

Calendar No. 633

118TH CONGRESS
2D SESSION**S. 4932**

To amend the National Quantum Initiative Act to provide for a research, development, and demonstration program, and for other purposes.

IN THE SENATE OF THE UNITED STATES

AUGUST 1, 2024

Mr. DURBIN (for himself, Mr. DAINES, Mr. HEINRICH, Ms. MURKOWSKI, and Mr. SCHUMER) introduced the following bill; which was read twice and referred to the Committee on Energy and Natural Resources

NOVEMBER 21, 2024

Reported by Mr. MANCHIN, with an amendment

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

A BILL

To amend the National Quantum Initiative Act to provide for a research, development, and demonstration program, and for other purposes.

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.**

4 This Act may be cited as the “Department of Energy
5 Quantum Leadership Act of 2024”.

1 **SEC. 2. DEPARTMENT OF ENERGY QUANTUM INFORMATION**
2 **SCIENCE RESEARCH PROGRAM.**

3 Section 401 of the National Quantum Initiative Act
4 (15 U.S.C. 8851) is amended—

5 (1) by striking subsection (a) and inserting the
6 following:

7 “(a) IN GENERAL.—The Secretary of Energy shall
8 carry out a research, development, and demonstration pro-
9 gram on quantum information science, engineering, and
10 technology.”;

11 (2) in subsection (b)—

12 (A) in paragraph (1), by inserting “, engi-
13 neering, and technology” after “science”;

14 (B) in paragraph (2), by inserting “, engi-
15 neering, and technology” after “science”;

16 (C) by striking paragraph (3) and insert-
17 ing the following:

18 “(3) provide research experiences and training
19 for additional undergraduate and graduate students
20 in quantum information science, engineering, and
21 technology, including in the fields specified in para-
22 graph (4);”;

23 (D) by redesignating paragraphs (3)
24 through (5) as paragraphs (5) through (7), re-
25 spectively;

1 (E) by inserting after paragraph (2) the
2 following:

3 “(3) operate National Quantum Information
4 Science Research Centers under section 402 to ac-
5 celerate and scale scientific and technical break-
6 throughs in quantum information science, engineer-
7 ing, and technology, and maintain state-of-the-art
8 infrastructure for quantum researchers and industry
9 partners;

10 “(4) conduct cooperative research with indus-
11 try, National Laboratories, institutions of higher
12 education, and other research institutions to facili-
13 tate the development and demonstration of quantum
14 information science, engineering, and technology pri-
15 orities, as determined by the Secretary of Energy,
16 including in the fields of—

17 “(A) quantum information theory;

18 “(B) quantum physics;

19 “(C) quantum computational science, in-
20 cluding hardware and software, machine learn-
21 ing, and data science;

22 “(D) applied mathematics and algorithm
23 development;

1 ~~“(E) quantum communications and net-~~
 2 ~~working, including hardware and software for~~
 3 ~~quantum communications and networking;~~

4 ~~“(F) quantum sensing and detection;~~

5 ~~“(G) materials science and engineering;~~

6 ~~“(H) quantum modeling and simulation,~~
 7 ~~including molecular modeling;~~

8 ~~“(I) near- and long-term application devel-~~
 9 ~~opment, as determined by the Secretary of En-~~
 10 ~~ergy;~~

11 ~~“(J) quantum chemistry;~~

12 ~~“(K) quantum biology;~~

13 ~~“(L) superconductive and high-perform-~~
 14 ~~ance microelectronics; and~~

15 ~~“(M) quantum security technologies;”;~~

16 ~~(F) in paragraph (6) (as so redesign-~~
 17 ~~ated)—~~

18 (i) in subparagraph (E), by striking

19 ~~“and” at the end;~~

20 (ii) by redesignating subparagraph
 21 ~~(F) as subparagraph (J); and~~

22 (iii) by inserting after subparagraph
 23 ~~(E) the following:~~

24 ~~“(F) the Office of Electricity;~~

1 “(G) the Office of Cybersecurity, Energy
2 Security, and Emergency Response;

3 “(H) the Office of Fossil Energy and Car-
4 bon Management;

5 “(I) the Office of Technology Transitions;
6 and”;

7 (G) in paragraph (7) (as so redesign-
8 ated)—

9 (i) by striking “and” before “poten-
10 tial”; and

11 (ii) by inserting “, and other relevant
12 stakeholders, as determined by the Sec-
13 retary of Energy” before the period at the
14 end; and

15 (3) by adding at the end the following:

16 “(c) INDUSTRY OUTREACH.—In carrying out the pro-
17 gram under subsection (a), the Secretary of Energy shall
18 support the quantum technology industry and promote
19 commercialization of applications of quantum technology
20 relevant to the activities of the Department of Energy
21 by—

22 “(1) educating—

23 “(A) the energy industry on near-term and
24 commercially available quantum technologies;
25 and

1 “(B) the quantum industry on potential
2 energy applications;

3 “(2) accelerating the advancements of United
4 States quantum computing, communications, net-
5 working, sensing, and security capabilities to protect
6 and optimize the energy sector;

7 “(3) advancing relevant domestic supply chains,
8 manufacturing capabilities, and associated simula-
9 tions or modeling capabilities;

10 “(4) facilitating commercialization of quantum
11 technologies from National Laboratories and engag-
12 ing with the Quantum Economic Development Con-
13 sortium and other organizations, as applicable, to
14 transition component technologies that advance the
15 development of a quantum supply chain; and

16 “(5) to the extent practicable, ensuring industry
17 partner access, especially for small- and medium-
18 sized businesses, to specialized quantum instrumen-
19 tation, equipment, testbeds, and other infrastructure
20 to design, prototype, and test novel quantum hard-
21 ware and streamline user access to reduce costs and
22 other administrative burdens.

23 “(d) HIGH-PERFORMANCE COMPUTING STRATEGIC
24 PLAN.—

1 “(1) IN GENERAL.—Not later than 1 year after
2 the date of enactment of this subsection, the Sec-
3 retary of Energy shall submit to Congress a 10-year
4 strategic plan to guide Federal programs in design-
5 ing, expanding, and procuring hybrid, energy-effi-
6 cient high-performance computing systems capable
7 of integrating with a diverse set of accelerators, in-
8 cluding quantum, artificial intelligence, and machine
9 learning accelerators, to enable the computing facili-
10 ties of the Department of Energy to advance na-
11 tional computing resources.

12 “(2) CONTENTS.—The strategic plan under
13 paragraph (1) shall include the following:

14 “(A) A conceptual plan to leverage capa-
15 bilities and infrastructure from the exascale
16 computing program, as the Secretary of Energy
17 determines necessary.

18 “(B) A plan to minimize disruptions to the
19 advanced scientific computing workforce.

20 “(C) A consideration of a diversity of
21 quantum computing modalities.

22 “(D) A plan to integrate cloud access of
23 commercially available quantum hardware and
24 software to complement on-premises high-per-
25 formance computing systems and resources con-

1 sistent with the QUEST program established
2 under section 404.

3 ~~“(e) EARLY-STAGE QUANTUM HIGH-PERFORMANCE~~
4 ~~COMPUTING RESEARCH AND DEVELOPMENT PROGRAM.—~~

5 ~~“(1) IN GENERAL.—The Secretary of Energy~~
6 ~~shall establish an early-stage research and develop-~~
7 ~~ment program in quantum high-performance com-~~
8 ~~puting—~~

9 ~~“(A) to inform the 10-year strategic plan~~
10 ~~described in subsection (d)(1); and~~

11 ~~“(B) to build the necessary scientific com-~~
12 ~~puting workforce to fulfill the objectives of that~~
13 ~~plan.~~

14 ~~“(2) ACTIVITIES.—The program established~~
15 ~~under paragraph (1) shall—~~

16 ~~“(A) support early-stage quantum super-~~
17 ~~computing testbeds and prototypes; and~~

18 ~~“(B) connect early-stage quantum high-~~
19 ~~performance computing projects to the Centers~~
20 ~~funded under this Act.~~

21 ~~“(3) FUNDING.—Of funds made available under~~
22 ~~subsection (i)(1), the Secretary of Energy shall use~~
23 ~~not more than \$20,000,000 for each of fiscal years~~
24 ~~2025 through 2029 to carry out the activities under~~
25 ~~this subsection.~~

1 “(f) SUPPLY CHAIN STUDY.—Not later than 180
 2 days after the date of enactment of this subsection, the
 3 Secretary of Energy shall conduct a study on quantum
 4 science, engineering, and technology supply chain needs,
 5 including—

6 “(1) identifying hurdles to growth in the quan-
 7 tum industry by leveraging the expertise of the
 8 Quantum Economic Development Consortium; and

9 “(2) making recommendations on how to
 10 strengthen the domestic supply of materials and
 11 technologies necessary for the development of a ro-
 12 bust manufacturing base and workforce.

13 “(g) TRAINEESHIP PROGRAM.—

14 “(1) IN GENERAL.—The Secretary of Energy
 15 shall establish a university-led traineeship pro-
 16 gram—

17 “(A) to address workforce development
 18 needs in quantum information science, engi-
 19 neering, and technology; and

20 “(B) that will focus on supporting in-
 21 creased participation, workforce development,
 22 and research experiences for underrepresented
 23 undergraduate and graduate students.

24 “(2) FUNDING.—Of funds made available under
 25 subsection (i)(1), the Secretary of Energy shall use

1 not more than \$5,000,000 for each of fiscal years
2 2025 through 2029 to carry out the activities under
3 this subsection.

4 “(h) COORDINATION OF ACTIVITIES.—In carrying
5 out this section, the Secretary of Energy shall, to the max-
6 imum extent practicable, coordinate with the Director of
7 the National Science Foundation, the Director of the Na-
8 tional Institute of Standards and Technology, the Admin-
9 istrator of the National Aeronautics and Space Adminis-
10 tration, the Director of the Defense Advanced Research
11 Projects Agency, and the heads of other relevant Federal
12 departments and agencies to ensure that programs and
13 activities carried out under this section complement and
14 do not duplicate existing efforts across the Federal govern-
15 ment.

16 “(i) FUNDING.—

17 “(1) IN GENERAL.—Of the funds authorized to
18 be appropriated to the Office of Science under sec-
19 tion 303(j) of the Department of Energy Research
20 and Innovation Act (42 U.S.C. 18641(j)), there is
21 authorized to be appropriated to the Secretary of
22 Energy not more than \$175,000,000 for each of fis-
23 cal years 2025 through 2029 to carry out activities
24 under this section.

25 “(2) RESTRICTIONS.—

1 “(A) CONFUCIUS INSTITUTE.—None of the
 2 funds made available under this subsection may
 3 be obligated to or expended by an institution of
 4 higher education that maintains a contract or
 5 other agreement with a Confucius Institute or
 6 any successor of a Confucius Institute.

7 “(B) FOREIGN COUNTRIES AND ENTITIES
 8 OF CONCERN.—

9 “(i) DEFINITIONS.—In this subpara-
 10 graph:

11 “(I) FOREIGN COUNTRY OF CON-
 12 CERN.—The term ‘foreign country of
 13 concern’ means—

14 “(aa) a covered nation (as
 15 defined in section 4872(d) of title
 16 10, United States Code); and

17 “(bb) any other country that
 18 the Secretary of Energy, in con-
 19 sultation with the Secretary of
 20 Defense, the Secretary of State,
 21 and the Director of National In-
 22 telligence, determines to be en-
 23 gaged in conduct that is detri-
 24 mental to the national security or

foreign policy of the United States.

~~“(H) FOREIGN ENTITY OF CONCERN.—~~The term ‘foreign entity of concern’ means a foreign entity that—

~~“(aa) is designated as a foreign terrorist organization by the Secretary of State under section 219(a) of the Immigration and Nationality Act (8 U.S.C. 1189(a));~~

~~“(bb) is included on the list of specially designated nationals and blocked persons maintained by the Office of Foreign Assets Control of the Department of the Treasury;~~

~~“(cc) is owned by, controlled by, or subject to the jurisdiction or direction of a government of a foreign country that is a covered nation (as defined in section 4872(d) of title 10, United States Code);~~

1 “(dd) is alleged by the At-
2 torney General to have been in-
3 volved in activities for which a
4 conviction was obtained under—

5 “(AA) chapter 37 of
6 title 18, United States Code
7 (commonly known as the
8 ‘Espionage Act’);

9 “(BB) section 951 or
10 1030 of title 18, United
11 States Code;

12 “(CC) chapter 90 of
13 title 18, United States Code
14 (commonly known as the
15 ‘Economic Espionage Act of
16 1996’);

17 “(DD) the Arms Ex-
18 port Control Act (22 U.S.C.
19 2751 et seq.);

20 “(EE) section 224,
21 225, 226, 227, or 236 of the
22 Atomic Energy Act of 1954
23 (42 U.S.C. 2274, 2275,
24 2276, 2277, 2284);

1 “(FF) the Export Con-
 2 trol Reform Act of 2018 (50
 3 U.S.C. 4801 et seq.); or

4 “(GG) the International
 5 Emergency Economic Pow-
 6 ers Act (50 U.S.C. 1701 et
 7 seq.); or

8 “(ee) is determined by the
 9 Secretary of Energy, in consulta-
 10 tion with the Secretary of De-
 11 fense and the Director of Na-
 12 tional Intelligence, to be engaged
 13 in unauthorized conduct that is
 14 detrimental to the national secu-
 15 rity or foreign policy of the
 16 United States.

17 “(ii) RESTRICTION.—None of the
 18 funds made available under this subsection
 19 may be obligated or expended to promote,
 20 establish, or finance quantum research ac-
 21 tivities between a United States entity and
 22 a foreign country of concern or a foreign
 23 entity of concern.”.

1 **SEC. 3. DOE QUANTUM INSTRUMENTATION AND FOUNDRY**
 2 **PROGRAM.**

3 The National Quantum Initiative Act is amended by
 4 inserting after section 401 (15 U.S.C. 8851) the following:

5 **“SEC. 401A. DEPARTMENT OF ENERGY QUANTUM INSTRU-**
 6 **MENTATION AND FOUNDRY PROGRAM.**

7 **“(a) IN GENERAL.**—The Secretary of Energy shall
 8 establish an instrumentation and infrastructure program
 9 to carry out the following:

10 **“(1)** Maintain United States leadership in
 11 quantum information science, engineering, and tech-
 12 nology.

13 **“(2)** Develop domestic quantum supply chains.

14 **“(3)** Provide resources for the broader scientific
 15 community.

16 **“(4)** Support activities carried out under sec-
 17 tions 401, 403, and 404.

18 **“(b) PROGRAM COMPONENTS.**—In carrying out the
 19 program under subsection (a), the Secretary of Energy
 20 shall—

21 **“(1)** develop, design, build, purchase, and com-
 22 mercialize specialized equipment, laboratory infra-
 23 structure, and state-of-the-art instrumentation to
 24 advance quantum engineering research and the de-
 25 velopment of quantum component technologies at a
 26 scale sufficient to meet the needs of the scientific

1 community and enable commercialization of quan-
 2 tum technology;

3 “(2) leverage the capabilities of National Lab-
 4 oratories and Nanoscale Science Research Centers;
 5 including facilities and experts that research and de-
 6 velop novel quantum materials and devices; and

7 “(3) consider the technologies and end-use ap-
 8 plications identified by the Quantum Economic De-
 9 velopment Consortium as having significant eco-
 10 nomic potential.

11 “(c) QUANTUM FOUNDRIES.—In carrying out the
 12 program under subsection (a), and in coordination with
 13 institutions of higher education and industry, the Sec-
 14 retary of Energy shall support the development of quan-
 15 tum foundries focused on meeting the device, hardware,
 16 software, and materials needs of the scientific community
 17 and the quantum supply chain.

18 “(d) FUNDING.—Of amounts appropriated or other-
 19 wise made available to the Office of Science, the Secretary
 20 of Energy shall use not more than \$50,000,000 for each
 21 of fiscal years 2025 through 2029 to carry out this sec-
 22 tion.”.

1 **SEC. 4. NATIONAL QUANTUM INFORMATION SCIENCE RE-**
 2 **SEARCH CENTERS.**

3 Section 402 of the National Quantum Initiative Act
 4 (15 U.S.C. 8852) is amended—

5 (1) in subsection (a)—

6 (A) in paragraph (1)—

7 (i) by striking “basic”; and

8 (ii) by striking “science and tech-
 9 nology and to support research conducted
 10 under section 401” and inserting “science,
 11 engineering, and technology, expand capac-
 12 ity for the domestic quantum workforce,
 13 and support research conducted under sec-
 14 tions 401, 403, and 404”; and

15 (B) in paragraph (2)(C), by inserting
 16 “that may include 1 or more commercial enti-
 17 ties” after “collaborations”;

18 (2) in subsection (b), by inserting “and should
 19 be inclusive of the variety of viable quantum tech-
 20 nologies, as appropriate” before the period at the
 21 end;

22 (3) in subsection (c)—

23 (A) by striking “basic”; and

24 (B) by inserting “, engineering, and tech-
 25 nology, accelerating quantum workforce devel-
 26 opment,” after “science”;

1 (4) in subsection (d)(1)—

2 (A) in subparagraph (C), by striking
3 “and” at the end;

4 (B) by redesignating subparagraph (D) as
5 subparagraph (E); and

6 (C) by inserting after subparagraph (C)
7 the following:

8 “(D) the Office of Technology Transitions;
9 and”;

10 (5) in subsection (e), by striking paragraph (2)
11 and inserting the following:

12 “(2) RENEWAL.—Each Center established
13 under this section may be renewed for an additional
14 period of 5 years following a successful, merit-based
15 review and approval by the Director.”; and

16 (6) in subsection (f), in the first sentence—

17 (A) by striking “\$25,000,000” and insert-
18 ing “\$35,000,000”; and

19 (B) by striking “2019 through 2023” and
20 inserting “2025 through 2029”.

21 **SEC. 5. DEPARTMENT OF ENERGY QUANTUM NETWORK IN-**
22 **FRASTRUCTURE RESEARCH AND DEVELOP-**
23 **MENT PROGRAM.**

24 Section 403 of the National Quantum Initiative Act
25 (15 U.S.C. 8853) is amended—

1 (1) in subsection (a)—

2 (A) in paragraph (4)—

3 (i) by inserting “, including” after
4 “networking”; and

5 (ii) by striking “and” at the end;

6 (B) in paragraph (5); by striking the pe-
7 riod at the end and inserting a semicolon; and

8 (C) by adding at the end the following:

9 “~~(6)~~ as applicable; leverage a diversity of mo-
10 dalities and commercially available quantum hard-
11 ware and software; and

12 “~~(7)~~ develop education and training pathways
13 related to quantum network infrastructure invest-
14 ments, aligned with existing programmatic invest-
15 ments by the Department of Energy.”; and

16 (2) in subsection (b)—

17 (A) in paragraph (1)—

18 (i) by redesignating subparagraphs
19 (C) and (D) as subparagraphs (D) and
20 (E), respectively; and

21 (ii) by inserting after subparagraph
22 (B) the following:

23 “~~(C)~~ the Administrator of the National
24 Aeronautics and Space Administration.”;

25 (B) in paragraph (2)—

1 (i) in subparagraph (A), by inserting
 2 “ground-to-space and” before “space-to-
 3 ground”;

4 (ii) in subparagraph (E), by striking
 5 “photon-based” and inserting “all applica-
 6 ble modalities of”;

7 (iii) in subparagraph (F), by inserting
 8 “, quantum sensors,” after “quantum re-
 9 peaters”;

10 (iv) in subparagraph (G)—

11 (I) by inserting “data centers,”
 12 after “repeaters,”; and

13 (II) by striking “and” at the end;

14 (v) in subparagraph (H)—

15 (I) by striking “the quantum
 16 technology stack” and inserting
 17 “quantum technology modality
 18 stacks”; and

19 (II) by striking “National Lab-
 20 oratories in” and inserting “National
 21 Laboratories such as”; and

22 (vi) by adding at the end the fol-
 23 lowing:

24 “(I) development of quantum network and
 25 entanglement distribution protocols or applica-

tions, including development of network stack protocols and protocols enabling integration with existing technologies or infrastructure; and

“(J) development of high-efficiency room-temperature photon detectors for quantum photonic applications, including quantum networking and communications;”;

(C) in paragraph (4)—

(i) by striking “basic”; and

(ii) by striking “material” and inserting “materials”; and

(D) in paragraph (5), by striking “fundamental”; and

(3) in subsection (d), by striking “basic research” and inserting “research, development, and demonstration”.

SEC. 6. DEPARTMENT OF ENERGY QUANTUM USER EXPANSION FOR SCIENCE AND TECHNOLOGY PROGRAM.

Section 404 of the National Quantum Initiative Act (15 U.S.C. 8854) is amended—

(1) in subsection (a)—

(A) in the matter preceding paragraph (1), by striking “and quantum computing clouds”

1 and inserting “, software, and cloud-based
2 quantum computing”;

3 (B) in paragraph (3), by striking “and” at
4 the end;

5 (C) in paragraph (4), by striking the pe-
6 riod at the end and inserting a semicolon; and

7 (D) by adding at the end the following:

8 “(5) to enable development of software and ap-
9 plications, including estimation of resources needed
10 to scale applications; and

11 “(6) to develop near-term quantum applications
12 to solve public and private sector problems.”;

13 (2) in subsection (b)—

14 (A) in paragraph (4), by striking “and” at
15 the end;

16 (B) in paragraph (5), by striking the pe-
17 riod at the end and inserting a semicolon; and

18 (C) by adding at the end the following:

19 “(6) enable users to develop algorithms, soft-
20 ware tools, simulators, and applications for quantum
21 systems using cloud-based quantum computers; and

22 “(7) partner with appropriate public- and pri-
23 vate-sector entities to develop training and education
24 opportunities on prototype and early-stage devices.”;

25 (3) in subsection (c)—

1 (A) by redesignating paragraphs (4)
2 through (8) as paragraphs (5) through (9), re-
3 spectively; and

4 (B) by inserting after paragraph (3) the
5 following:

6 “(4) the National Oceanic and Atmospheric Ad-
7 ministration;”, and

8 (4) in subsection (c)—

9 (A) in paragraph (4), by striking “and” at
10 the end;

11 (B) in paragraph (5), by striking the pe-
12 riod at the end and inserting “; and”; and

13 (C) by adding at the end the following:

14 “(6) \$38,000,000 for fiscal year 2028.”.

15 **SECTION 1. SHORT TITLE.**

16 *This Act may be cited as the “Department of Energy*
17 *Quantum Leadership Act of 2024”.*

18 **SEC. 2. DEPARTMENT OF ENERGY QUANTUM INFORMATION**

19 **SCIENCE RESEARCH PROGRAM.**

20 *Section 401 of the National Quantum Initiative Act*
21 *(15 U.S.C. 8851) is amended—*

22 (1) *by striking subsection (a) and inserting the*
23 *following:*

24 “(a) *IN GENERAL.—The Secretary of Energy shall*
25 *carry out a research, development, and demonstration pro-*

1 *gram on quantum information science, engineering, and*
 2 *technology.”;*

3 *(2) in subsection (b)—*

4 *(A) in paragraph (1), by inserting “, engi-*
 5 *neering, and technology” after “science”;*

6 *(B) in paragraph (2), by inserting “, engi-*
 7 *neering, and technology” after “science”;*

8 *(C) by striking paragraph (3) and inserting*
 9 *the following:*

10 *“(3) provide research experiences and training*
 11 *for additional undergraduate and graduate students*
 12 *in quantum information science, engineering, and*
 13 *technology, including in the fields specified in para-*
 14 *graph (4);”;*

15 *(D) by redesignating paragraphs (3)*
 16 *through (5) as paragraphs (5) through (7), re-*
 17 *spectively;*

18 *(E) by inserting after paragraph (2) the fol-*
 19 *lowing:*

20 *“(3) operate National Quantum Information*
 21 *Science Research Centers under section 402 to accel-*
 22 *erate and scale scientific and technical breakthroughs*
 23 *in quantum information science, engineering, and*
 24 *technology, and maintain state-of-the-art infrastruc-*
 25 *ture for quantum researchers and industry partners;*

1 “(4) conduct cooperative basic and applied re-
 2 search with industry, National Laboratories, institu-
 3 tions of higher education, and other research institu-
 4 tions to facilitate the development, demonstration,
 5 and commercial application of quantum information
 6 science, engineering, and technology priorities, as de-
 7 termined by the Secretary of Energy, including in the
 8 fields of—

9 “(A) quantum information theory;

10 “(B) quantum physics;

11 “(C) quantum computational science, in-
 12 cluding hardware and software, machine learn-
 13 ing, and data science;

14 “(D) applied mathematics and algorithm
 15 development;

16 “(E) quantum communications and net-
 17 working, including hardware and software for
 18 quantum communications and networking;

19 “(F) quantum sensing, imaging, and detec-
 20 tion;

21 “(G) materials science and engineering;

22 “(H) quantum modeling and simulation,
 23 including molecular modeling;

1 “(I) near- and long-term application devel-
 2 opment, as determined by the Secretary of En-
 3 ergy;

4 “(J) quantum chemistry;

5 “(K) quantum biology;

6 “(L) superconductive and high-performance
 7 microelectronics; and

8 “(M) quantum security technologies;”;

9 (F) in paragraph (6) (as so redesignated),
 10 in subparagraph (F), by striking “and” at the
 11 end;

12 (G) in paragraph (7) (as so redesignated)—

13 (i) by striking “and” before “poten-
 14 tial”; and

15 (ii) by striking the period at the end
 16 and inserting “, and other relevant stake-
 17 holders, as determined by the Secretary of
 18 Energy; and”; and

19 (H) by adding at the end the following:

20 “(8) leverage the collective body of knowledge and
 21 data, including experience and resources from exist-
 22 ing Federal research activities and commercially
 23 available quantum computing hardware and software,
 24 to the extent practicable.”; and

25 (3) by adding at the end the following:

1 “(c) *INDUSTRY OUTREACH*.—In carrying out the pro-
2 gram under subsection (a), the Secretary of Energy shall
3 engage with the quantum technology industry and promote
4 commercialization of applications of quantum technology
5 relevant to the activities of the Department of Energy by—

6 “(1) educating—

7 “(A) the energy industry on near-term and
8 commercially available quantum technologies;
9 and

10 “(B) the quantum industry on potential en-
11 ergy applications;

12 “(2) accelerating the advancements of United
13 States quantum computing, communications, net-
14 working, sensing, and security capabilities to protect
15 and optimize the energy sector;

16 “(3) advancing relevant domestic supply chains,
17 manufacturing capabilities, and associated simula-
18 tions or modeling capabilities;

19 “(4) facilitating commercialization of quantum
20 technologies from National Laboratories and engaging
21 with the Quantum Economic Development Consor-
22 tium and other organizations, as applicable, to tran-
23 sition component technologies that advance the devel-
24 opment of a quantum supply chain; and

1 “(5) to the extent practicable, ensuring industry
 2 partner access, especially for small- and medium-
 3 sized businesses, to specialized quantum instrumenta-
 4 tion, equipment, testbeds, and other infrastructure to
 5 design, prototype, and test novel quantum hardware
 6 and streamline user access to reduce costs and other
 7 administrative burdens.

8 “(d) *HIGH-PERFORMANCE COMPUTING STRATEGIC*
 9 *PLAN.*—

10 “(1) *IN GENERAL.*—Not later than 1 year after
 11 the date of enactment of this subsection, the Secretary
 12 of Energy shall submit to Congress a 10-year strategic
 13 plan to guide Federal programs in designing, expand-
 14 ing, and procuring hybrid, energy-efficient high-per-
 15 formance computing systems capable of integrating
 16 with a diverse set of accelerators, including quantum,
 17 artificial intelligence, and machine learning accelera-
 18 tors, to enable the computing facilities of the Depart-
 19 ment of Energy to advance national computing re-
 20 sources.

21 “(2) *CONTENTS.*—The strategic plan under para-
 22 graph (1) shall include the following:

23 “(A) A conceptual plan to leverage capabili-
 24 ties and infrastructure from the exascale com-

1 *puting program, as the Secretary of Energy de-*
 2 *termines necessary.*

3 *“(B) A plan to minimize disruptions to the*
 4 *advanced scientific computing workforce.*

5 *“(C) A consideration of a diversity of quan-*
 6 *tum computing modalities.*

7 *“(D) A plan to integrate cloud access of*
 8 *commercially available quantum hardware and*
 9 *software to complement on-premises high-per-*
 10 *formance computing systems and resources con-*
 11 *sistent with the QUEST program established*
 12 *under section 404.*

13 *“(e) EARLY-STAGE QUANTUM HIGH-PERFORMANCE*
 14 *COMPUTING RESEARCH AND DEVELOPMENT PROGRAM.—*

15 *“(1) DEFINITION OF QUANTUM HIGH-PERFORM-*
 16 *ANCE COMPUTING.—In this subsection, the term*
 17 *‘quantum high-performance computing’ means the use*
 18 *of classical high-performance computing systems with*
 19 *quantum processing units and hybrid quantum-clas-*
 20 *sical algorithms to leverage the strength of computa-*
 21 *tional architectures and solve complex problems.*

22 *“(2) PROGRAM.—The Secretary of Energy shall*
 23 *establish an early-stage research and development*
 24 *program in quantum high-performance computing—*

1 “(A) to inform the 10-year strategic plan
2 described in subsection (d)(1); and

3 “(B) to build the necessary scientific com-
4 puting workforce to fulfill the objectives of that
5 plan.

6 “(3) *ACTIVITIES.*—The program established
7 under paragraph (2) shall—

8 “(A) support early-stage quantum super-
9 computing testbeds and prototypes; and

10 “(B) connect early-stage quantum high-per-
11 formance computing projects to the Centers fund-
12 ed under this Act.

13 “(4) *FUNDING.*—Of funds made available under
14 subsection (i)(1), the Secretary of Energy shall use
15 not more than \$20,000,000 for each of fiscal years
16 2025 through 2029 to carry out the activities under
17 this subsection.

18 “(f) *SUPPLY CHAIN STUDY.*—Not later than 1 year
19 after the date of enactment of this subsection, the Secretary
20 of Energy, in consultation with the Secretary of Commerce,
21 shall conduct a study on quantum science, engineering, and
22 technology supply chain needs, including—

23 “(1) identifying hurdles to growth in the quan-
24 tum industry by leveraging the expertise of relevant

1 *stakeholders in academia and industry, including the*
 2 *Quantum Economic Development Consortium; and*

3 *“(2) making recommendations on how to*
 4 *strengthen the domestic supply of materials and tech-*
 5 *nologies necessary for the development of a robust*
 6 *manufacturing base and workforce.*

7 *“(g) TRAINEESHIP PROGRAM.—*

8 *“(1) IN GENERAL.—The Secretary of Energy*
 9 *shall establish a university-led traineeship program—*

10 *“(A) to address workforce development needs*
 11 *in quantum information science, engineering,*
 12 *and technology; and*

13 *“(B) that will focus on supporting increased*
 14 *participation, workforce development, and re-*
 15 *search experiences for underrepresented under-*
 16 *graduate and graduate students.*

17 *“(2) FUNDING.—Of funds made available under*
 18 *subsection (i)(1), the Secretary of Energy shall use*
 19 *not more than \$5,000,000 for each of fiscal years*
 20 *2025 through 2029 to carry out the activities under*
 21 *this subsection.*

22 *“(h) COORDINATION OF ACTIVITIES.—In carrying out*
 23 *this section, the Secretary of Energy shall, to the maximum*
 24 *extent practicable, coordinate with the Director of the Na-*
 25 *tional Science Foundation, the Director of the National In-*

1 *stitute of Standards and Technology, the Administrator of*
 2 *the National Aeronautics and Space Administration, the*
 3 *Director of the Defense Advanced Research Projects Agency,*
 4 *and the heads of other relevant Federal departments and*
 5 *agencies to ensure that programs and activities carried out*
 6 *under this section complement and do not duplicate existing*
 7 *efforts across the Federal government.*

8 “(i) *FUNDING.*—

9 “(1) *IN GENERAL.*—Of amounts authorized to be
 10 appropriated for the Department of Energy, the Sec-
 11 retary of Energy shall use not more than
 12 \$175,000,000 for each of fiscal years 2025 through
 13 2029 to carry out activities under this section.

14 “(2) *RESTRICTIONS.*—

15 “(A) *CONFUCIUS INSTITUTE.*—None of the
 16 funds made available under this subsection may
 17 be obligated to or expended by an institution of
 18 higher education that maintains a contract or
 19 other agreement with a Confucius Institute or
 20 any successor of a Confucius Institute.

21 “(B) *FOREIGN COUNTRIES AND ENTITIES OF*
 22 *CONCERN.*—

23 “(i) *DEFINITIONS.*—In this subpara-
 24 graph:

1 “(I) *FOREIGN COUNTRY OF CON-*
 2 *CERN.—The term ‘foreign country of*
 3 *concern’ means—*

4 “(aa) *a covered nation (as*
 5 *defined in section 4872(d) of title*
 6 *10, United States Code); and*

7 “(bb) *any other country that*
 8 *the Secretary of Energy, in con-*
 9 *sultation with the Secretary of*
 10 *Defense, the Secretary of State,*
 11 *and the Director of National In-*
 12 *telligence, determines to be en-*
 13 *gaged in conduct that is detri-*
 14 *mental to the national security or*
 15 *foreign policy of the United*
 16 *States.*

17 “(II) *FOREIGN ENTITY OF CON-*
 18 *CERN.—The term ‘foreign entity of*
 19 *concern’ means a foreign entity that—*

20 “(aa) *is designated as a for-*
 21 *ign terrorist organization by the*
 22 *Secretary of State under section*
 23 *219(a) of the Immigration and*
 24 *Nationality Act (8 U.S.C.*
 25 *1189(a));*

1 “(bb) is included on the list
2 of specially designated nationals
3 and blocked persons maintained
4 by the Office of Foreign Assets
5 Control of the Department of the
6 Treasury;

7 “(cc) is owned by, controlled
8 by, or subject to the jurisdiction
9 or direction of a government of a
10 foreign country that is a covered
11 nation (as defined in section
12 4872(d) of title 10, United States
13 Code);

14 “(dd) is alleged by the Attor-
15 ney General to have been involved
16 in activities for which a convic-
17 tion was obtained under—

18 “(AA) chapter 37 of title
19 18, United States Code (com-
20 monly known as the ‘Espio-
21 nage Act’);

22 “(BB) section 951 or
23 1030 of title 18, United
24 States Code;

1 “(CC) chapter 90 of title
 2 18, United States Code (com-
 3 monly known as the ‘Eco-
 4 nomic Espionage Act of
 5 1996’);

6 “(DD) the Arms Export
 7 Control Act (22 U.S.C. 2751
 8 et seq.);

9 “(EE) section 224, 225,
 10 226, 227, or 236 of the Atom-
 11 ic Energy Act of 1954 (42
 12 U.S.C. 2274, 2275, 2276,
 13 2277, 2284);

14 “(FF) the Export Con-
 15 trol Reform Act of 2018 (50
 16 U.S.C. 4801 et seq.); or

17 “(GG) the International
 18 Emergency Economic Powers
 19 Act (50 U.S.C. 1701 et seq.);
 20 or

21 “(ee) is determined by the
 22 Secretary of Energy, in consulta-
 23 tion with the Secretary of Defense
 24 and the Director of National In-
 25 telligence, to be engaged in unaut-

1 *thorized conduct that is detri-*
 2 *mental to the national security or*
 3 *foreign policy of the United*
 4 *States.*

5 “(ii) *RESTRICTION.*—None of the funds
 6 *made available under this subsection may*
 7 *be obligated or expended to promote, estab-*
 8 *lish, or finance quantum research activities*
 9 *between a United States entity and a for-*
 10 *ign country of concern or a foreign entity*
 11 *of concern.”.*

12 **SEC. 3. DOE QUANTUM INSTRUMENTATION AND FOUNDRY**
 13 **PROGRAM.**

14 *The National Quantum Initiative Act is amended by*
 15 *inserting after section 401 (15 U.S.C. 8851) the following:*

16 **“SEC. 401A. DEPARTMENT OF ENERGY QUANTUM INSTRU-**
 17 **MENTATION AND FOUNDRY PROGRAM.**

18 “(a) *IN GENERAL.*—The Secretary of Energy shall es-
 19 *tablish an instrumentation and infrastructure program to*
 20 *carry out the following:*

21 “(1) *Maintain United States leadership in quan-*
 22 *tum information science, engineering, and technology.*

23 “(2) *Develop domestic quantum supply chains.*

24 “(3) *Provide resources for the broader scientific*
 25 *community.*

1 “(4) *Support activities carried out under sec-*
 2 *tions 401, 402, 403, and 404.*

3 “(b) *PROGRAM COMPONENTS.—In carrying out the*
 4 *program under subsection (a), the Secretary of Energy*
 5 *shall—*

6 “(1) *develop, design, build, purchase, and com-*
 7 *mercialize specialized equipment, laboratory infra-*
 8 *structure, and state-of-the-art instrumentation to ad-*
 9 *vance quantum engineering research and the develop-*
 10 *ment of quantum component technologies at a scale*
 11 *sufficient to meet the needs of the scientific commu-*
 12 *nity and enable commercialization of quantum tech-*
 13 *nology;*

14 “(2) *leverage the capabilities of National Labora-*
 15 *tories and Nanoscale Science Research Centers, in-*
 16 *cluding facilities and experts that research and de-*
 17 *velop novel quantum materials and devices; and*

18 “(3) *consider the technologies and end-use appli-*
 19 *cations that have significant economic potential, as*
 20 *determined by the Secretary, based on consultation*
 21 *with relevant stakeholders in academia and industry,*
 22 *including the Quantum Economic Development Con-*
 23 *sortium.*

24 “(c) *QUANTUM FOUNDRIES.—In carrying out the pro-*
 25 *gram under subsection (a), and in coordination with insti-*

1 *tutions of higher education and industry, the Secretary of*
 2 *Energy shall support the development of quantum foundries*
 3 *focused on meeting the device, hardware, software, and ma-*
 4 *terials needs of the scientific community and the quantum*
 5 *supply chain.*

6 “(d) *CONSULTATION.*—*In carrying out the program*
 7 *under subsection (a), the Secretary of Energy shall consult*
 8 *with the following entities to identify the instrumentation,*
 9 *equipment, infrastructure, and materials needed to support*
 10 *the objectives of that program:*

11 “(1) *The National Institute of Standards and*
 12 *Technology.*

13 “(2) *The National Science Foundation.*

14 “(3) *The National Aeronautics and Space Ad-*
 15 *ministration.*

16 “(4) *Any other relevant Federal agency.*

17 “(5) *The National Laboratories.*

18 “(6) *National Quantum Information Science Re-*
 19 *search Centers.*

20 “(7) *Industry stakeholders.*

21 “(8) *Institutions of higher education.*

22 “(9) *Any other research institution.*

23 “(e) *FUNDING.*—*Of amounts authorized to be appro-*
 24 *priated for the Department of Energy, the Secretary of En-*

1 *ergy shall use not more than \$50,000,000 for each of fiscal*
 2 *years 2025 through 2029 to carry out this section.”.*

3 **SEC. 4. NATIONAL QUANTUM INFORMATION SCIENCE RE-**
 4 **SEARCH CENTERS.**

5 *Section 402 of the National Quantum Initiative Act*
 6 *(15 U.S.C. 8852) is amended—*

7 *(1) in subsection (a)—*

8 *(A) in paragraph (1)—*

9 *(i) by striking “basic”; and*

10 *(ii) by striking “science and technology*
 11 *and to support research conducted under*
 12 *section 401” and inserting “science, engi-*
 13 *neering, and technology, expand capacity*
 14 *for the domestic quantum workforce, and*
 15 *support research conducted under sections*
 16 *401, 403, and 404”; and*

17 *(B) in paragraph (2)(C), by inserting “that*
 18 *may include 1 or more commercial entities”*
 19 *after “collaborations”;*

20 *(2) in subsection (b), by inserting “and should be*
 21 *inclusive of the variety of viable quantum tech-*
 22 *nologies, as appropriate” before the period at the end;*

23 *(3) in subsection (c)—*

24 *(A) by striking “basic”; and*

1 (B) by inserting “, engineering, and tech-
 2 nology, accelerating quantum workforce develop-
 3 ment,” after “science”;

4 (4) in subsection (e), by striking paragraph (2)
 5 and inserting the following:

6 “(2) *RENEWAL*.—Each Center established under
 7 this section may be renewed for an additional period
 8 of 5 years following a successful, merit-based review
 9 and approval by the Director.”; and

10 (5) in subsection (f), in the first sentence—

11 (A) by striking “\$25,000,000” and inserting
 12 “\$35,000,000”; and

13 (B) by striking “2019 through 2023” and
 14 inserting “2025 through 2029”.

15 **SEC. 5. DEPARTMENT OF ENERGY QUANTUM NETWORK IN-**
 16 **FRASTRUCTURE RESEARCH AND DEVELOP-**
 17 **MENT PROGRAM.**

18 Section 403 of the National Quantum Initiative Act
 19 (15 U.S.C. 8853) is amended—

20 (1) in subsection (a)—

21 (A) in paragraph (4)—

22 (i) by inserting “, including” after
 23 “networking”; and

24 (ii) by striking “and” at the end;

1 (B) in paragraph (5), by striking the period
2 at the end and inserting a semicolon; and

3 (C) by adding at the end the following:

4 “(6) as applicable, leverage a diversity of modal-
5 ities and commercially available quantum hardware
6 and software; and

7 “(7) develop education and training pathways
8 related to quantum network infrastructure invest-
9 ments, aligned with existing programmatic invest-
10 ments by the Department of Energy.”; and

11 (2) in subsection (b)—

12 (A) in paragraph (1)—

13 (i) by redesignating subparagraphs (C)
14 and (D) as subparagraphs (D) and (E), re-
15 spectively; and

16 (ii) by inserting after subparagraph
17 (B) the following:

18 “(C) the Administrator of the National Aer-
19 onautics and Space Administration and the head
20 of any other relevant Federal agency, as deter-
21 mined by the Secretary;”;

22 (B) in paragraph (2)—

23 (i) in subparagraph (A), by inserting
24 “ground-to-space and” before “space-to-
25 ground”;

1 (ii) in subparagraph (E), by striking
2 “photon-based” and inserting “all applica-
3 ble modalities of”;

4 (iii) in subparagraph (F), by inserting
5 “, quantum sensors,” after “quantum re-
6 peaters”;

7 (iv) in subparagraph (G)—

8 (I) by inserting “data centers,”
9 after “repeaters,”; and

10 (II) by striking “and” at the end;

11 (v) in subparagraph (H)—

12 (I) by striking “the quantum tech-
13 nology stack” and inserting “quantum
14 technology modality stacks”; and

15 (II) by striking “National Lab-
16 oratories in” and inserting “National
17 Laboratories such as”; and

18 (vi) by adding at the end the following:

19 “(I) development of quantum network and
20 entanglement distribution protocols or applica-
21 tions, including development of network stack
22 protocols and protocols enabling integration with
23 existing technologies or infrastructure; and

24 “(J) development of high-efficiency room-
25 temperature photon detectors for quantum

1 *photonic applications, including quantum net-*
 2 *working and communications;*”;

3 (C) in paragraph (4)—

4 (i) by striking “basic”; and

5 (ii) by striking “material” and insert-
 6 ing “materials”; and

7 (D) in paragraph (5), by striking “funda-
 8 mental”; and

9 (3) in subsection (d), by striking “basic re-
 10 search” and inserting “research, development, and
 11 demonstration”.

12 **SEC. 6. DEPARTMENT OF ENERGY QUANTUM USER EXPAN-**
 13 **SION FOR SCIENCE AND TECHNOLOGY PRO-**
 14 **GRAM.**

15 Section 404 of the National Quantum Initiative Act
 16 (15 U.S.C. 8854) is amended—

17 (1) in subsection (a)—

18 (A) in the matter preceding paragraph (1),
 19 by striking “and quantum computing clouds”
 20 and inserting “, software, and cloud-based quan-
 21 tum computing”;

22 (B) in paragraph (3), by striking “and” at
 23 the end;

24 (C) in paragraph (4), by striking the period
 25 at the end and inserting a semicolon; and

1 (D) by adding at the end the following:

2 “(5) to enable development of software and ap-
3 plications, including estimation of resources needed to
4 scale applications; and

5 “(6) to develop near-term quantum applications
6 to solve public and private sector problems.”;

7 (2) in subsection (b)—

8 (A) in paragraph (4), by striking “and” at
9 the end;

10 (B) in paragraph (5), by striking the period
11 at the end and inserting a semicolon; and

12 (C) by adding at the end the following:

13 “(6) enable users to develop algorithms, software
14 tools, simulators, and applications for quantum sys-
15 tems using cloud-based quantum computers; and

16 “(7) partner with appropriate public- and pri-
17 vate-sector entities to develop training and education
18 opportunities on prototype and early-stage devices to
19 support commercial applications.”;

20 (3) in subsection (c)—

21 (A) by redesignating paragraphs (4)
22 through (8) as paragraphs (5) through (9), re-
23 spectively; and

24 (B) by inserting after paragraph (3) the fol-
25 lowing:

- 1 “(4) *the National Oceanic and Atmospheric Ad-*
2 *ministration;*”; and
3 (4) *in subsection (e)*—
4 (A) *in paragraph (4), by striking “and” at*
5 *the end;*
6 (B) *in paragraph (5), by striking the period*
7 *at the end and inserting “; and”; and*
8 (C) *by adding at the end the following:*
9 “(6) \$38,000,000 for fiscal year 2028.”.

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118TH CONGRESS
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S. 4932

A BILL

To amend the National Quantum Initiative Act to provide for a research, development, and demonstration program, and for other purposes.

NOVEMBER 21, 2024

Reported with an amendment