

117TH CONGRESS
2D SESSION

S. 3740

To provide for a comprehensive and integrative program to accelerate microelectronics research and development at the Department of Energy, and for other purposes.

IN THE SENATE OF THE UNITED STATES

MARCH 2, 2022

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

A BILL

To provide for a comprehensive and integrative program to accelerate microelectronics research and development at the Department of Energy, 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 “Microelectronics Re-
5 search for Energy Innovation Act of 2022” or the “Micro
6 Act of 2022”.

7 **SEC. 2. DEFINITIONS.**

8 In this Act:

1 (1) CENTER.—The term “Center” means a
2 Microelectronics Science Research Center established
3 pursuant to section 5.

4 (2) DEPARTMENT.—The term “Department”
5 means the Department of Energy.

6 (3) DIRECTOR.—The term “Director” means
7 the Director of the Office of Science.

8 (4) HISTORICALLY BLACK COLLEGE OR UNI-
9 VERSITY.—The term “historically Black college or
10 university” has the meaning given the term “part B
11 institution” in section 322 of the Higher Education
12 Act of 1965 (20 U.S.C. 1061).

13 (5) INSTITUTION OF HIGHER EDUCATION.—The
14 term “institution of higher education” has the
15 meaning given the term in section 101(a) of the
16 Higher Education Act of 1965 (20 U.S.C. 1001(a)).

17 (6) MINORITY-SERVING INSTITUTION.—The
18 term “minority-serving institution” means an insti-
19 tution described in any of paragraphs (1) through
20 (7) of section 371(a) of the Higher Education Act
21 of 1965 (20 U.S.C. 1067q(a)).

22 (7) NATIONAL LABORATORY.—The term “Na-
23 tional Laboratory” has the meaning given the term
24 in section 2 of the Energy Policy Act of 2005 (42
25 U.S.C. 15801).

1 (8) PROGRAM.—The term “program” means
2 the program established under section 4(a).

3 (9) SECRETARY.—The term “Secretary” means
4 the Secretary of Energy.

5 (10) SKILLED TECHNICAL WORKFORCE.—The
6 term “skilled technical workforce” has the meaning
7 given the term in section 4(b)(3) of the Innovations
8 in Mentoring, Training, and Apprenticeships Act (42
9 U.S.C. 1862p note; Public Law 115–402).

10 (11) TRIBAL COLLEGE OR UNIVERSITY.—The
11 term “Tribal College or University” has the meaning
12 given the term in section 316 of the Higher Edu-
13 cation Act of 1965 (20 U.S.C. 1059c).

14 **SEC. 3. FINDINGS.**

15 Congress finds that—

16 (1) the coming end of Moore’s Law presents
17 major technological challenges and opportunities for
18 the United States and has important implications
19 for national security, economic competitiveness, and
20 scientific discovery;

21 (2) future progress and innovation in microelec-
22 tronics, and the maintenance of a robust domestic
23 microelectronics supply chain, will require an ap-
24 proach that advances relevant materials science,
25 electronic and photonic device technologies, proc-

1 essing and packaging technologies, manufacturing
2 technologies, circuit, chip, and system architecture,
3 and software system and algorithm development in
4 a codesign fashion;

5 (3) the National Laboratories possess unique
6 technical expertise and user facilities that are essen-
7 tial to—

8 (A) overcoming foundational research chal-
9 lenges relevant to the topics described in para-
10 graph (2); and

11 (B) translating and transferring research
12 outcomes to industry; and

13 (4) the expertise and user facilities of the Na-
14 tional Laboratories described in paragraph (3) will
15 enable the Department to drive advances in micro-
16 electronics that are essential to meeting future needs
17 in areas critical to the missions of the Department
18 and the future competitiveness of the domestic
19 microelectronics industry, including high-perform-
20 ance computing, emerging data-centric computing
21 approaches and energy-efficient computing, optical
22 sensors, sources, and wireless networks, and power
23 electronics and electricity delivery systems.

1 **SEC. 4. MICROELECTRONICS RESEARCH PROGRAM.**

2 (a) IN GENERAL.—The Secretary shall carry out a
3 crosscutting program of research, development, and dem-
4 onstration of microelectronics relevant to the missions of
5 the Department to enable advances and breakthroughs in
6 measurement science, standards, material characteriza-
7 tion, instrumentation, testing, and manufacturing capa-
8 bilities that will—

9 (1) accelerate underlying research and develop-
10 ment for design, development, and manufacturability
11 of next-generation microelectronics; and

12 (2) ensure the global competitiveness of the
13 United States in the field of microelectronics.

14 (b) RESEARCH PROJECTS.—

15 (1) IN GENERAL.—In carrying out the program,
16 the Secretary shall provide financial assistance to el-
17 igible entities described in paragraph (2) to carry
18 out research projects in—

19 (A) foundational science areas, including—

20 (i) materials sciences, chemical
21 sciences, and plasma science synthesis and
22 fabrication;

23 (ii) novel microelectronics devices, in-
24 cluding emerging memory and storage
25 technologies;

- 1 (iii) diverse computing architectures
- 2 and paradigms, including analog com-
- 3 puting and edge computing;
- 4 (iv) data-driven modeling and simula-
- 5 tion;
- 6 (v) integrated sensing, power har-
- 7 vesting, and communications;
- 8 (vi) component integration and sub-
- 9 systems;
- 10 (vii) photonic integration and pack-
- 11 aging; and
- 12 (viii) development of codesign frame-
- 13 works for all stages of microelectronics de-
- 14 sign, development, fabrication, and applica-
- 15 tion;
- 16 (B) cybersecurity by design to result in
- 17 trusted and resilient microelectronics;
- 18 (C) methods for leveraging advanced sim-
- 19 ulation and artificial intelligence to enhance co-
- 20 design and discovery in microelectronics;
- 21 (D) in consultation with the National In-
- 22 stitute of Standards and Technology, fabrica-
- 23 tion and processing science and metrology asso-
- 24 ciated with microelectronics manufacturing, in-

cluding lithography, patterning, surface deposition, etching, and cleaning;

(E) approaches for optimizing system-level energy efficiency of advanced computing systems, the electrical grid, power electronics, and other energy infrastructure;

(F) approaches for enhancing the durability and lifetime of radiation-hardened electronics;

(G) enhancement of microelectronics security, including the development of integrated devices, packages, and thermal management for severe environments and national security; and

(H) in coordination with other relevant initiatives of the Department, methods to improve the lifetime, maintenance, recycling, reuse, and sustainability of microelectronics components and systems, including technologies and strategies that reduce the use of energy, water, critical materials, and other commodities that the Secretary determines are vulnerable to disruption.

(2) ELIGIBLE ENTITIES.—An eligible entity referred to in paragraph (1) is—

1 (A) an institution of higher education, in-
2 cluding a historically Black college or univer-
3 sity, a Tribal College or University, and a mi-
4 nority-serving institution;

5 (B) a nonprofit research organization;

6 (C) a State research agency;

7 (D) a National Laboratory;

8 (E) a private commercial entity;

9 (F) a partnership or consortium of 2 or
10 more entities described in subparagraphs (A)
11 through (E); and

12 (G) any other entity that the Secretary de-
13 termines appropriate.

14 (3) NOTIFICATION.—Not later than 30 days
15 after the Secretary provides financial assistance to
16 an eligible entity under paragraph (1), the Secretary
17 shall submit to the Committee on Energy and Nat-
18 ural Resources of the Senate and the Committee on
19 Science, Space, and Technology of the House of
20 Representatives a notification of the financial assist-
21 ance provided, including—

22 (A) the criteria used by the Secretary to
23 select the eligible entity receiving the financial
24 assistance;

1 (B) the manner in which the criteria de-
2 scribed in subparagraph (A) comport with the
3 purposes of the program described in subsection
4 (a); and

5 (C) a description of the research project
6 that the eligible entity will carry out using the
7 financial assistance.

8 (c) TECHNOLOGY TRANSFER.—In carrying out the
9 program, the Secretary, in coordination with the Director
10 of the Office of Technology Transitions and in consulta-
11 tion with the private sector, shall—

12 (1) support translational research and transfer
13 of microelectronics technologies; and

14 (2) identify emerging research and development
15 needs of industry and government for the benefit of
16 United States economic competitiveness.

17 (d) WORKFORCE DEVELOPMENT.—In carrying out
18 the program, the Secretary shall support—

19 (1) workforce development through existing au-
20 thorities and mechanisms available to the Depart-
21 ment, including internships, fellowships, individual
22 investigator grants, and other activities the Sec-
23 retary determines appropriate; and

24 (2) education and outreach activities—

1 (A) to disseminate information and pro-
2 mote understanding of microelectronics and re-
3 lated fields among students at elementary
4 school, secondary school, high school, under-
5 graduate, and graduate levels; and

6 (B) that may include educational program-
7 ming with an emphasis on experiential and
8 project-based learning.

9 (e) OUTREACH.—The Secretary shall conduct out-
10 reach to recruit applicants to the program and engage par-
11 ticipants from all regions of the United States, especially
12 individuals from underserved communities and groups his-
13 torically underrepresented in science, technology, engi-
14 neering, and mathematics.

15 (f) COORDINATION.—In carrying out the program,
16 the Secretary shall—

17 (1) coordinate across all relevant programs and
18 offices of the Department; and

19 (2) coordinate the research carried out under
20 the program relating to microelectronics with activi-
21 ties carried out by other Federal agencies and pro-
22 grams relating to microelectronics research, develop-
23 ment, manufacturing, and supply chain security, in-
24 cluding the programs authorized under subsections

25 (c) through (f) of section 9906 of the William M.

1 (Mac) Thornberry National Defense Authorization
 2 Act for Fiscal Year 2021 (15 U.S.C. 4656).

3 (g) REPORT.—Not later than 180 days after the date
 4 of enactment of this Act, the Secretary shall submit to
 5 the Committee on Energy and Natural Resources of the
 6 Senate and the Committee on Science, Space, and Tech-
 7 nology of the House of Representatives a report describing
 8 the goals, priorities, and anticipated outcomes of the pro-
 9 gram.

10 (h) FUNDING.—There are authorized to be appro-
 11 priated to the Secretary to carry out this section—

- 12 (1) \$75,000,000 for fiscal year 2022;
- 13 (2) \$100,000,000 for fiscal year 2023;
- 14 (3) \$100,000,000 for fiscal year 2024;
- 15 (4) \$100,000,000 for fiscal year 2025; and
- 16 (5) \$100,000,000 for fiscal year 2026.

17 **SEC. 5. MICROELECTRONICS SCIENCE RESEARCH CEN-**
 18 **TERS.**

19 (a) IN GENERAL.—In carrying out the program, sub-
 20 ject to the availability of appropriations, the Director shall
 21 designate not more than 4 eligible entities as Microelec-
 22 tronics Science Research Centers—

- 23 (1) to conduct mission-driven research to ad-
 24 dress foundational challenges in the design, develop-

1 ment, characterization, prototyping, demonstration,
2 and fabrication of microelectronics; and

3 (2) to facilitate the translation of research re-
4 sults to industry.

5 (b) ELIGIBLE ENTITIES.—An eligible entity referred
6 to in subsection (a) is—

7 (1) a National Laboratory;

8 (2) an institution of higher education, including
9 a historically Black college or university, a Tribal
10 College or University, and a minority-serving institu-
11 tion;

12 (3) a private commercial entity;

13 (4) a research center;

14 (5) a partnership or consortium of 2 or more
15 entities described in paragraphs (1) through (4); and

16 (6) any other entity that the Secretary deter-
17 mines appropriate.

18 (c) ACTIVITIES.—The activities of a Center shall in-
19 clude research, development, and demonstration activities
20 for—

21 (1) accelerating the development of new micro-
22 electronics science and technology, including mate-
23 rials, devices, circuits, systems, architectures, fab-
24 rication tools, processes, diagnostics, modeling, syn-

1 thesis, and, in consultation with the National Insti-
2 tute of Standards and Technology, metrology;

3 (2) advancing the sustainability and energy effi-
4 ciency of new microelectronics devices, packages, and
5 systems;

6 (3) application-driven codesign and prototyping
7 of novel devices to facilitate laboratory-to-fabrication
8 transition;

9 (4) advancing knowledge and experimental ca-
10 pabilities in surface and materials science, plasma
11 science, and computational and theoretical methods,
12 including artificial intelligence, multiscale codesign,
13 and advanced supercomputing capabilities to invent
14 and manufacture revolutionary microelectronic de-
15 vices;

16 (5) creating technology testbeds for prototyping
17 platforms for validation and verification of new ca-
18 pabilities and sharing of ideas, intellectual property,
19 and the unique facilities of the Department;

20 (6) supporting development of cybersecurity ca-
21 pabilities for computing architectures that measur-
22 ably improve safety and security and are adaptable
23 for existing and future applications; and

24 (7) supporting long-term and short-term work-
25 force development in microelectronics.

1 (d) REQUEST FOR PROPOSALS.—The Director shall,
2 at such time, in such manner, and containing such infor-
3 mation as the Director determines to be appropriate, issue
4 a request for proposals from eligible entities described in
5 subsection (b) seeking to be designated as a Center.

6 (e) OPERATION.—

7 (1) DURATION.—

8 (A) IN GENERAL.—Each Center shall oper-
9 ate for a period of not more than 5 years, un-
10 less renewed for an additional 5-year period in
11 accordance with subparagraph (B).

12 (B) RENEWAL.—

13 (i) INITIAL RENEWAL.—In the case of
14 a Center that has operated for not more
15 than 5 years, the Director may renew sup-
16 port for the Center on a merit-reviewed
17 basis for a period of not more than 5
18 years.

19 (ii) 10-YEAR OPERATION.—In the case
20 of a Center that has operated for not less
21 than 5 years but not more than 10 years,
22 the Director may renew support for the
23 Center on a competitive, merit-reviewed
24 basis for a period of not more than 5
25 years.

1 (iii) 15-YEAR OPERATION.—In the
2 case of a Center that has operated for not
3 less than 10 years but not more than 15
4 years, the Director may renew support for
5 the Center on a merit-reviewed basis for a
6 period of not more than 5 years.

7 (2) TERMINATION.—Consistent with the exist-
8 ing authorities of the Department, the Director may
9 terminate an underperforming Center during the
10 performance period.

11 (f) TECHNOLOGY TRANSFER.—The Director, in co-
12 ordination with the Director of the Office of Technology
13 Transitions, shall seek to enter into partnerships with in-
14 dustry groups to facilitate the translation and transfer of
15 research results produced by the Centers.

16 (g) COORDINATION.—The Secretary shall—

17 (1) establish a coordinating network to coordi-
18 nate cross-cutting research and foster communica-
19 tion and collaboration among the Centers; and

20 (2) ensure coordination, and avoid unnecessary
21 duplication, of the activities of each Center with the
22 activities of—

23 (A) other research entities of the Depart-
24 ment, including—

1 (i) the Nanoscale Science Research
2 Centers;

3 (ii) the National Quantum Informa-
4 tion Science Research Centers;

5 (iii) the Energy Frontier Research
6 Centers;

7 (iv) the Energy Innovation Hubs;

8 (v) the National Laboratories; and

9 (vi) other offices of the Department;

10 (B) the national semiconductor technology
11 center established under section 9906(c)(1) of
12 the William M. (Mac) Thornberry National De-
13 fense Authorization Act for Fiscal Year 2021
14 (15 U.S.C. 4656(c)(1));

15 (C) institutions of higher education;

16 (D) industry; and

17 (E) relevant research activities carried out
18 by other Federal agencies.

19 (h) WORKFORCE DEVELOPMENT.—Each Center shall
20 support workforce development through—

21 (1) incorporation of undergraduate students,
22 postdoctoral fellows, graduate students, and early
23 career researchers, as well as elementary school, sec-
24 ondary school, and high school students, through op-

1 portunities such as dual-enrollment programs and
2 work-based learning programs, as applicable;

3 (2) hands-on research and equipment training
4 programs;

5 (3) technical training and certificate programs
6 for the skilled technical workforce;

7 (4) facilitation of engagement among academic,
8 industry, and laboratory researchers; and

9 (5) public outreach activities, including to stu-
10 dents at elementary school, secondary school, high
11 school, undergraduate, and graduate levels, which
12 activities may include educational programming with
13 an emphasis on experiential and project-based learn-
14 ing.

15 (i) OUTREACH.—The Secretary shall conduct out-
16 reach to recruit applicants to the program and engage par-
17 ticipants from all regions of the United States, especially
18 individuals from underserved communities and groups his-
19 torically underrepresented in science, technology, engi-
20 neering, and mathematics.

21 (j) INTELLECTUAL PROPERTY.—The Secretary shall
22 ensure that the intellectual property and value proposition
23 created by the Centers are retained within the United
24 States.

25 (k) NOTIFICATION.—

1 (1) DEFINITION OF COVERED DETERMINA-
 2 TION.—In this subsection, the term “covered deter-
 3 mination” means a determination of the Secretary—

4 (A) to designate an eligible entity as a
 5 Center under subsection (a);

6 (B) to renew support for a Center under
 7 subsection (e)(1)(B); or

8 (C) to terminate a Center under subsection
 9 (e)(2).

10 (2) NOTIFICATION.—Not later than 30 days
 11 after the Secretary makes a covered determination,
 12 the Secretary shall submit to the Committee on En-
 13 ergy and Natural Resources of the Senate and the
 14 Committee on Science, Space, and Technology of the
 15 House of Representatives a notification of the cov-
 16 ered determination, including—

17 (A) the criteria used by the Secretary to
 18 make the covered determination; and

19 (B) the manner in which the criteria de-
 20 scribed in subparagraph (A) comport with the
 21 purposes of the program described in subsection
 22 (a).

23 (l) FUNDING.—Subject to the availability of appro-
 24 priations, the Secretary shall use not more than

- 1 \$25,000,000 to fund each Center for each of fiscal years
- 2 2022 through 2026.

