

119TH CONGRESS  
2D SESSION

# S. 4406

To amend the Energy Independence and Security Act of 2007 to direct research, development, demonstration, and commercial application activities in support of next-generation geothermal systems in various conditions, and for other purposes.

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## IN THE SENATE OF THE UNITED STATES

APRIL 28, 2026

Ms. CORTEZ MASTO (for herself and Ms. MURKOWSKI) 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 Energy Independence and Security Act of 2007 to direct research, development, demonstration, and commercial application activities in support of next-generation geothermal systems in various conditions, 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 “Next-Generation Geo-  
5       thermal Research and Development Act”.

1 **SEC. 2. GEOTHERMAL ENERGY.**

2 (a) EISA DEFINITIONS.—Section 612 of the Energy  
3 Independence and Security Act of 2007 (42 U.S.C.  
4 17191) is amended—

5 (1) by redesignating paragraphs (1) through  
6 (8) as paragraphs (2), (3), (4), (5), (6), (7), (8),  
7 and (12), respectively;

8 (2) by inserting before paragraph (2) (as so re-  
9 designated) the following:

10 “(1) CLOSED-LOOP GEOTHERMAL SYSTEMS.—  
11 The term ‘closed-loop geothermal systems’ means a  
12 wellbore or subsurface circuit of wellbores containing  
13 a fluid heated through contact with the borehole  
14 wall.”; and

15 (3) by inserting after paragraph (8) (as so re-  
16 designated) the following:

17 “(9) NEXT-GENERATION GEOTHERMAL SYS-  
18 TEMS.—The term ‘next-generation geothermal sys-  
19 tems’ means—

20 “(A) enhanced geothermal systems;

21 “(B) closed-loop geothermal systems; and

22 “(C) in supercritical conditions—

23 “(i) enhanced geothermal systems;

24 “(ii) closed-loop geothermal systems;

25 or

1 “(iii) other technologies, as deter-  
 2 mined by the Secretary.

3 “(10) SUPERCRITICAL CONDITIONS.—The term  
 4 ‘supercritical conditions’ means subsurface tempera-  
 5 ture conditions at or above the supercritical tem-  
 6 perature of the primary fluid present.

7 “(11) SUPERCRITICAL GEOTHERMAL.—The  
 8 term ‘supercritical geothermal’ means energy derived  
 9 from a subsurface geologic rock resource existing in-  
 10 situ at or above the supercritical temperature of the  
 11 primary fluid present.”.

12 (b) HYDROTHERMAL RESEARCH AND DEVELOPMENT  
 13 PROGRAMS.—Section 613(b)(1) of the Energy Independ-  
 14 ence and Security Act of 2007 (42 U.S.C. 17192(b)(1))  
 15 is amended by striking “advanced geologic tools to assist”  
 16 and inserting “advanced tools, including machine learning  
 17 algorithms, to assist”.

18 (c) GEOTHERMAL SYSTEMS RESEARCH AND DEVEL-  
 19 OPMENT.—Section 614 of the Energy Independence and  
 20 Security Act of 2007 (42 U.S.C. 17193) is amended—

21 (1) in subsection (d)(1), by striking “among the  
 22 Office of Fossil Energy, the Office of Energy Effi-  
 23 ciency and Renewable Energy,” and inserting  
 24 “across the Department”; and

25 (2) in subsection (h)—

1 (A) in paragraph (1), by inserting “and  
2 publicly available subsurface data, including  
3 data reported as part of fossil fuel and mining  
4 operations,” after “geothermal drilling informa-  
5 tion”; and

6 (B) in paragraph (2), by adding at the end  
7 the following:

8 “(C) UPDATES.—The repository estab-  
9 lished under paragraph (1) shall be periodically  
10 updated in order to carry out the following:

11 “(i) Standardize data in a uniform  
12 manner to the maximum extent practicable  
13 and enable analysis across different  
14 projects.

15 “(ii) Enhance the accessibility and  
16 usability of data to increase analysis of  
17 geothermal energy, including next-genera-  
18 tion geothermal systems on regional, local,  
19 and site-specific scales.

20 “(iii) Increase uses of data, including  
21 data viewable by map and organization by  
22 common attributes such as region.

23 “(iv) Make other improvements in  
24 functionality and usability, as determined  
25 by the Secretary.

1                   “(D)     MEMORANDUM     OF     UNDER-  
2                   STANDING.—

3                   “(i)   IN   GENERAL.—The   Secretary  
4                   shall enter into a memorandum of under-  
5                   standing with the Secretary of the Interior,  
6                   and may enter into a memorandum of un-  
7                   derstanding with the head of any other rel-  
8                   evant Federal department or agency, for  
9                   notifying, sharing, and providing opportu-  
10                  nities for additional data collection regard-  
11                  ing shared geothermal development data  
12                  from projects funded by each applicable  
13                  department or agency, including data from  
14                  mining, critical minerals, and energy  
15                  projects, such as subsurface heat data,  
16                  seismic data, lithology data, boundaries of  
17                  State-protected and federally protected  
18                  areas, and existing transmission capacity.

19                  “(ii) PRIORITIZATION.—To the max-  
20                  imum extent practicable, activities con-  
21                  ducted under a memorandum of under-  
22                  standing entered into under clause (i) shall  
23                  prioritize heat, lithology, and strain pro-  
24                  files through deep exploration boreholes

and control points for deep heat mapping  
and geothermal development.

“(E) REGIONAL DEEP DATA PROBES.—

“(i) IN GENERAL.—The Secretary shall work with the Secretary of the Interior, who shall be responsible for commissioning the drilling of deep exploration boreholes deeper than 8 kilometers in depth in representative geological provinces in the United States to provide control points for deep heat mapping and geothermal development.

“(ii) REQUIREMENTS.—The resulting data shall—

“(I) include an exploration of heat, lithology, and subsurface stress state; and

“(II) be shared publicly on the drilling data repository.”.

(d) ENHANCED GEOTHERMAL SYSTEMS RESEARCH AND DEVELOPMENT.—Section 615 of the Energy Independence and Security Act of 2007 (42 U.S.C. 17194) is amended—

(1) in the section heading, by striking “**RESEARCH AND DEVELOPMENT**” and inserting

1       **“AND CLOSED-LOOP GEOTHERMAL SYSTEMS**  
 2       **RESEARCH, DEVELOPMENT, AND TESTING”;**

3           (2) by inserting “and closed-loop geothermal  
 4       systems” after “enhanced geothermal systems” each  
 5       place it appears;

6           (3) in subsection (b)—

7               (A) in the subsection heading, by inserting  
 8       “AND CLOSED-LOOP GEOTHERMAL SYSTEMS”  
 9       after “SYSTEMS”;

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

12           (C) in paragraph (12), by striking the pe-  
 13       riod at the end and inserting “; and”; and

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

15       “(13) the research topics described in para-  
 16       graphs (1) through (12) in supercritical condi-  
 17       tions.”;

18           (4) in subsection (c)—

19               (A) by inserting “systems and closed-loop  
 20       geothermal systems” after “enhanced geo-  
 21       thermal” each place it appears;

22           (B) by redesignating paragraph (7) as  
 23       paragraph (8); and

24           (C) by inserting after paragraph (6) the  
 25       following:

1           “(7) TESTING OF NEXT-GENERATION GEO-  
 2           THERMAL SYSTEMS IN SUPERCRITICAL CONDI-  
 3           TIONS.—Not later than 1 year after the date of en-  
 4           actment of the Next-Generation Geothermal Re-  
 5           search and Development Act, the Secretary shall  
 6           take such actions as may be necessary to ensure that  
 7           at least 1 FORGE site has the capabilities to in-  
 8           clude testing of next-generation geothermal systems  
 9           in supercritical conditions.”;

10           (5) in subsection (d)—

11                   (A) in the subsection heading, by inserting  
 12                   “AND CLOSED-LOOP GEOTHERMAL SYSTEMS”  
 13                   after “SYSTEMS”; and

14                   (B) in paragraph (2)(C), by inserting “and  
 15                   closed-loop geothermal” after “enhanced geo-  
 16                   thermal”; and

17           (6) by adding at the end the following:

18           “(e) NEXT-GENERATION GEOTHERMAL RESEARCH  
 19           AND DEVELOPMENT PROGRAM.—

20                   “(1) IN GENERAL.—Within the Geothermal  
 21                   Technologies Office of the Department, the Sec-  
 22                   retary shall support a program, to be called the  
 23                   ‘Next-Generation Research and Development Pro-  
 24                   gram’, for next-generation geothermal systems re-



1 search, development, demonstration, and commercial  
2 application activities.

3 “(2) SUPERCRITICAL GEOTHERMAL.—

4 “(A) IN GENERAL.—The program de-  
5 scribed in paragraph (1) shall include research  
6 on supercritical geothermal, including on the  
7 following topics in supercritical conditions:

8 “(i) Well completion.

9 “(ii) Reservoir creation and manage-  
10 ment, including drilling tools, casing pro-  
11 duction equipment, proppants, and pack-  
12 ers.

13 “(iii) Materials development and  
14 equipment design, including power produc-  
15 tion, specific to supercritical geothermal  
16 systems.

17 “(iv) Sensor development.

18 “(v) Water-rock geochemistry.

19 “(vi) Rock properties.

20 “(vii) Hard rock and deep drilling.

21 “(viii) Any other topics the Secretary  
22 determines necessary.

23 “(B) MILESTONE-BASED GRANTS.—In car-  
24 rying out supercritical geothermal research  
25 under the program described in paragraph (1),

1 the Secretary shall award milestone-based  
2 grants for deep drilling projects in unique  
3 geodynamic settings at each of the following  
4 milestones:

5 “(i) Tectonic crustal stress and frac-  
6 ture characterization.

7 “(ii) Laboratory work.

8 “(iii) Drilling.

9 “(iv) Flow testing.

10 “(v) Power production.

11 “(C) ADMINISTRATION.—The Secretary  
12 shall administer grants to institutions of higher  
13 education and private sector entities to carry  
14 out activities on the topics described in sub-  
15 paragraphs (A) and (B) and, to the maximum  
16 extent practicable, share data, results, and in-  
17 formation publicly.

18 “(3) REPORT ON WATER USE.—

19 “(A) IN GENERAL.—Not later than 5 years  
20 after the date of enactment of this subsection,  
21 the Secretary shall submit to the Committee on  
22 Natural Resources and the Committee on  
23 Science, Space, and Technology of the House of  
24 Representatives and the Committee on Energy  
25 and Natural Resources of the Senate a report

1 on estimated water withdrawal and consump-  
2 tion of next-generation geothermal systems.

3 “(B) REQUIREMENTS.—The report re-  
4 quired under subparagraph (A) shall include an  
5 analysis of—

6 “(i) the ability of next-generation geo-  
7 thermal systems to use brackish and non-  
8 potable water;

9 “(ii) the withdrawal and consumption  
10 of water per megawatt hour of next-gen-  
11 eration geothermal systems, as compared  
12 to other power-generation technologies;  
13 and

14 “(iii) technological and operational  
15 improvements that could lead to decreases  
16 in water withdrawal and consumption of  
17 next-generation geothermal systems.

18 “(4) NEXT-GENERATION GEOTHERMAL CENTER  
19 OF EXCELLENCE.—

20 “(A) ESTABLISHMENT.—The Secretary  
21 shall award grants, through a competitive,  
22 merit-reviewed process, to National Labora-  
23 tories (as defined in section 2 of the Energy  
24 Policy Act of 2005 (42 U.S.C. 15801)) (re-  
25 ferred to in this paragraph as the ‘National

Laboratories’), multi-institutional collaborations, public-private partnerships, State geological surveys, or institutions of higher education (or consortia thereof), for the following:

“(i) The continuation and expansion of research, development, demonstration, testing, and commercial application activities applicable to FORGE sites, including activities in supercritical conditions.

“(ii) The establishment of a next-generation geothermal systems center of excellence.

“(B) LOCATION.—In selecting National Laboratories, multi-institutional collaborations, public-private partnerships, or institutions of higher education for the establishment of a center of excellence under subparagraph (A), the Secretary shall consider the following criteria:

“(i) Whether the institution hosts an existing geothermal energy research and development program.

“(ii) Whether the institution has proven technical expertise to support geothermal energy research.

1 “(iii) Whether the institution has ac-  
2 cess to diverse geothermal resources to  
3 support next-generation geothermal sys-  
4 tems in various conditions.

5 “(C) PURPOSE.—A center of excellence es-  
6 tablished under subparagraph (A) shall coordi-  
7 nate among existing FORGE sites, the Depart-  
8 ment, institutions of higher education, and Na-  
9 tional Laboratories to carry out the following:

10 “(i) Advance research, development,  
11 demonstration, and commercial application  
12 of next-generation geothermal systems, in-  
13 cluding supercritical geothermal tech-  
14 nologies, to address both fundamental sci-  
15 entific challenges and industry and com-  
16 mercial needs, including by partnering with  
17 other academic or research institutions, in-  
18 dustry, nongovernmental organizations,  
19 Tribal entities (including Alaska Native  
20 Corporations), and State, local, or Tribal  
21 governments.

22 “(ii) Foster collaboration for edu-  
23 cation, research, and partnership initiatives  
24 in order to support the technology, deploy-  
25 ment, and workforce needs of the United

1 States geothermal energy industry, includ-  
2 ing a focus on next-generation geothermal  
3 systems.

4 “(iii) Support workforce development  
5 across the next-generation geothermal sys-  
6 tems energy development lifecycle.

7 “(iv) Provide educational, technical,  
8 and analytical assistance on next-genera-  
9 tion geothermal systems to Federal agen-  
10 cies, industry, and State, local, and Tribal  
11 governments.

12 “(v) Collect and disseminate informa-  
13 tion on best practices in all areas relating  
14 to developing and managing geothermal  
15 energy resources and energy systems, in-  
16 cluding next-generation geothermal sys-  
17 tems.

18 “(5) COMMERCIAL-READINESS INNOVATION  
19 GRANTS.—

20 “(A) IN GENERAL.—The Secretary shall  
21 award grants to accelerate the development,  
22 testing, and implementation of innovative tech-  
23 nologies identified by in-field operations as  
24 areas for improving the performance of com-  
25 mercial geothermal energy projects using en-

hanced geothermal systems and closed-loop geothermal systems.

“(B) FOCUS AREAS.—Grants may be awarded under this paragraph for innovative technologies, including—

“(i) hardrock drilling equipment, components, and systems, including bit design and vibration control;

“(ii) reservoir characterization, well design and spacing, and completions; and

“(iii) data acquisition and analysis, including fiber optic sensing tools and methodologies.

“(C) APPLICATIONS.—

“(i) IN GENERAL.—An entity seeking a grant under this paragraph shall submit to the Secretary an application at such time, in such manner, and containing such information as the Secretary may require.

“(ii) PRIORITIZATION.—In awarding grants under this paragraph, the Secretary shall give priority to—

“(I) applicants, especially for-profit entities and public-private partnerships, with demonstrated success

1 relating to in-field development and  
2 commercial operations for geothermal  
3 energy projects;

4 “(II) projects with the greatest  
5 ability to advance near-term commer-  
6 cial deployment of enhanced geo-  
7 thermal systems and closed-loop geo-  
8 thermal systems; and

9 “(III) projects that advance the  
10 commercialization of geothermal en-  
11 ergy projects in diverse geological con-  
12 ditions or supercritical conditions.

13 “(D) COST SHARING.—The Federal share  
14 of the cost of a project carried out with a grant  
15 under this paragraph shall be not more than 80  
16 percent.

17 “(6) NEXT-GENERATION GEOTHERMAL SYS-  
18 TEMS SURFACE FACILITY INNOVATION GRANTS.—

19 “(A) IN GENERAL.—The Secretary shall  
20 award grants for innovation in the operation,  
21 cost, and design of surface facility components  
22 of next-generation geothermal systems.

23 “(B) FOCUS AREAS.—Grants may be  
24 awarded under this paragraph for development



1 and testing of innovative technologies, includ-  
2 ing—

3 “(i) improved organic Rankine cycle  
4 generation efficiency, working fluids, and  
5 performance at low and supercritical tem-  
6 peratures;

7 “(ii) improved performance of air-  
8 cooled condensers in warm ambient weath-  
9 er conditions, and improved efficiency of  
10 water-cooled condensers; and

11 “(iii) component and facility design,  
12 including gathering lines, generation unit  
13 standardization, and data collection and  
14 monitoring.

15 “(C) APPLICATIONS.—

16 “(i) IN GENERAL.—An entity seeking  
17 a grant under this paragraph shall submit  
18 to the Secretary an application at such  
19 time, in such manner, and containing such  
20 information as the Secretary may require.

21 “(ii) PRIORITIZATION.—In awarding  
22 grants under this paragraph, the Secretary  
23 shall give priority to—

24 “(I) applicants, especially private  
25 entities and public-private partner-

ships, with demonstrated success relating to in-field operation of geothermal energy technologies, including manufacturing power generation and industrial energy components;

“(II) projects with the greatest ability to advance near-term commercial deployment of geothermal energy projects; and

“(III) projects that advance the commercialization of geothermal energy projects in diverse geological conditions or in supercritical conditions.

“(7) AUTHORIZATION OF APPROPRIATIONS.—

There are authorized to be appropriated to the Secretary to carry out this subsection \$5,000,000 for each of fiscal years 2027 through 2031.”.

(e) ORGANIZATION AND ADMINISTRATION OF PROGRAMS.—Section 617 of the Energy Independence and Security Act of 2007 (42 U.S.C. 17196) is amended—

(1) in subsection (e), by striking “Committee on Science and Technology” and inserting “Committee on Science, Space, and Technology”; and

(2) by striking subsection (f) and inserting the following:

1       “(f) PROGRESS REPORTS.—Not later than 1 year  
2 after the date of enactment of the Next-Generation Geo-  
3 thermal Research and Development Act, and every 2 years  
4 thereafter, the Secretary shall submit to the Committee  
5 on Science, Space, and Technology of the House of Rep-  
6 resentatives and the Committee on Energy and Natural  
7 Resources of the Senate a report that contains the fol-  
8 lowing:

9               “(1) A description of the maximum potential of  
10 geothermal resources in the United States, including  
11 the States of Alaska and Hawaii, using the geo-  
12 thermal resource assessment under section 2501 of  
13 the Energy Policy Act of 1992 (30 U.S.C. 1028) or  
14 other such means, as the Secretary determines ap-  
15 propriate, including a consideration of next-genera-  
16 tion geothermal systems.

17               “(2) Information relating to the results of  
18 projects undertaken under this section.

19               “(3) An assessment of the barriers to commer-  
20 cialization of next-generation geothermal systems.

21               “(4) Such other information as the Secretary  
22 considers appropriate.”.

23       (f) REAUTHORIZATION OF ADVANCED GEOTHERMAL  
24 INNOVATION LEADERSHIP.—Section 623 of the Energy

1 Independence and Security Act of 2007 (42 U.S.C.  
2 17202) is amended—

3 (1) by striking “There are authorized” and in-  
4 serting the following:

5 “(a) IN GENERAL.—There are authorized”; and

6 (2) by adding at the end the following:

7 “(b) PROGRAM CONTINUANCE.—In addition to  
8 amounts provided under section 615(e), there are author-  
9 ized to be appropriated to the Secretary to carry out the  
10 programs under this subtitle such sums as are necessary  
11 for each of fiscal years 2026 through 2031, to remain  
12 available until expended.”.

13 (g) INTERNATIONAL GEOTHERMAL ENERGY DEVEL-  
14 OPMENT.—Section 624(a) of the Energy Independence  
15 and Security Act of 2007 (42 U.S.C. 17203(a)) is amend-  
16 ed by striking “system resources” and inserting “systems  
17 resources”.

18 (h) UPDATE TO GEOTHERMAL RESOURCE ASSESS-  
19 MENT.—Section 2501 of the Energy Policy Act of 1992  
20 (30 U.S.C. 1028) is amended—

21 (1) by striking “acting through the United  
22 States Geological Survey” each place it appears and  
23 inserting “acting through the Director of the United  
24 States Geological Survey”;

25 (2) in subsection (c)—

1 (A) in the matter preceding paragraph (1),  
 2 by inserting “, subject to subsection (d), quad-  
 3 rennially” after “shall”;

4 (B) in paragraph (1)(D)(ii), by striking  
 5 “and” at the end;

6 (C) in paragraph (2)—

7 (i) by inserting “, State geological  
 8 surveys,” after “State officials”; and

9 (ii) by striking the period at the end  
 10 and inserting “; and”; and

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

12 “(3) by assessing regions of the United States  
 13 with significant potential for supercritical geo-  
 14 thermal (as defined in section 612 of the Energy  
 15 Independence and Security Act of 2007 (42 U.S.C.  
 16 17191)).”; and

17 (3) by striking subsection (d) and inserting the  
 18 following:

19 “(d) INITIAL ASSESSMENTS.—

20 “(1) IN GENERAL.—Not later than 2 years  
 21 after the date of enactment of the Next-Generation  
 22 Geothermal Research and Development Act, the Sec-  
 23 retary of the Interior, acting through the Director of  
 24 the United States Geological Survey (referred to in

1 this subsection as the ‘Director’), shall complete up-  
2 dated assessments of—

3 “(A) conventional hydrothermal resources;

4 and

5 “(B) next-generation geothermal resources,  
6 including enhanced geothermal systems.

7 “(2) METHODOLOGIES.—Not later than 5 years  
8 after the date of enactment of the Next-Generation  
9 Geothermal Research and Development Act, the Di-  
10 rector shall develop methodologies for, and complete  
11 an initial assessment of, next-generation geothermal  
12 resources, including supercritical geothermal sys-  
13 tems.

14 “(3) INTERIM PRODUCTS.—In carrying out  
15 paragraphs (1) and (2), the Director may publish in-  
16 terim datasets, analyses, or partial assessments prior  
17 to the completion of a full assessment under those  
18 paragraphs.

19 “(4) PRIORITIZATION.—To the extent prac-  
20 ticable, the Director shall prioritize carrying out geo-  
21 thermal resource assessments in a sustained effort  
22 and manner consistent with the requirements of the  
23 Advanced Geothermal Energy Research and Devel-  
24 opment Act of 2007 (42 U.S.C. 17191 et seq.).

1           “(5) IMPLEMENTATION.—The completion of the  
 2       initial assessments required under paragraphs (1)  
 3       and (2) shall satisfy the first update required after  
 4       the date of enactment of the Next-Generation Geo-  
 5       thermal Research and Development Act under sub-  
 6       section (c).”.

7       (i) CLERICAL AMENDMENT.—The table of contents  
 8       of the Energy Independence and Security Act of 2007 (42  
 9       U.S.C. 17001 note; Public Law 110–140) is amended by  
 10      striking the item relating to section 615 and inserting the  
 11      following:

“Sec. 615. Enhanced geothermal systems and closed-loop geothermal systems  
 research, development, and testing.”.

○