of the Department of Energy*
3 *Science and Innovation Act of 2018, for Biological and En-*
4 *vironmental Research, the Secretary make available to*
5 *carry out this section—*

6 “(1) \$20,000,000 for fiscal year 2018; and

7 “(2) \$20,000,000 for fiscal year 2019.”.

8 (2) *CONFORMING AMENDMENT.*—*The table of*
9 *contents for subtitle G of title IX of the Energy Policy*
10 *Act of 2005 is amended by inserting after the item re-*
11 *lating to section 977 the following:*

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

12 (e) *MODELING RESEARCH.*—*As part of the activities*
13 *described in subsection (a), the Director is authorized to*
14 *carry out research to develop multiscale computational*
15 *models that incorporate and examine interactions among*
16 *human and earth systems.*

17 (f) *LIMITATION FOR RESEARCH FUNDS.*—*The Director*
18 *shall not approve new climate science-related initiatives*
19 *without making a determination that such work is well-*
20 *coordinated with any relevant work carried out by other*
21 *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 founda-*
2 *tion 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 inertial*
6 *fusion for energy applications, including ion beam, laser,*
7 *and pulsed power fusion systems.*

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

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

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

18 **“(7) 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 to*
22 *under the April 25, 2007 ‘Agreement on the Es-*
23 *tablishment of the ITER International Fusion*
24 *Energy Organization for the Joint Implementa-*
25 *tion of the ITER Project.’.*

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

6 “(i) *A tokamak device with a plasma*
7 *radius of 6.2 meters and a magnetic field of*
8 *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 APPROPRIA-*
13 *TIONS.*—*From within funds authorized to be ap-*
14 *propriated under section 11 of the Department of*
15 *Energy Science and Innovation Act of 2018, for*
16 *Fusion Energy Sciences, there is authorized for*
17 *in-kind contributions under this paragraph—*

18 “(i) *\$122,000,000 for fiscal year 2018;*

19 *and*

20 “(ii) *\$163,000,000 for fiscal year 2019.*

21 “(D) *AUTHORIZATION OF APPROPRIA-*
22 *TIONS.*—*From within funds authorized to be ap-*
23 *propriated under section 11 of the Department of*
24 *Energy Science and Innovation Act of 2018, for*

1 *Fusion Energy Sciences, there is authorized for*
2 *cash contributions under this paragraph—*

3 “(i) \$50,000,000 for fiscal year 2018;

4 *and*

5 “(ii) \$50,000,000 for fiscal year
6 2019.”.

7 (d) *ALTERNATIVE AND ENABLING CONCEPTS.—*

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

21 (A) *high magnetic field approaches facili-*
22 *tated by high temperature superconductors;*

23 (B) *advanced stellarator concepts;*

24 (C) *non-tokamak confinement configura-*
25 *tions operating at low magnetic fields;*

1 (D) magnetized target fusion energy con-
2 cepts;

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

6 (F) immersion blankets for heat manage-
7 ment and fuel breeding;

8 (G) advanced scientific computing activi-
9 ties; and

10 (H) other promising fusion energy concepts
11 identified by the Director.

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

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

21 (B) determine whether the results of any fu-
22 sion energy project supported by ARPA-E merit
23 the support of follow-on research activities car-
24 ried out by the Office of Science; and

1 (C) *avoid unintentional duplication of ac-*
2 *tivities.*

3 (e) *FAIRNESS IN COMPETITION FOR SOLICITATIONS*
4 *FOR INTERNATIONAL PROJECT ACTIVITIES.*—Section 33 of
5 *the Atomic Energy Act of 1954 (42 U.S.C. 2053) is amend-*
6 *ed by inserting before the first sentence the following: “In*
7 *this section, with respect to international research projects,*
8 *the term ‘private facilities or laboratories’ means facilities*
9 *or laboratories located in the United States.”.*

10 (f) *IDENTIFICATION OF PRIORITIES.*—

11 (1) *REPORT.*—

12 (A) *IN GENERAL.*—Not later than 2 years
13 *after the date of enactment of this Act, the Sec-*
14 *retary shall submit to Congress a report on the*
15 *fusion energy research and development activities*
16 *that the Department proposes to carry out over*
17 *the 10-year period following the date of the re-*
18 *port under not fewer than 3 realistic budget sce-*
19 *narios, including a scenario based on 3-percent*
20 *annual growth in the non-ITER portion of the*
21 *budget for fusion energy research and develop-*
22 *ment activities.*

23 (B) *INCLUSIONS.*—The report required
24 *under subparagraph (A) shall—*

1 (i) identify specific areas of fusion en-
2 ergy research and enabling technology devel-
3 opment, including activities to advance in-
4 ertial and alternative fusion energy con-
5 cepts, in which the United States can and
6 should establish or solidify a lead in the
7 global fusion energy development effort;

8 (ii) identify priorities for initiation of
9 facility construction and facility decommis-
10 sioning under each of the three budget sce-
11 narios described in subparagraph (A); and

12 (iii) assess the ability of the fusion
13 workforce of the United States to carry out
14 the activities identified under clauses (i)
15 and (ii), including the adequacy of pro-
16 grams at institutions of higher education in
17 the United States to train the leaders and
18 workers of the next generation of fusion en-
19 ergy researchers.

20 (2) *PROCESS.*—In order to develop the report re-
21 quired under paragraph (1)(A), the Secretary shall le-
22 verage best practices and lessons learned from the
23 process used to develop the most recent report of the
24 Particle Physics Project Prioritization Panel of the
25 High Energy Physics Advisory Panel.

1 (3) *REQUIREMENT.*—*No member of the Fusion*
2 *Energy Sciences Advisory Committee shall be ex-*
3 *cluded from participating in developing or voting on*
4 *final approval of the report required under paragraph*
5 *(1)(A).*

6 **SEC. 9. NUCLEAR PHYSICS.**

7 (a) *PROGRAM.*—*The Director shall carry out a pro-*
8 *gram of experimental and theoretical research, and support*
9 *associated facilities, to discover, explore, and understand all*
10 *forms of nuclear matter.*

11 (b) *ISOTOPE DEVELOPMENT AND PRODUCTION FOR*
12 *RESEARCH APPLICATIONS.*—*The Director—*

13 (1) *may carry out a program for the production*
14 *of isotopes, including the development of techniques to*
15 *produce isotopes, that the Secretary determines are*
16 *needed for research, medical, industrial, or related*
17 *purposes; and*

18 (2) *shall ensure that isotope production activities*
19 *carried out under the program under this paragraph*
20 *do not compete with private industry unless the Di-*
21 *rector determines that critical national interests re-*
22 *quire the involvement of the Federal Government.*

23 (c) *RENAMING OF THE RARE ISOTOPE ACCEL-*
24 *ERATOR.*—*Section 981 of the Energy Policy Act of 2005*
25 *(42 U.S.C. 16321) is amended—*

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

4 (2) *by striking “Rare Isotope Accelerator” each*
5 *place it appears and inserting “Facility for Rare Iso-*
6 *tope Beams”.*

7 (d) *FACILITY FOR RARE ISOTOPE BEAMS.—*

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

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

16 (3) *START OF OPERATIONS.—The Secretary*
17 *shall, to the maximum extent practicable, ensure that*
18 *the start of full operations of the facility under this*
19 *subsection occurs before June 30, 2022, with early op-*
20 *eration in 2018.*

21 (4) *FUNDING.—Out of funds authorized to be ap-*
22 *propriated under section 11 for Nuclear Physics, there*
23 *shall be made available to the Secretary to carry out*
24 *activities, including construction of the facility, under*
25 *this subsection—*

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

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

3 **SEC. 10. SCIENCE LABORATORIES INFRASTRUCTURE PRO-**
4 **GRAM.**

5 (a) *IN GENERAL.*—*The Director shall carry out a pro-*
6 *gram to improve the safety, efficiency, and mission readi-*
7 *ness of infrastructure at Office of Science laboratories. The*
8 *program shall include projects to—*

9 (1) *renovate or replace space that does not meet*
10 *research needs;*

11 (2) *replace facilities that are no longer cost effec-*
12 *tive to renovate or operate;*

13 (3) *modernize utility systems to prevent failures*
14 *and ensure efficiency;*

15 (4) *remove excess facilities to allow safe and effi-*
16 *cient operations; and*

17 (5) *construct modern facilities to conduct ad-*
18 *vanced research in controlled environmental condi-*
19 *tions.*

20 (b) *APPROACH.*—*In carrying out this section, the Di-*
21 *rector shall utilize all available approaches and mecha-*
22 *nisms, including capital line items, minor construction*
23 *projects, energy savings performance contracts, utility en-*
24 *ergy service contracts, alternative financing, and expense*
25 *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 Phys-*
8 *ics;*

9 (3) *\$673,000,000 shall be for Biological and En-*
10 *vironmental Research;*

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

12 (5) *\$810,000,000 shall be for Advanced Scientific*
13 *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 Se-*
21 *curity; and*

22 (10) *\$19,500,000 shall be for Workforce Develop-*
23 *ment 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 En-*
6 *vironmental Research*;

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

8 (5) \$899,010,000 shall be for *Advanced Scientific*
9 *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 Se-*
17 *curity*; and

18 (10) \$19,500,000 shall be for *Workforce Develop-*
19 *ment for Teachers and Scientists*.

Union Calendar No. 609

115TH CONGRESS
2^D SESSION

H. R. 5905

[Report No. 115-787]

A BILL

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

JUNE 27, 2018

Reported with an amendment, committed to the Committee of the Whole House on the State of the Union, and ordered to be printed