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(Original Signature of Member)

116TH CONGRESS
1ST SESSION

H. R. 5374

To establish and support advanced geothermal research and development programs at the Department of Energy, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

Mr. LUCAS introduced the following bill; which was referred to the Committee on _____

A BILL

To establish and support advanced geothermal research and development programs 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; TABLE OF CONTENTS.**

4 (a) SHORT TITLE.—This Act may be cited as the
5 “Advanced Geothermal Research and Development Act of
6 2019”.

7 (b) TABLE OF CONTENTS.—The table of contents for
8 this Act is as follows:

- Sec. 1. Short title; table of contents.
- Sec. 2. Definitions.
- Sec. 3. Hydrothermal research and development.
- Sec. 4. General geothermal systems research and development.
- Sec. 5. Enhanced geothermal systems research and development.
- Sec. 6. Cost sharing and proposal evaluation.
- Sec. 7. Advanced geothermal computing and data science research and development.
- Sec. 8. Geothermal workforce development.
- Sec. 9. Reporting requirements.
- Sec. 10. Repeals.
- Sec. 11. Authorization of appropriations.
- Sec. 12. International geothermal energy development.
- Sec. 13. Reauthorization of High Cost Region Geothermal Energy Grant Program.

1 SEC. 2. DEFINITIONS.

2 Section 612(1) of the Energy Independence and Se-
3 curity Act of 2007 (42 U.S.C. 17191(1)) is amended to
4 read as follows:

5 “(1) ENGINEERED.—When referring to en-
6 hanced geothermal systems, the term ‘engineered’
7 means designed to access subsurface heat, including
8 stimulation and nonstimulation technologies to ad-
9 dress one or more of the following issues:

10 “(A) Lack of effective permeability, poros-
11 ity or open fracture connectivity within the heat
12 reservoir.

13 “(B) Insufficient contained geofluid in the
14 heat reservoir.

15 “(C) A low average geothermal gradient
16 which necessitates deeper drilling, or the use of
17 alternative heat sources or heat generation
18 processes.”.

1 **SEC. 3. HYDROTHERMAL RESEARCH AND DEVELOPMENT.**

2 Section 613 of the Energy Independence and Security
3 Act of 2007 (42 U.S.C. 17192) is amended to read as
4 follows:

5 **“SEC. 613. HYDROTHERMAL RESEARCH AND DEVELOP-**
6 **MENT.**

7 “(a) IN GENERAL.—The Secretary shall carry out a
8 program of research, development, demonstration, and
9 commercial application for geothermal energy production
10 from hydrothermal systems.

11 “(b) PROGRAMS.—The program authorized in sub-
12 section (a) shall include the following:

13 “(1) ADVANCED HYDROTHERMAL RESOURCE
14 TOOLS.—The research and development of advanced
15 geologic tools to assist in locating hydrothermal re-
16 sources, and to increase the reliability of site charac-
17 terization, including the development of new imaging
18 and sensing technologies and techniques to assist in
19 prioritization of targets for characterization;

20 “(2) EXPLORATORY DRILLING FOR GEO-
21 THERMAL RESOURCES.—The demonstration of ad-
22 vanced technologies and techniques of siting and ex-
23 ploratory drilling for undiscovered resources in a va-
24 riety of geologic settings, carried out in collaboration
25 with industry partners that will assist in the acquisi-

1 tion of high quality data sets relevant for hydro-
2 thermal subsurface characterization activities”.

3 **SEC. 4. GENERAL GEOTHERMAL SYSTEMS RESEARCH AND**
4 **DEVELOPMENT.**

5 Section 614 of the Energy Independence and Security
6 Act of 2007 (42 U.S.C. 17193) is amended to read as
7 follows:

8 **“SEC. 614. GENERAL GEOTHERMAL SYSTEMS RESEARCH**
9 **AND DEVELOPMENT.**

10 “(a) SUBSURFACE COMPONENTS AND SYSTEMS.—

11 The Secretary shall support a program of research, devel-
12 opment, demonstration, and commercial application of
13 components and systems capable of withstanding geo-
14 thermal environments and necessary to develop, produce,
15 and monitor geothermal reservoirs and produce geo-
16 thermal energy.

17 “(b) ENVIRONMENTAL IMPACTS.—The Secretary
18 shall—

19 “(1) support a program of research, develop-
20 ment, demonstration, and commercial application of
21 technologies and practices designed to mitigate or
22 preclude potential adverse environmental impacts of
23 geothermal energy development, production or use;
24 and

1 “(2) support a research program to identify po-
2 tential environmental impacts and environmental
3 benefits of geothermal energy development, produc-
4 tion, and use, and ensure that the program de-
5 scribed in paragraph (1) addresses such impacts, in-
6 cluding effects on groundwater and local hydrology;

7 “(3) support a program of research to compare
8 the potential environmental impacts and environ-
9 mental benefits identified as part of the develop-
10 ment, production, and use of geothermal energy with
11 the potential emission reductions of greenhouse
12 gases gained by geothermal energy development,
13 production, and use; and

14 “(4) in carrying out this section, the Secretary
15 shall, to the maximum extent practicable, consult
16 with relevant federal agencies, including the Envi-
17 ronmental Protection Agency.

18 “(c) RESERVOIR THERMAL ENERGY STORAGE.—The
19 Secretary shall support a program of research, develop-
20 ment, and demonstration of reservoir thermal energy stor-
21 age, emphasizing cost-effective improvements through
22 deep direct use engineering, design, and systems research.

23 “(d) OIL AND GAS TECHNOLOGY TRANSFER INITIA-
24 TIVE.—

1 “(1) IN GENERAL.—The Secretary shall sup-
2 port an initiative among the Office of Fossil Energy,
3 the Office of Energy Efficiency and Renewable En-
4 ergy, and the private sector to research, develop, and
5 demonstrate relevant advanced technologies and op-
6 eration techniques used in the oil and gas sector for
7 use in geothermal energy development.

8 “(2) PRIORITIES.—In carrying out paragraph
9 (1), the Secretary shall prioritize technologies with
10 the greatest potential to significantly increase the
11 use and lower the cost of geothermal energy in the
12 United States, including the cost and speed of geo-
13 thermal drilling.

14 “(3) COPRODUCTION OF GEOTHERMAL ENERGY
15 AND MINERALS PRODUCTION RESEARCH AND DE-
16 VELOPMENT INITIATIVE.—

17 “(A) IN GENERAL.—The Secretary shall
18 carry out a research and development initiative
19 under which the Secretary shall award grants
20 to demonstrate the coproduction of critical min-
21 erals from geothermal resources.

22 “(B) REQUIREMENTS.—An award made
23 under subparagraph (A) shall—

1 “(i) improve the cost effectiveness of
2 removing minerals from geothermal brines
3 as part of the coproduction process;

4 “(ii) increase recovery rates of the
5 targets mineral commodity;

6 “(iii) decrease water use and other en-
7 vironmental impacts, as determined by the
8 Secretary; and

9 “(iv) demonstrate a path to commer-
10 cial viability.”.

11 **SEC. 5. ENHANCED GEOTHERMAL SYSTEMS RESEARCH**
12 **AND DEVELOPMENT.**

13 Section 615 of the Energy Independence and Security
14 Act of 2007 (42 U.S.C. 17194) is amended to read as
15 follows:

16 **“SEC. 615. ENHANCED GEOTHERMAL SYSTEMS RESEARCH**
17 **AND DEVELOPMENT.**

18 “(a) IN GENERAL.—The Secretary shall support a
19 program of research, development, demonstration, and
20 commercial application for enhanced geothermal systems,
21 including the programs described in subsection (b).

22 “(b) ENHANCED GEOTHERMAL SYSTEMS TECH-
23 NOLOGIES.—In collaboration with industry partners, the
24 Secretary shall support a program of research, develop-
25 ment, demonstration, and commercial application of the

1 technologies to achieve higher efficiency and lower cost en-
2 hanced geothermal systems, including—

3 “(1) reservoir stimulation;

4 “(2) reservoir characterization, monitoring, and
5 modeling;

6 “(3) stress and fracture mapping including real
7 time monitoring and modeling;

8 “(4) tracer development;

9 “(5) three and four-dimensional seismic imag-
10 ing and tomography;

11 “(6) well placement and orientation;

12 “(7) long-term reservoir management;

13 “(8) drilling technologies, methods, and tools;

14 “(9) improved exploration tools;

15 “(10) zonal isolation; and

16 “(11) understanding induced seismicity risks
17 from reservoir engineering and stimulation.

18 “(c) FRONTIER OBSERVATORY FOR RESEARCH IN
19 GEOTHERMAL ENERGY.—The Secretary shall support the
20 establishment and construction of up to 3 field research
21 sites operated by public or academic entities, which shall
22 each be known as a ‘Frontier Observatory for Research
23 in Geothermal Energy’ or ‘FORGE’ site to develop, test,
24 and enhance techniques and tools for enhanced geothermal
25 energy.

1 “(1) DUTIES.—The Secretary shall—

2 “(A) award grants in support of research
3 and development projects focused on advanced
4 monitoring technologies, new technologies and
5 approaches for implementing multi-zone stimu-
6 lations, and dynamic reservoir modeling that in-
7 corporates all available high-fidelity character-
8 ization data; and

9 “(B) seek opportunities to coordinate ef-
10 forts and share information with domestic and
11 international partners engaged in research and
12 development of geothermal systems and related
13 technology.

14 “(2) SITE SELECTION.—Of the FORGE sites
15 referred to in paragraph (1), the Secretary shall—

16 “(A) consider applications through a com-
17 petitive, merit-reviewed process, from National
18 Laboratories, multi-institutional collaborations,
19 institutes of higher education and other appro-
20 priate entities best suited to provide national
21 leadership on geothermal related issues and
22 perform the duties enumerated under this sub-
23 section; and

1 “(B) prioritize existing field sites and fa-
2 cilities with capabilities relevant to the duties
3 enumerated under this subsection.

4 “(3) FUNDING.—Out of funds authorized to be
5 appropriated under section 11 of the ‘Advanced Geo-
6 thermal Research and Development Act of 2019’,
7 there shall be made available to the Secretary to
8 carry out the FORGE activities under this para-
9 graph—

10 “(A) \$45,000,000 for fiscal year 2020;

11 “(B) \$55,000,000 for fiscal year 2021;

12 “(C) \$65,000,000 for fiscal year 2022;

13 “(D) \$70,000,000 for fiscal year 2023;

14 and

15 “(E) \$70,000,000 for fiscal year 2024.

16 In carrying out this section, the Secretary shall con-
17 sider the balance between funds dedicated to con-
18 struction and operations and research activities to
19 reflect the state of site development.

20 “(4) ENHANCED GEOTHERMAL SYSTEMS DEM-
21 ONSTRATIONS.—

22 “(A) IN GENERAL.—Beginning on the date
23 of enactment of the ‘Advanced Geothermal En-
24 ergy Research and Development Act of 2019’,
25 the Secretary, in collaboration with industry

1 partners and institutions of higher education,
2 shall support an initiative for demonstration of
3 enhanced geothermal systems for power produc-
4 tion or direct use.

5 “(B) PROJECTS.—

6 “(i) IN GENERAL.—Under the initia-
7 tive described in subparagraph (A), dem-
8 onstration projects shall be carried out in
9 locations that are commercially viable for
10 enhanced geothermal systems development,
11 while also considering environmental im-
12 pacts to the maximum extent practicable,
13 as determined by the Secretary.

14 “(ii) REQUIREMENTS.—Demonstra-
15 tion projects under clause (i) shall—

16 “(I) collectively demonstrate—

17 “(aa) different geologic set-
18 tings, such as hot sedimentary
19 aquifers, layered geologic sys-
20 tems, supercritical systems, and
21 basement rock systems; and

22 “(bb) a variety of develop-
23 ment techniques, including open
24 hole and cased hole completions,

1 differing well orientations, and
2 stimulation mechanisms; and

3 “(II) to the extent practicable,
4 use existing sites where subsurface
5 characterization or geothermal energy
6 integration analysis has been con-
7 ducted.

8 “(iii) EASTERN DEMONSTRATION.—
9 Not less than 1 demonstration project car-
10 ried out under clause (i) shall be located in
11 an area east of the Mississippi River that
12 is suitable for enhanced geothermal dem-
13 onstration for power, heat, or a combina-
14 tion of power and heat.”.

15 **SEC. 6. COST SHARING AND PROPOSAL EVALUATION.**

16 Section 617(b) of the Energy Independence and Se-
17 curity Act of 2007 (42 U.S.C. 17196) is amended by strik-
18 ing paragraph (2) and redesignating paragraphs (3) and
19 (4) as paragraphs (2) and (3), respectively.

20 **SEC. 7. ADVANCED GEOTHERMAL COMPUTING AND DATA**
21 **SCIENCE RESEARCH AND DEVELOPMENT.**

22 (a) IN GENERAL.—Section 618 of the Energy Inde-
23 pendence and Security Act of 2007 (42 U.S.C. 17197) is
24 amended to read as follows:

1 **“SEC. 618. ADVANCED GEOTHERMAL COMPUTING AND**
2 **DATA SCIENCE RESEARCH AND DEVELOP-**
3 **MENT.**

4 “(a) IN GENERAL.—The Secretary shall carry out a
5 program of research and development of advanced com-
6 puting and data science tools for geothermal energy.

7 “(b) PROGRAMS.—The program authorized in sub-
8 section (a) shall include the following:

9 “(1) ADVANCED COMPUTING FOR GEOTHERMAL
10 SYSTEMS TECHNOLOGIES.—Research, development,
11 and demonstration of technologies to develop ad-
12 vanced data, machine learning, artificial intelligence,
13 and related computing tools to assist in locating geo-
14 thermal resources, to increase the reliability of site
15 characterization, to increase the rate and efficiency
16 of drilling, to improve induced seismicity mitigation,
17 and to support enhanced geothermal systems tech-
18 nologies.

19 “(2) GEOTHERMAL SYSTEMS RESERVOIR MOD-
20 ELING.—Research, development, and demonstration
21 of models of geothermal reservoir performance and
22 enhanced geothermal systems reservoir stimulation
23 technologies and techniques, with an emphasis on
24 accurately modeling heat flow, permeability evo-
25 lution, seismicity, and operational performance over

1 time, including collaboration with industry and field
2 validation.

3 “(c) COORDINATION.—In carrying out these pro-
4 grams, the Secretary shall ensure coordination and con-
5 sultation with the Department of Energy’s Office of
6 Science. The Secretary shall ensure, to the maximum ex-
7 tent practicable, coordination of these activities with the
8 Department of Energy National Laboratories, institutes
9 of higher education, and the private sector.”.

10 (b) CONFORMING AMENDMENT.—Section 1(b) of the
11 Energy Independence and Security Act of 2007 (42
12 U.S.C. 17001 note) is amended in the table of contents
13 by amending the item related to section 618 to read as
14 follows:

“Sec. 618. Advanced geothermal computing and data science research and de-
velopment.”.

15 **SEC. 8. GEOTHERMAL WORKFORCE DEVELOPMENT.**

16 (a) IN GENERAL.—Section 619 of the Energy Inde-
17 pendence and Security Act of 2007 (42 U.S.C. 17198) is
18 amended to read as follows:

19 **“SEC. 619. GEOTHERMAL WORKFORCE DEVELOPMENT.**

20 “The Secretary shall support the development of a
21 geothermal energy workforce through a program that—

22 “(1) facilitates collaboration between university
23 students and researchers at the national labora-
24 tories; and

1 “(2) prioritizes science in areas relevant to the
2 mission of the Department through the application
3 of geothermal energy tools and technologies.”.

4 (b) CONFORMING AMENDMENT.—Section 1(b) of the
5 Energy Independence and Security Act of 2007 (42
6 U.S.C. 17001 note) is amended in the table of contents
7 by amending the item related to section 619 to read as
8 follows:

 “Sec. 619. Geothermal workforce development.”.

9 **SEC. 9. REPORTING REQUIREMENTS.**

10 Section 621 of the Energy Independence and Security
11 Act of 2007 (42 U.S.C. 17200) is amended to read as
12 follows:

13 **“SEC. 621. REPORTS.**

14 “(a) REPORT.—Every 5 years after the date of enact-
15 ment of Advanced Geothermal Research and Development
16 Act of 2019 , the Secretary shall report to the Committee
17 on Science and Technology of the House of Representa-
18 tives and the Committee on Energy and Natural Re-
19 sources of the Senate on advanced concepts and tech-
20 nologies to maximize the geothermal resource potential of
21 the United States.

22 “(b) PROGRESS REPORTS.—Not later than 1 year
23 after the date of enactment of the ‘Advanced Geothermal
24 Research and Development Act of 2019’, and every 2
25 years thereafter, the Secretary shall submit to the Com-

1 mittee on Science and Technology of the House of Rep-
2 resentatives and the Committee on Energy and Natural
3 Resources of the Senate a report on the results of projects
4 undertaken under this part and other such information
5 the Secretary considers appropriate.”.

6 **SEC. 10. REPEALS.**

7 (a) IN GENERAL.—Subtitle B of title VI of the En-
8 ergy Independence and Security Act of 2007 (42 U.S.C.
9 17191 et seq.) is amended by striking section 620.

10 (b) CONFORMING AMENDMENT.—Section 1(b) of the
11 Energy Independence and Security Act of 2007 (42
12 U.S.C. 17001 note) is amended in the table of contents
13 by striking the item related to section 620.

14 **SEC. 11. AUTHORIZATION OF APPROPRIATIONS.**

15 Section 623 of the Energy Independence and Security
16 Act of 2007 (42 U.S.C. 17202) is amended to read as
17 follows:

18 **“SEC. 623. AUTHORIZATION OF APPROPRIATIONS.**

19 “There are authorized to be appropriated to the Sec-
20 retary to carry out the programs under the ‘Advanced
21 Geothermal Research and Development Act of 2019’—

22 “(1) \$100,000,000 for fiscal year 2020;

23 “(2) \$111,125,000 for fiscal year 2021;

24 “(3) \$122,250,000 for fiscal year 2022;

25 “(4) \$128,375,000 for fiscal year 2023; and

1 “(5) \$129,500,000 for fiscal year 2024.”.

2 **SEC. 12. INTERNATIONAL GEOTHERMAL ENERGY DEVELOP-**
3 **MENT.**

4 Section 624 of the Energy Independence and Security
5 Act of 2007 (42 U.S.C. 17203) is amended—

6 (1) in subsection (a), to read as follows:

7 “(a) IN GENERAL.—The Secretary of Energy, in co-
8 ordination with other appropriate Federal and multilateral
9 agencies (including the United States Agency for Inter-
10 national Development) shall support collaborative efforts
11 with international partners to promote the research, devel-
12 opment, and demonstration of geothermal technologies
13 used to develop hydrothermal and enhanced geothermal
14 system resources.”; and

15 (2) by striking subsection (c).

16 **SEC. 13. REAUTHORIZATION OF HIGH COST REGION GEO-**
17 **THERMAL ENERGY GRANT PROGRAM.**

18 Section 625 of the Energy Independence and Security
19 Act of 2007 (42 U.S.C. 17204) is amended—

20 (1) in subsection (a)(2), by inserting “ or heat”
21 after “electrical power”; and

22 (2) in subsection (e), to read as follows:

23 “(e) AUTHORIZATION OF APPROPRIATIONS.—Out of
24 funds authorized under section 11 of the ‘Advanced Geo-
25 thermal Research and Development Act of 2019’, there

- 1 is authorized to be appropriated to carry out this section
- 2 \$5,000,000 for each of fiscal years 2020 through 2024.”.