

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.

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IN THE SENATE OF THE UNITED STATES

AUGUST 1, 2024

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

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## 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”.

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

8 Section 401 of the National Quantum Initiative Act  
9 (15 U.S.C. 8851) is amended—

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

3           “(a) IN GENERAL.—The Secretary of Energy shall  
4 carry out a research, development, and demonstration pro-  
5 gram on quantum information science, engineering, and  
6 technology.”;

7           (2) in subsection (b)—

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

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

12           (C) by striking paragraph (3) and insert-  
13 ing the following:

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

19           (D) by redesignating paragraphs (3)  
20 through (5) as paragraphs (5) through (7), re-  
21 spectively;

22           (E) by inserting after paragraph (2) the  
23 following:

24           “(3) operate National Quantum Information  
25 Science Research Centers under section 402 to ac-

1 celerate and scale scientific and technical break-  
2 throughs in quantum information science, engineer-  
3 ing, and technology, and maintain state-of-the-art  
4 infrastructure for quantum researchers and industry  
5 partners;

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

13 “(A) quantum information theory;

14 “(B) quantum physics;

15 “(C) quantum computational science, in-  
16 cluding hardware and software, machine learn-  
17 ing, and data science;

18 “(D) applied mathematics and algorithm  
19 development;

20 “(E) quantum communications and net-  
21 working, including hardware and software for  
22 quantum communications and networking;

23 “(F) quantum sensing and detection;

24 “(G) materials science and engineering;

1           “(H) quantum modeling and simulation,  
2 including molecular modeling;

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

6           “(J) quantum chemistry;

7           “(K) quantum biology;

8           “(L) superconductive and high-perform-  
9 ance microelectronics; and

10          “(M) quantum security technologies;”;

11          (F) in paragraph (6) (as so redesign-  
12 nated)—

13           (i) in subparagraph (E), by striking  
14 “and” at the end;

15           (ii) by redesignating subparagraph  
16 (F) as subparagraph (J); and

17           (iii) by inserting after subparagraph  
18 (E) the following:

19           “(F) the Office of Electricity;

20           “(G) the Office of Cybersecurity, Energy  
21 Security, and Emergency Response;

22           “(H) the Office of Fossil Energy and Car-  
23 bon Management;

24           “(I) the Office of Technology Transitions;  
25 and”; and

1 (G) in paragraph (7) (as so redesignig-  
2 nated)—

3 (i) by striking “and” before “poten-  
4 tial”; and

5 (ii) by inserting “, and other relevant  
6 stakeholders, as determined by the Sec-  
7 retary of Energy” before the period at the  
8 end; and

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

10 “(c) INDUSTRY OUTREACH.—In carrying out the pro-  
11 gram under subsection (a), the Secretary of Energy shall  
12 support the quantum technology industry and promote  
13 commercialization of applications of quantum technology  
14 relevant to the activities of the Department of Energy  
15 by—

16 “(1) educating—

17 “(A) the energy industry on near-term and  
18 commercially available quantum technologies;  
19 and

20 “(B) the quantum industry on potential  
21 energy applications;

22 “(2) accelerating the advancements of United  
23 States quantum computing, communications, net-  
24 working, sensing, and security capabilities to protect  
25 and optimize the energy sector;

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

4           “(4) facilitating commercialization of quantum  
5           technologies from National Laboratories and engag-  
6           ing with the Quantum Economic Development Con-  
7           sortium and other organizations, as applicable, to  
8           transition component technologies that advance the  
9           development of a quantum supply chain; and

10           “(5) to the extent practicable, ensuring industry  
11           partner access, especially for small- and medium-  
12           sized businesses, to specialized quantum instrumen-  
13           tation, equipment, testbeds, and other infrastructure  
14           to design, prototype, and test novel quantum hard-  
15           ware and streamline user access to reduce costs and  
16           other administrative burdens.

17           “(d) HIGH-PERFORMANCE COMPUTING STRATEGIC  
18           PLAN.—

19           “(1) IN GENERAL.—Not later than 1 year after  
20           the date of enactment of this subsection, the Sec-  
21           retary of Energy shall submit to Congress a 10-year  
22           strategic plan to guide Federal programs in design-  
23           ing, expanding, and procuring hybrid, energy-effi-  
24           cient high-performance computing systems capable  
25           of integrating with a diverse set of accelerators, in-

1 including quantum, artificial intelligence, and machine  
2 learning accelerators, to enable the computing facili-  
3 ties of the Department of Energy to advance na-  
4 tional computing resources.

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

7 “(A) A conceptual plan to leverage capa-  
8 bilities and infrastructure from the exascale  
9 computing program, as the Secretary of Energy  
10 determines necessary.

11 “(B) A plan to minimize disruptions to the  
12 advanced scientific computing workforce.

13 “(C) A consideration of a diversity of  
14 quantum computing modalities.

15 “(D) A plan to integrate cloud access of  
16 commercially available quantum hardware and  
17 software to complement on-premises high-per-  
18 formance computing systems and resources con-  
19 sistent with the QUEST program established  
20 under section 404.

21 “(e) EARLY-STAGE QUANTUM HIGH-PERFORMANCE  
22 COMPUTING RESEARCH AND DEVELOPMENT PROGRAM.—

23 “(1) IN GENERAL.—The Secretary of Energy  
24 shall establish an early-stage research and develop-

1       ment program in quantum high-performance com-  
2       puting—

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

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

8       “(2) ACTIVITIES.—The program established  
9       under paragraph (1) shall—

10              “(A) support early-stage quantum super-  
11       computing testbeds and prototypes; and

12              “(B) connect early-stage quantum high-  
13       performance computing projects to the Centers  
14       funded under this Act.

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

20       “(f) SUPPLY CHAIN STUDY.—Not later than 180  
21       days after the date of enactment of this subsection, the  
22       Secretary of Energy shall conduct a study on quantum  
23       science, engineering, and technology supply chain needs,  
24       including—



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

4           “(2) making recommendations on how to  
5 strengthen the domestic supply of materials and  
6 technologies necessary for the development of a ro-  
7 bust manufacturing base and workforce.

8           “(g) TRAINEESHIP PROGRAM.—

9           “(1) IN GENERAL.—The Secretary of Energy  
10 shall establish a university-led traineeship pro-  
11 gram—

12           “(A) to address workforce development  
13 needs in quantum information science, engi-  
14 neering, and technology; and

15           “(B) that will focus on supporting in-  
16 creased participation, workforce development,  
17 and research experiences for underrepresented  
18 undergraduate and graduate students.

19           “(2) FUNDING.—Of funds made available under  
20 subsection (i)(1), the Secretary of Energy shall use  
21 not more than \$5,000,000 for each of fiscal years  
22 2025 through 2029 to carry out the activities under  
23 this subsection.

24           “(h) COORDINATION OF ACTIVITIES.—In carrying  
25 out this section, the Secretary of Energy shall, to the max-

1 imum extent practicable, coordinate with the Director of  
2 the National Science Foundation, the Director of the Na-  
3 tional Institute of Standards and Technology, the Admin-  
4 istrator of the National Aeronautics and Space Adminis-  
5 tration, the Director of the Defense Advanced Research  
6 Projects Agency, and the heads of other relevant Federal  
7 departments and agencies to ensure that programs and  
8 activities carried out under this section complement and  
9 do not duplicate existing efforts across the Federal govern-  
10 ment.

11 “(i) FUNDING.—

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

20 “(2) RESTRICTIONS.—

21 “(A) CONFUCIUS INSTITUTE.—None of the  
22 funds made available under this subsection may  
23 be obligated to or expended by an institution of  
24 higher education that maintains a contract or

1 other agreement with a Confucius Institute or  
2 any successor of a Confucius Institute.

3 “(B) FOREIGN COUNTRIES AND ENTITIES  
4 OF CONCERN.—

5 “(i) DEFINITIONS.—In this subpara-  
6 graph:

7 “(I) FOREIGN COUNTRY OF CON-  
8 CERN.—The term ‘foreign country of  
9 concern’ means—

10 “(aa) a covered nation (as  
11 defined in section 4872(d) of title  
12 10, United States Code); and

13 “(bb) any other country that  
14 the Secretary of Energy, in con-  
15 sultation with the Secretary of  
16 Defense, the Secretary of State,  
17 and the Director of National In-  
18 telligence, determines to be en-  
19 gaged in conduct that is detri-  
20 mental to the national security or  
21 foreign policy of the United  
22 States.

23 “(II) FOREIGN ENTITY OF CON-  
24 CERN.—The term ‘foreign entity of

1 concern’ means a foreign entity  
2 that—

3 “(aa) is designated as a for-  
4 eign terrorist organization by the  
5 Secretary of State under section  
6 219(a) of the Immigration and  
7 Nationality Act (8 U.S.C.  
8 1189(a));

9 “(bb) is included on the list  
10 of specially designated nationals  
11 and blocked persons maintained  
12 by the Office of Foreign Assets  
13 Control of the Department of the  
14 Treasury;

15 “(cc) is owned by, controlled  
16 by, or subject to the jurisdiction  
17 or direction of a government of a  
18 foreign country that is a covered  
19 nation (as defined in section  
20 4872(d) of title 10, United  
21 States Code);

22 “(dd) is alleged by the At-  
23 torney General to have been in-  
24 volved in activities for which a  
25 conviction was obtained under—

1                   “(AA) chapter 37 of  
2 title 18, United States Code  
3 (commonly known as the  
4 ‘Espionage Act’);

5                   “(BB) section 951 or  
6 1030 of title 18, United  
7 States Code;

8                   “(CC) chapter 90 of  
9 title 18, United States Code  
10 (commonly known as the  
11 ‘Economic Espionage Act of  
12 1996’);

13                   “(DD) the Arms Ex-  
14 port Control Act (22 U.S.C.  
15 2751 et seq.);

16                   “(EE) section 224,  
17 225, 226, 227, or 236 of the  
18 Atomic Energy Act of 1954  
19 (42 U.S.C. 2274, 2275,  
20 2276, 2277, 2284);

21                   “(FF) the Export Con-  
22 trol Reform Act of 2018 (50  
23 U.S.C. 4801 et seq.); or

24                   “(GG) the International  
25 Emergency Economic Pow-

1                   ers Act (50 U.S.C. 1701 et  
2                   seq.); or

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

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

19 **SEC. 3. DOE QUANTUM INSTRUMENTATION AND FOUNDRY**  
20 **PROGRAM.**

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

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

3 “(a) IN GENERAL.—The Secretary of Energy shall  
4 establish an instrumentation and infrastructure program  
5 to carry out the following:

6 “(1) Maintain United States leadership in  
7 quantum information science, engineering, and tech-  
8 nology.

9 “(2) Develop domestic quantum supply chains.

10 “(3) Provide resources for the broader scientific  
11 community.

12 “(4) Support activities carried out under sec-  
13 tions 401, 403, and 404.

14 “(b) PROGRAM COMPONENTS.—In carrying out the  
15 program under subsection (a), the Secretary of Energy  
16 shall—

17 “(1) develop, design, build, purchase, and com-  
18 mercialize specialized equipment, laboratory infra-  
19 structure, and state-of-the-art instrumentation to  
20 advance quantum engineering research and the de-  
21 velopment of quantum component technologies at a  
22 scale sufficient to meet the needs of the scientific  
23 community and enable commercialization of quan-  
24 tum technology;

25 “(2) leverage the capabilities of National Lab-  
26 oratories and Nanoscale Science Research Centers,

1 including facilities and experts that research and de-  
 2 velop novel quantum materials and devices; and

3 “(3) consider the technologies and end-use ap-  
 4 plications identified by the Quantum Economic De-  
 5 velopment Consortium as having significant eco-  
 6 nomic potential.

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

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

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

21 Section 402 of the National Quantum Initiative Act  
 22 (15 U.S.C. 8852) is amended—

23 (1) in subsection (a)—

24 (A) in paragraph (1)—

25 (i) by striking “basic”; and



- 1                   (ii) by striking “science and tech-  
2                   nology and to support research conducted  
3                   under section 401” and inserting “science,  
4                   engineering, and technology, expand capac-  
5                   ity for the domestic quantum workforce,  
6                   and support research conducted under sec-  
7                   tions 401, 403, and 404”; and
- 8                   (B) in paragraph (2)(C), by inserting  
9                   “that may include 1 or more commercial enti-  
10                  ties” after “collaborations”;
- 11                  (2) in subsection (b), by inserting “and should  
12                  be inclusive of the variety of viable quantum tech-  
13                  nologies, as appropriate” before the period at the  
14                  end;
- 15                  (3) in subsection (c)—
- 16                    (A) by striking “basic”; and
- 17                    (B) by inserting “, engineering, and tech-  
18                    nology, accelerating quantum workforce devel-  
19                    opment,” after “science”;
- 20                  (4) in subsection (d)(1)—
- 21                    (A) in subparagraph (C), by striking  
22                    “and” at the end;
- 23                    (B) by redesignating subparagraph (D) as  
24                    subparagraph (E); and

1 (C) by inserting after subparagraph (C)  
2 the following:

3 “(D) the Office of Technology Transitions;  
4 and”;

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

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

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

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

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

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

19 Section 403 of the National Quantum Initiative Act  
20 (15 U.S.C. 8853) is amended—

21 (1) in subsection (a)—

22 (A) in paragraph (4)—

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

25 (ii) by striking “and” at the end;

1 (B) in paragraph (5), by striking the pe-  
2 riod 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 mo-  
5 dalities and commercially available quantum hard-  
6 ware 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  
14 (C) and (D) as subparagraphs (D) and  
15 (E), respectively; and

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

18 “(C) the Administrator of the National  
19 Aeronautics and Space Administration;”;

20 (B) in paragraph (2)—

21 (i) in subparagraph (A), by inserting  
22 “ground-to-space and” before “space-to-  
23 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  
13 technology stack” and inserting  
14 “quantum technology modality  
15 stacks”; and

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

19 (vi) by adding at the end the fol-  
20 lowing:

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

1           “(J) development of high-efficiency room-  
2           temperature photon detectors for quantum  
3           phonic applications, including quantum net-  
4           working and communications;”;

5           (C) in paragraph (4)—

6           (i) by striking “basic”; and

7           (ii) by striking “material” and insert-  
8           ing “materials”; and

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

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

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

17          Section 404 of the National Quantum Initiative Act  
18 (15 U.S.C. 8854) is amended—

19          (1) in subsection (a)—

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

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

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

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

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

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

9 (2) in subsection (b)—

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

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

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

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

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

21 (3) in subsection (c)—

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

1 (B) by inserting after paragraph (3) the  
2 following:

3 “(4) the National Oceanic and Atmospheric Ad-  
4 ministration;”; and

5 (4) in subsection (e)—

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

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

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

11 “(6) \$38,000,000 for fiscal year 2028.”.

○