

ADVANCED GEOTHERMAL ENERGY RESEARCH AND
DEVELOPMENT ACT OF 2007

JUNE 21, 2007.—Committed to the Committee of the Whole House on the State of
the Union and ordered to be printed

Mr. GORDON of Tennessee, from the Committee on Science and
Technology, submitted the following

R E P O R T

[To accompany H.R. 2304]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science and Technology, to whom was referred the bill (H.R. 2304) to direct the Secretary of Energy to conduct a program of research, development, demonstration, and commercial application for geothermal energy, and for other purposes, having considered the same, report favorably thereon with an amendment and recommend that the bill as amended do pass.

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I. AMENDMENT

The amendment is as follows:

Strike all after the enacting clause and insert the following:

SECTION 1. SHORT TITLE.

This Act may be cited as the “Advanced Geothermal Energy Research and Development Act of 2007”.

SEC. 2. FINDINGS.

The Congress finds the following:

- (1) The United States has a critical national interest in developing clean, domestic, renewable sources of energy in order to mitigate the causes of climate change, reduce other environmental impacts of energy production, increase national security, improve public health, and bolster economic stability.
- (2) Geothermal energy is a renewable energy resource.
- (3) Geothermal energy is unusual among renewable energy sources because of its ability to provide an uninterrupted supply of baseload electricity.
- (4) Recently published assessments by reputable experts, including the Massachusetts Institute of Technology, the Western Governors Association, and the National Renewable Energy Laboratory, indicate that the Nation’s geothermal resources are widely distributed, vast in size, and barely tapped.
- (5) Sustained and expanded research, development, demonstration, and commercial application programs are needed to locate and characterize geothermal resources, and to develop the technologies that will enable their widespread commercial development.
- (6) Federal support is critical to reduce the financial risk associated with developing new geothermal technologies, thereby encouraging the private sector investment necessary to make geothermal resources commercially viable as a source of electric power and for other applications.

SEC. 3. DEFINITIONS.

For purposes of this Act:

- (1) **ENGINEERED.**—When referring to enhanced geothermal systems, the term “engineered” means subjected to intervention, including intervention to address one or more of the following issues:
 - (A) Lack of effective permeability or porosity or open fracture connectivity within the reservoir.
 - (B) Insufficient contained geofluid in the reservoir.
 - (C) A low average geothermal gradient, which necessitates deeper drilling.
- (2) **ENHANCED GEOTHERMAL SYSTEMS.**—The term “enhanced geothermal systems” means geothermal reservoir systems that are engineered, as opposed to occurring naturally.
- (3) **GEOFLUID.**—The term “geofluid” means any fluid used to extract thermal energy from the Earth which is transported to the surface for direct use or electric power generation, except that such term shall not include oil or natural gas.
- (4) **GEOPRESSURED RESOURCES.**—The term “geopressured resources” mean geothermal deposits found in sedimentary rocks under higher than normal pressure and saturated with gas or methane.
- (5) **GEO THERMAL.**—The term “geothermal” refers to heat energy stored in the Earth’s crust that can be accessed for direct use or electric power generation.
- (6) **HYDROTHERMAL.**—The term “hydrothermal” refers to naturally occurring subsurface reservoirs of hot water or steam.
- (7) **SECRETARY.**—The term “Secretary” means the Secretary of Energy.
- (8) **SYSTEMS APPROACH.**—The term “systems approach” means an approach to solving problems or designing systems that attempts to optimize the performance of the overall system, rather than a particular component of the system.

SEC. 4. HYDROTHERMAL RESEARCH AND DEVELOPMENT.

(a) **IN GENERAL.**—The Secretary shall support programs of research, development, demonstration, and commercial application to expand the use of geothermal energy production from hydrothermal systems, including the programs described in subsection (b).

(b) **PROGRAMS.**—

- (1) **ADVANCED HYDROTHERMAL RESOURCE TOOLS.**—The Secretary, in consultation with other appropriate agencies, shall support a program to develop advanced geophysical, geochemical, and geologic tools to assist in locating hidden hydrothermal resources, and to increase the reliability of site characterization before, during, and after initial drilling. The program shall develop new prospecting techniques to assist in prioritization of targets for characterization. The program shall include a field component.

(2) **INDUSTRY COUPLED EXPLORATORY DRILLING.**—The Secretary shall support a program of cost-shared field demonstration programs, to be pursued, simultaneously and independently, in collaboration with industry partners, for the demonstration of technologies and techniques of siting and exploratory drilling for undiscovered resources in a variety of geologic settings. The program shall include incentives to encourage the use of advanced technologies and techniques.

SEC. 5. GENERAL GEOTHERMAL SYSTEMS RESEARCH AND DEVELOPMENT.

(a) **SUBSURFACE COMPONENTS AND SYSTEMS.**—The Secretary shall support a program of research, development, demonstration, and commercial application of components and systems capable of withstanding extreme geothermal environments and necessary to cost-effectively develop, produce, and monitor geothermal reservoirs and produce geothermal energy. These components and systems shall include advanced casing systems (expandable tubular casing, low-clearance casing designs, and others), high-temperature cements, high-temperature submersible pumps, and high-temperature packers, as well as technologies for under-reaming, multilateral completions, high-temperature logging, and logging while drilling.

(b) **RESERVOIR PERFORMANCE MODELING.**—The Secretary shall support a program of research, development, demonstration, and commercial application of models of geothermal reservoir performance, with an emphasis on accurately modeling performance over time. Models shall be developed to assist both in the development of geothermal reservoirs and to more accurately account for stress-related effects in stimulated hydrothermal and enhanced geothermal systems production environments.

(c) **ENVIRONMENTAL IMPACTS.**—The Secretary shall—

(1) support a program of research, development, demonstration, and commercial application of technologies and practices designed to mitigate or preclude potential adverse environmental impacts of geothermal energy development, production or use, and seek to ensure that geothermal energy development is consistent with the highest practicable standards of environmental stewardship; and

(2) in conjunction with the Assistant Administrator for Research and Development at the Environmental Protection Agency, support a research program to identify potential environmental impacts of geothermal energy development, production, and use, and ensure that the program described in paragraph (1) addresses such impacts, including effects on groundwater and local hydrology. Any potential environmental impacts identified as part of the development, production, and use of geothermal energy shall be measured and examined against the potential emissions offsets of greenhouse gases gained by geothermal energy development, production, and use.

SEC. 6. ENHANCED GEOTHERMAL SYSTEMS RESEARCH AND DEVELOPMENT.

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

(b) **PROGRAMS.**—

(1) **ENHANCED GEOTHERMAL SYSTEMS TECHNOLOGIES.**—The Secretary shall support a program of research, development, demonstration, and commercial application of the technologies and knowledge necessary for enhanced geothermal systems to advance to a state of commercial readiness, including advances in—

- (A) reservoir stimulation;
- (B) reservoir characterization, monitoring, and modeling;
- (C) stress mapping;
- (D) tracer development;
- (E) three-dimensional tomography;
- (F) understanding seismic effects of reservoir engineering and stimulation; and
- (G) laser-based drilling technology.

(2) **ENHANCED GEOTHERMAL SYSTEMS RESERVOIR STIMULATION.**—

(A) **PROGRAM.**—In collaboration with industry partners, the Secretary shall support a program of research, development, and demonstration of enhanced geothermal systems reservoir stimulation technologies and techniques. A minimum of 5 sites shall be selected in locations that show particular promise for enhanced geothermal systems development. Each site shall—

- (i) represent a different class of subsurface geologic environments;
- and

(ii) take advantage of an existing site where subsurface characterization has been conducted or existing drill holes can be utilized, if possible.

(B) CONSIDERATION OF EXISTING SITES.—The following 2 sites, where Department of Energy and industry cooperative enhanced geothermal systems projects are already underway, may be considered for inclusion among the sites selected under subparagraph (A):

- (i) Desert Peak, Nevada.
- (ii) Coso, California.

SEC. 7. GEOTHERMAL ENERGY PRODUCTION FROM OIL AND GAS FIELDS AND RECOVERY AND PRODUCTION OF GEOPRESSURED GAS RESOURCES.

(a) IN GENERAL.—The Secretary shall establish a program of research, development, demonstration, and commercial application to support development of geothermal energy production from oil and gas fields and production and recovery of energy from geopressured resources. In addition, the Secretary shall conduct such supporting activities including research, resource characterization, and technology development as necessary.

(b) GEOTHERMAL ENERGY PRODUCTION FROM OIL AND GAS FIELDS.—The Secretary shall implement a grant program in support of geothermal energy production from oil and gas fields. The program shall include grants for a total of not less than three demonstration projects of the use of geothermal techniques such as organic rankine cycle systems at marginal, unproductive, and productive oil and gas wells. The Secretary shall, to the extent practicable and in the public interest, make awards that—

- (1) include not less than five oil or gas well sites per project award;
- (2) use a range of oil or gas well hot water source temperatures from 150 degrees Fahrenheit to 300 degrees Fahrenheit;
- (3) cover a range of sizes up to one megawatt;
- (4) are located at a range of sites;
- (5) can be replicated at a wide range of sites;
- (6) facilitate identification of optimum techniques among competing alternatives;
- (7) include business commercialization plans that have the potential for production of equipment at high volumes and operation and support at a large number of sites; and
- (8) satisfy other criteria that the Secretary determines are necessary to carry out the program and collect necessary data and information.

The Secretary shall give preference to assessments that address multiple elements contained in paragraphs (1) through (8).

(c) GRANT AWARDS.—Each grant award for demonstration of geothermal technology such as organic rankine cycle systems at oil and gas wells made by the Secretary under subsection (b) shall include—

- (1) necessary and appropriate site engineering study;
- (2) detailed economic assessment of site specific conditions;
- (3) appropriate feasibility studies to determine whether the demonstration can be replicated;
- (4) design or adaptation of existing technology for site specific circumstances or conditions;
- (5) installation of equipment, service, and support;
- (6) operation for a minimum of one year and monitoring for the duration of the demonstration; and
- (7) validation of technical and economic assumptions and documentation of lessons learned.

(d) GEOPRESSURED GAS RESOURCE RECOVERY AND PRODUCTION.—(1) The Secretary shall implement a program to support the research, development, demonstration, and commercial application of cost-effective techniques to produce energy from geopressured resources situated in and near the Gulf of Mexico.

(2) The Secretary shall solicit preliminary engineering designs for geopressured resources production and recovery facilities.

(3) Based upon a review of the preliminary designs, the Secretary shall award grants, which may be cost-shared, to support the detailed development and completion of engineering, architectural and technical plans needed to support construction of new designs.

(4) Based upon a review of the final design plans above, the Secretary shall award cost-shared development and construction grants for demonstration geopressured production facilities that show potential for economic recovery of the heat, kinetic energy and gas resources from geopressured resources.

(e) COMPETITIVE GRANT SELECTION.—Not less than 90 days after the date of the enactment of this Act, the Secretary shall conduct a national solicitation for applica-

tions for grants under the programs outlined in subsections (b) and (d). Grant recipients shall be selected on a competitive basis based on criteria in the respective subsection.

(f) WELL DRILLING.—No funds may be used under this section for the purpose of drilling new wells.

SEC. 8. COST SHARING AND PROPOSAL EVALUATION.

(a) FEDERAL SHARE.—(1) The Federal share of costs of projects funded under this Act shall be in accordance with section 988 of the Energy Policy Act of 2005.

(2) The Secretary may waive the Federal cost share requirement for grants awarded to universities, national laboratories, or similar noncommercial entities awarded grants under this Act.

(3) The Secretary shall allow for a competitive bidding process to play a role in determining the final cost-share ratio.

(b) ORGANIZATION AND ADMINISTRATION OF PROGRAMS.—Programs under this Act shall incorporate the following organizational and administrative elements:

(1) Non-Federal participants shall be chosen through a competitive selection process.

(2) The request for proposals for each program shall stipulate, at a minimum, the following:

(A) The non-Federal funding requirements for projects.

(B) The funding mechanism to be used (i.e. grants, contracts, or cooperative agreements).

(C) Milestones and a schedule for completion.

(D) Criteria for evaluating proposals.

(3) In evaluating proposals, the Secretary shall give priority to proposals that draw on relevant expertise from industry, academia, and the national laboratories, as appropriate.

(4) The Secretary shall coordinate with, and where appropriate may provide funds in furtherance of the purposes of this Act to, other Department of Energy research and development programs focused on drilling, subsurface characterization, and other related technologies.

(5) In evaluating proposals, the Secretary shall consult with relevant experts from industry, academia, and the national laboratories, as appropriate.

(6) In evaluating proposals, the Secretary shall give priority to proposals that demonstrate clear evidence of employing a systems approach.

(7) In evaluating proposals for projects with a field component, the Secretary shall, where appropriate, give priority consideration to proposals that contain provisions to study local environmental impacts of the technologies developed or the operations undertaken.

(8) Data collected by the Secretary as a result of any project supported with funds provided under this Act shall be made available to the public, except to the extent that they contain information that is protected from disclosure under section 552(b) of title 5, United States Code.

SEC. 9. CENTERS FOR GEOTHERMAL TECHNOLOGY TRANSFER.

(a) IN GENERAL.—The Secretary shall award grants to institutions of higher education (or consortia thereof) to establish 2 Centers for Geothermal Technology Transfer.

(b) CENTERS.—

(1) HYDROTHERMAL CENTER.—The purpose of one Technology Transfer Center shall be to serve as an information clearinghouse for the geothermal industry, collecting and disseminating information on best practices in all areas related to developing and managing hydrothermal resources, including data available for disclosure as provided under section 8(b)(8). This Center shall be based at the institution west of the Mississippi River that the Secretary considers to be best suited to the purpose. The Center shall collect and disseminate information on all subjects germane to the development and user of hydrothermal systems, including—

(A) resource location;

(B) reservoir characterization, monitoring, and modeling;

(C) drilling techniques;

(D) reservoir management techniques; and

(E) technologies for electric power conversion or direct use of geothermal energy.

(2) ENHANCED GEOTHERMAL SYSTEMS CENTER.—The purpose of a second Technology Transfer Center shall be to serve as an information clearinghouse for the geothermal industry, collecting and disseminating information on best practices in all areas related to developing and managing enhanced geothermal systems resources, including data available for disclosure as provided under section

8(b)(8). This Center is encouraged to seek opportunities to coordinate efforts and share information with international partners engaged in research and development of enhanced geothermal systems or engaged in collection of data related to enhanced geothermal systems development. This Center shall be based at an academic institution east of the Rocky Mountains which, in the opinion of the Secretary, is best suited to provide national leadership on enhanced geothermal systems-related issues. The Center shall collect and disseminate information on all subjects germane to the development and use of enhanced geothermal systems.

(c) AWARD DURATION.—An award made by the Secretary under this section shall be for an initial period of 5 years, and may be renewed for additional 5-year periods on the basis of—

- (1) satisfactory performance in meeting the goals of the research plan proposed by the Center; and
- (2) other requirements as specified by the Secretary.

SEC. 10. GEOPOWERING AMERICA.

The Secretary shall expand the Department of Energy’s GeoPowering the West program to extend its geothermal technology transfer activities throughout the entire United States. The program shall be renamed “GeoPowering America”. The program shall continue to be based in the Department of Energy office in Golden, Colorado.

SEC. 11. REPORTS.

(a) REPORTS ON ADVANCED USES OF GEOTHERMAL ENERGY.—Not later than 1 year, 3 years, and 5 years, after the date of enactment of this Act, the Secretary shall report to the Committee on Science and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate on advanced concepts and technologies to maximize the geothermal resource potential of the United States. The reports shall include—

- (1) the use of carbon dioxide as an alternative geofluid with potential carbon sequestration benefits;
- (2) mineral recovery from geofluids;
- (3) use of geothermal energy to produce hydrogen;
- (4) use of geothermal energy to produce biofuels;
- (5) use of geothermal heat for oil recovery from oil shales and tar sands; and
- (6) other advanced geothermal technologies, including advanced drilling technologies and advanced power conversion technologies.

(b) PROGRESS REPORTS.—(1) Not later than 36 months after the date of enactment of this Act, the Secretary shall submit to the Committee on Science and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate an interim report describing the progress made under this Act. At the end of 60 months, the Secretary shall submit to Congress a report on the results of projects undertaken under this Act and other such information the Secretary considers appropriate.

(2) As necessary, the Secretary shall report to the Congress on any legal, regulatory, or other barriers encountered that hinder economic development of these resources, and provide recommendations on legislative or other actions needed to address such impediments.

SEC. 12. APPLICABILITY OF OTHER LAWS.

Nothing in this Act shall be construed as waiving the applicability of any requirement under any environmental or other Federal or State law.

SEC. 13. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary to carry out this Act \$90,000,000 for each of the fiscal years 2008 through 2012, of which \$10,000,000 for each fiscal year shall be for carrying out section 7.

II. PURPOSE

The purpose of the H.R. 2304 is to direct the Secretary of Energy to conduct a program of research, development, demonstration, and commercial application for geothermal energy, and to establish technology transfer centers to facilitate the collection and dissemination of technological, scientific, and best practices information relevant to geothermal energy development and use.

III. BACKGROUND AND NEED FOR THE LEGISLATION

Geothermal energy is heat from the Earth's core that is trapped in the Earth's crust. It can be tapped and used either to generate electricity or for direct use (e.g. heating buildings, greenhouses, or aquaculture operations). It is very attractive as an energy resource because it is not only renewable and emits no greenhouse gases, but can also provide continuously dispatchable, baseload power, day and night, 365 days a year. Geothermal energy is also a domestic resource, creating domestic jobs and increasing national security.

In locations where high temperatures coincide with naturally-occurring, underground, fluid-filled reservoirs, the resulting hot water or steam can be tapped directly to run a geothermal power plant. Such locations are referred to as hydrothermal (hot water) resources, and they have been the focus of traditional geothermal energy development. The United States is the world's largest producer of electric power from geothermal energy with approximately 2,800 megawatts (MW) of geothermal electrical generating capacity currently connected to the grid, mostly in California and the Intermountain West, where high grade hydrothermal systems have been found close to the surface. However, significant hydrothermal potential remains untapped. The U.S. Geological Survey (USGS) estimates there are between 95,000 MW and 127,000 MW of hydrothermal resources sufficient for electrical power generation in the United States. However, many of these resources remain undiscovered and unconfirmed, as they are in locations without obvious surface manifestations.

Even that large number, however, pales in comparison to the potential of Enhanced Geothermal Systems (EGS). EGS differ from hydrothermal systems in that they lack either a natural reservoir (i.e. the cracks and spaces in the rock through which fluid can circulate), the fluid to circulate through the reservoir, or both. In EGS development, sometimes referred to as "heat mining", an injection well is drilled to a depth where temperatures are sufficiently high; if necessary, a reservoir is created, or "cracked", in the rock using one of various methods to apply pressure; and a fluid is introduced to circulate through the reservoir and absorb the heat. The fluid is extracted through a production well, the heat is used to run a geothermal power plant or for some direct use application and the fluid is reinjected to start the loop all over again.

Although it has been the subject of preliminary investigations in the United States, Europe, and Australia, the EGS concept has yet to be demonstrated as a commercially viable source of power production. However, experts familiar with the resource and the associated technologies believe the technical and economic hurdles are surmountable. In January 2007, a panel led by the Massachusetts Institute of Technology produced a report entitled *The Future of Geothermal Energy*, which contained an updated assessment of EGS potential in the United States. The authors of the report conservatively estimate that two percent of the EGS resource could be economically recoverable—an amount more than 2,000 times larger than all the primary energy consumed in the United States in

2005.¹ If the technological and economic hurdles to EGS development can be overcome, the potential of the resource is enormous. The authors of the report believe it is reasonable to develop 100 Gigawatts of electric generating capacity from EGS resources by 2050.

The United States has been involved in geothermal energy R&D since the 1970s. The program reached a high point, in terms of funding, in FY 1980, when it received approximately \$310 million (2006 dollars). Since then, funding has gradually declined to its present level of \$5 million (2006 dollars) in FY 2007. The current Administration has attempted to phase out the geothermal program entirely, requesting zero dollars in FY 2007 and FY 2008.

As justification for terminating the geothermal program, the Administration asserts that geothermal technologies are mature—a claim strongly disputed by researchers and the geothermal industry. Proponents point out that geothermal is not a single technology, but a complex resource, available in different grades in different places. While the technologies to tap the highest grade resources may indeed be mature (some have provided electric power at competitive rates for decades) these high grade locations, that are easily identifiable from the surface, represent a very small fraction of the total resource. To develop technologies capable of tapping lower grade resources, both hydrothermal and EGS, further research and development is essential. Recent indications suggest DOE officials may be open to reexamining investment in geothermal research and development, particularly in light of the opportunities in Enhanced Geothermal Systems that were highlighted in the recent MIT report: *The Future of Geothermal Energy*.

H.R. 2304 is intended to reinvigorate geothermal energy R&D in the United States in order to unlock the potential of this vast resource, across the full spectrum of grades, for the benefit of the nation.

IV. HEARING SUMMARY

The Energy and Environment Subcommittee held a hearing on Thursday, May 17, 2007 to hear testimony on H.R. 2304 (and also H.R. 2313, The Marine Renewable Energy Research and Development Act of 2007) from the following witnesses:

- Dr. Jefferson Tester, the HP Meissner Professor of Chemical Engineering at the Massachusetts Institute of Technology, an internationally recognized expert in Enhanced Geothermal Systems and chair of the MIT-led panel that produced the report: *The Future of Geothermal Energy*, released in January 2007.
- Mr. Paul Thomsen, Public Policy Manager for Ormat Technologies, Inc., a leading provider of geothermal exploration, development, and power conversion technologies. Mr. Thomsen testified on behalf of both Ormat and the Geothermal Energy Association.
- Mr. Nathanael Greene, a Sr. Energy Policy Specialist with the Natural Resources Defense Council with expertise in utility regulation, renewable energy, energy taxes, energy efficiency, and the environmental impacts of energy production.

¹ *The Future of Geothermal Energy*; Massachusetts Institute of Technology, 2006; p. 1–17.

The following witnesses testified at the hearing, but their testimony was directed to H.R. 2313, The Marine Renewable Energy Research and Development Act of 2007.

- Dr. Annette von Jouanne, Professor of Energy Systems and Power Electronics in the School of Electrical Engineering and Computer Science at Oregon State University (OSU). Dr. von Jouanne also leads the Wave Energy program at OSU.

- Mr. Sean O'Neill, President of the Ocean Renewable Energy Coalition (OREC), a trade association representing the marine renewable energy industry.

V. COMMITTEE ACTIONS

On May 14, 2007, Rep. Jerry McNerney, for himself, Science and Technology Committee Chairman Bart Gordon, and Energy and Environment Subcommittee Chairman Nick Lampson, introduced H.R. 2304, The Advanced Geothermal Energy Research and Development Act of 2007. The bill was referred to the House Committee on Science and Technology, Subcommittee on Energy and Environment.

The Subcommittee on Energy and Environment met to consider H.R. 2304 on June 6, 2007 and consider the following amendment to the bill:

1. On behalf of Mr. McNerney which, in addition to changes of a technical nature, revises instructions for establishing the Federal/non-Federal cost-share ratios for projects funded under the Act to provide greater leeway to tailor cost-share levels to individual projects; allows for a competitive bidding process to play a role in determining the cost-share ratio for a projects; eliminates cost-share requirements for research that is of a “fundamental or basic nature”; establishes an R&D program to develop technologies and techniques to mitigate or avoid adverse environmental impacts of geothermal energy development, production, or use; directs the Secretary to coordinate with the Environmental Protection Agency to study the environmental impacts of geothermal energy development, production, and use; directs the Secretary to give priority consideration for funding, where appropriate, to project proposals that include provisions to study the project’s environmental impacts; encourages the Enhanced Geothermal Systems Technology Transfer Center established in the bill to seek opportunities for coordination with appropriate international partners; and expands the scope of an existing, domestic geothermal technology transfer program from the western U.S. to the entire country. The amendment was agreed to by voice vote.

Following consideration of the amendments, the bill, as amended, was passed by voice vote.

Mr. Inglis then moved that the Subcommittee favorably report the bill, H.R. 2304, to the full Committee on Science and Technology. The motion was agreed to by voice vote.

The House Committee on Science and Technology met to consider H.R. 2304 on June 13, 2007 and considered the following amendments to the bill:

1. On behalf of Mr. Hall, which adds a section on co-produced (with oil and gas operations) and geopressured resources. It also adds \$10 million for those activities in authorized appropriations to the bill. It also streamlines the instructions for determining cost-

share ratios for projects, and calls for interim progress reports on projects funded under the Act. The amendment was agreed to by voice vote.

The following three amendments were offered and considered en bloc:

2. On behalf of Mr. Bartlett, which replaces “Study on Advanced Uses of Geothermal Energy” with “Reports on Advanced Uses of Geothermal Energy”. The amendment was agreed to by voice vote.

3. On behalf of Mr. Bartlett, which replaces “Geopower America” with “Geopowering America”. The amendment was agreed to by voice vote.

4. On behalf of Mr. Bartlett, which requires environmental impacts from geothermal energy production to be measured and examined against the potential for geothermal energy production to offset greenhouse gas emissions. The amendment was agreed to by voice vote.

The following two amendments were offered and considered en bloc:

5. On behalf of Mr. McCaul, which requires the Secretary of Energy to coordinate with other DOE research and development programs focused on drilling and related activities. The amendment was agreed to by voice vote.

6. On behalf of Mr. McCaul, which adds “laser-based drilling technology” to the EGS research and development program. The amendment was agreed to by voice vote.

7. On behalf of Ms. Biggert, which strikes the section establishing two university-based, geothermal technology transfer centers and transfers these responsibilities to the Geopowering America program. The amendment was rejected by voice vote.

8. On behalf of Ms. Biggert, which instructs the Secretary to choose a location for the EGS Technology Transfer Center east of the “Rocky Mountains”, rather than east of the “Mississippi River”. The amendment was agreed to by voice vote.

9. On behalf of Mr. Matheson, which increases the total authorization by \$5,000,000 for each of the five fiscal years 2008 through 2012, to fund the Intermountain West Geothermal Consortium. The amendment was offered and withdrawn.

Following consideration of the amendments, the bill, as amended, was passed by voice vote.

Mr. Hall then moved that the committee favorably report the bill, H.R. 2304, as amended, to the House for consideration. The motion was agreed to by a voice vote.

VI. SUMMARY OF MAJOR PROVISIONS OF THE BILL, AS REPORTED

H.R. 2304 authorizes \$90 million a year for each of the fiscal years 2008–2012 (\$450 million total) for research, development, demonstration, and commercial application of technologies to locate, characterize, and develop geothermal resources for energy production. Of the \$90 million annual authorization, \$10 million per year is specifically authorized for projects to develop co-produced and geopressed resources. The bill also establishes a research program, to be coordinated with EPA, to identify potential environmental impacts of geothermal energy production, and a program of research, development, demonstration, and commercial application of technologies to mitigate or avoid adverse environmental

impacts. The bill provides guidance for the Secretary to use in evaluation of project proposals, and calls for the inclusion of a competitive bidding process in the process used for establishing Federal/non-Federal cost-share ratios for projects. The bill establishes or expands several technology transfer programs to promote dissemination of technological and scientific information and best practices on geothermal energy development and use. Finally, the bill requires DOE to issue several reports: the first, to be issued 36 and 60 months after enactment, is a report on the progress made under the Act; the second, to be issued 12, 36, and 60 months after enactment, is a report tracking the development of advanced concepts and technologies related to geothermal energy development but not funded under the Act; the third, to be issued when and if necessary, is a report to Congress on any barriers encountered—legal, regulatory, or otherwise—that hinder economic development of geothermal resources.

VII. SECTION-BY-SECTION ANALYSIS

Section 1. Short title

Act may be cited as the “Advanced Geothermal Energy Research and Development Act of 2007”

Section 2. Findings

Geothermal energy is a renewable resource capable of providing baseload power generation (and other applications) with minimal environmental impact. The geothermal energy potential in the United States is widely distributed and vast in size, yet it remains barely tapped. Sustained and expanded funding for research, development, demonstration, and commercial application programs is needed to improve the technologies to locate, characterize, and develop geothermal resources.

Section 3. Definitions

Provides definitions for the following terms used in the Act: ‘Engineered’ (as it pertains to enhanced geothermal systems), ‘Enhanced Geothermal Systems’, ‘Geofluid’, ‘Geopressed Resources’, ‘Geothermal’, ‘Hydrothermal’, ‘Secretary’, and ‘Systems Approach’

Section 4. Hydrothermal research and development

Instructs the Secretary to support research, development, demonstration, and commercial application of technologies designed to assist in locating and characterizing undiscovered hydrothermal resources.

Section 4(b)(1) instructs the Secretary to support the development of geoscientific tools and technologies that can assist in the process of locating hidden hydrothermal resources that do not exhibit obvious manifestations at the earth’s surface. This research and tool development would likely be carried out by researchers at universities and national labs, though qualified candidates based at other institutions or organizations may also apply for funding. The bill specifies that this program shall include a field component, to encourage development of these tools under real world conditions, but this is not intended to suggest that only field-based research may qualify for funding under this Section.

Section 4(b)(2) establishes an “industry-coupled exploratory drilling” program, which is a cost-shared program with industry partners to demonstrate and apply advanced exploration technologies in the field. This is not intended as research and development program for drilling technologies per se; rather, it is intended as a demonstration program to apply existing technologies—especially the most advanced technologies available—in a practical setting to discover and confirm hidden hydrothermal resources and expand the confirmed hydrothermal resource base.

Section 5. General geothermal systems research and development

The programs under Section 5 are intended to support the development of technologies applicable to the locating, developing, and using all geothermal systems, whether they are hydrothermal systems, Enhanced Geothermal Systems, or a hybrid of the two. Subsection (a) establishes a program of research, development, demonstration, and commercial application of system components and materials capable of withstanding the extreme environment (high temperatures and corrosiveness) in geothermal wells. The Section includes a list of specific types of components and systems that shall qualify for funding under this Section, though in practice, any subsurface component that is essential to drilling to extreme depths and temperatures shall qualify for research, development, demonstration, and commercial applications funding under this section.

Subsection (b) establishes a program of research, development, demonstration, and commercial application of improved models of geothermal reservoir performance. The intent is to improve upon the accuracy of existing models. The models can be of any useful type, whether numerical, computer-based, or other.

Subsection (c)(1) establishes a program of research, development, demonstration, and commercial application of technologies to mitigate or preclude adverse environmental impacts from geothermal energy development, production or use. Subsection (c)(2) directs the Secretary, in conjunction with the Office of Research and Development at EPA, to study what such impacts of geothermal energy development might be, and ensure that the program in (c)(1) addresses such impacts. The intent is to ensure that all reasonable efforts are undertaken to ensure that geothermal energy development may proceed with the smallest possible environmental impact. This subsection also calls for any identified potential adverse environmental impacts of geothermal energy development to be weighed against the potential benefit of providing power production without greenhouse gas emissions.

Section 6. Enhanced geothermal systems research and development

Subsection (a) instructs the Secretary to support a program of research, development, demonstration, and commercial application of technologies necessary to advance EGS to a state of commercial readiness.

Subsection (b) establishes a cost-shared, field-based program of research, development, and demonstration of technologies to create and stimulate EGS reservoirs. The purpose of this subsection is to promote research, development, and demonstration of functional EGS systems capable of producing hot geofluid that could be used

for electric power production or direct use. (However, this section deliberately stops short of authorizing demonstration of the actual power conversion step, which is already considered commercially viable. The aim of this section is strictly to engineer a productive reservoir.) The subsection stipulates that a minimum of 5 sites be selected, each representing geologic conditions that are different from other sites and also showing potential for EGS development. The intent is to prove the viability of EGS technology in as many different geological settings as possible. The Secretary may pursue EGS reservoir stimulation work at more than 5 sites, and s/he is encouraged to do so if sufficient funds are available.

Finally, two sites where DOE has already sponsored some EGS research (Coso, CA and Desert Peak, NV) are listed as candidate sites that may be considered for further funding under this section, if the Secretary deems it appropriate to invest further in those sites. This decision, however, is left to the Secretary's discretion and should be based on the potential for these sites to yield additional useful information or developments.

Section 7. Geothermal energy production from oil and gas fields and recovery and production of geopressured gas resources

Establishes a demonstration program to prove the feasibility of co-producing geothermal power from hot water "co-produced" from oil and gas fields. This section also directs the Secretary of Energy to hold a design competition to produce preliminary designs for state-of-the-art approaches to recovering the energy contained in geopressured resources—which contain heat, pressure, and dissolved methane—in and near the Gulf of Mexico. The Secretary shall select the most promising preliminary designs submitted and award grants (which may be cost-shared) for the completion of the full engineering and other technical design work. Then, based upon an evaluation of the final designs, the Secretary is authorized to select the design that shows the greatest potential for economic recovery of the heat, kinetic energy and gas (the chosen design must effectively tap all three sources of energy) from geopressured resources, and award cost-shared grants for construction of a demonstration facility based on that design. The authorization for the overall bill includes \$10 million per year specifically for this Section. None of the appropriated funds may be used to drill new wells. This is to encourage developers to take advantage of the many existing wells already drilled.

Section 8. Cost sharing and proposal evaluation

Instructs the Secretary to use the guidelines established in Section 988 of the Energy Policy Act of 2005 to determine the Federal/non-Federal cost-share ratios for projects funded under this Act, but, in addition, to incorporate a competitive bidding process into the process of determining the cost-share ratio for each project. The intent of the competitive bidding process is to encourage funding applicants to offer to finance the greatest possible portion of a project's total costs that they can afford. In addition, the cost-share guidelines allow the Secretary to waive cost-share requirements for projects awarded to non-commercial entities, such as universities or national laboratories.

Section 9. Centers for geothermal technology transfer

Provides for the creation of two Centers of technology transfer to function as information clearinghouses for the benefit of geothermal researchers and the geothermal industry. These centers shall be dedicated to collecting and disseminating all available information relevant to locating, developing, and managing geothermal resources to produce energy. Relevant information is intended to include, but not be limited to, operational best practices in all stages of geothermal energy development, technological advances, and scientific data collected as a result of projects funded under the Act. One of the centers is to be located west of the Mississippi River, probably west of the Rocky Mountains, and shall be dedicated to managing information relevant to hydrothermal systems development; the other center shall be located east of the Rocky Mountains, and shall be dedicated to managing information relevant to Enhanced Geothermal Systems development.

It was decided that two Centers should be established, rather than one, for two reasons. First, the regions for the two Centers were chosen to match each Center's mission. The western Center is to be dedicated to collecting and disseminating information related to developing hydrothermal systems because the West is the geologically suited to be the center of hydrothermal development. The eastern Center is to be dedicated to Enhanced Geothermal Systems to emphasize the applicability of this enormous resource to the entire nation, including in the East—a region not commonly associated with geothermal energy development.

The second reason for establishing two Centers is that there are different engineering and scientific issues associated with developing the different types of resources. To the extent that those areas of expertise overlap, it may be appropriate and useful for the two Centers to handle duplicate information, and such appropriate duplication is not discouraged. Both centers are intended to serve the entire nation in their respective areas of expertise, not just their respective region. The eastern Center is specifically encouraged to seek opportunities for international cooperation because there is significant EGS research happening in other countries.

The rationale for locating the Centers at universities is two-fold: first, the close proximity of the Centers to university faculty and students is intended to create a valuable asset to the university research community and encourage the development of a new generation of geothermal scientists and engineers; second, there are numerous universities with strong programs in the geosciences that would make very attractive candidates for hosting these facilities.

It should be noted that these Centers are not intended as research Centers per se. Rather, they are intended as information clearinghouses or repositories—sort of specialized libraries that will actively seek to collect and disseminate relevant data. It is hoped that they will be of significant value to researchers, as well as the geothermal development industry, but their mandate does not include conducting original research themselves.

Section 10. Geopowering America

Expands the scope of an existing, domestic geothermal technology transfer program from the western U.S. to the entire country, so as to encourage the transfer and adoption of appropriate

geothermal energy technologies throughout the entire United States.

Section 11. Reports

Subsection 11(a) requires the Secretary to track technological advances impacting geothermal energy development and advanced uses of geothermal energy and fluids, and report back to the Committee every other year for the next five years (a total of three times). This report is intended to focus on areas of potential future interest for the geothermal program, but these areas are not considered appropriate candidates for Federal research, development, demonstration, and commercial application support at the current time, owing to their early stages of development and speculative nature. The report is not intended to be limited to the topics listed here. The bi-annual tracking effort is intended to highlight when these technologies become less speculative and more appropriate for Federal support.

Subsection 11(b)(1) requires the Secretary to report back to the Committee after 3 years describing the progress made under this Act up to that point. At the end of 5 years, the Secretary shall report on the results of projects undertaken under this Act.

Subsection 11(b)(2) requires the Secretary to report back to Congress, as necessary, on any legal, regulatory, or other barriers encountered that hinder economic development of geothermal resources and provide recommendations on legislative or other actions needed to address such impediments.

Section 12. Applicability of other laws

Affirms the applicability of all requirements under Federal and State laws, including environmental laws, to projects undertaken under this Act.

Section 13. Authorization of appropriations

Authorizes appropriations of \$90,000,000 for each of the fiscal years 2008 through 2012, of which \$10,000,000 for each fiscal year shall be for carrying out section 7.

VIII. COST ESTIMATE

A cost estimate and comparison prepared by the Director of the Congressional Budget Office under section 402 of the Congressional Budget Act of 1974 has been timely submitted to the Committee on Science and Technology prior to the filing of this report and is included in Section X of this report pursuant to House Rule XIII, clause 3(c)(3).

H.R. 2304 does not contain new budget authority, credit authority, or changes in revenues or tax expenditures. Assuming that the sums authorized under the bill are appropriated, H.R. 2304 does authorize additional discretionary spending, as described in the Congressional Budget Office report on the bill, which is contained in Section X of this report.

IX. CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

H.R. 2304—Advanced Geothermal Energy Research and Development Act of 2007

Summary: H.R. 2304 would authorize the appropriation of \$450 million over the 2008–2012 period for the Department of Energy (DOE) to support research and development activities related to the production and use of geothermal energy (heat energy stored in the Earth’s surface). Funds authorized by the bill would also be used to establish two Centers for Geothermal Technology Transfer within institutions of higher education to act as information clearinghouses for industry on geothermal energy development and management. CBO estimates that implementing H.R. 2304 would cost \$396 million over the 2008–2012 period, assuming the appropriation of the specified funds. Enacting H.R. 2304 would have no effect on direct spending or revenues.

H.R. 2304 contains no intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act (UMRA) and would benefit public institutions of higher education.

Estimated cost to the Federal Government: The estimated budgetary impact of H.R. 2304 is shown in the following table. The costs of this legislation fall within budget function 250 (general science, space, and technology).

	By fiscal year, in millions of dollars—				
	2008	2009	2010	2011	2012
CHANGES IN SPENDING SUBJECT TO APPROPRIATION					
Geothermal Energy Research and Development Programs:					
Authorization Level	80	80	80	80	80
Estimated Outlays	44	68	80	80	80
Other Geothermal Energy Programs:					
Authorization Level	10	10	10	10	10
Estimated Outlays	6	8	10	10	10
Total Changes:					
Authorization Level	90	90	90	90	90
Estimated Outlays	50	76	90	90	90

Basis of estimate: For this estimate, CBO assumes that the bill will be enacted in fiscal year 2007 and that the amounts specified by the bill will be appropriated for each fiscal year.

GEOTHERMAL ENERGY RESEARCH AND DEVELOPMENT PROGRAMS

H.R. 2304 would authorize the appropriation of \$80 million for each of fiscal years 2008 through 2012 for DOE to support research and development programs that expand the production of geothermal energy. Funds authorized by this legislation would be used to:

- Develop tools to locate hydrothermal resources (naturally occurring bodies of hot water or steam located below the earth’s surface) and improve site characterization;
- Establish field demonstration programs, in cooperation with industry partners, to demonstrate techniques and technologies used in exploratory drilling;
- Develop components and systems capable of sustaining the extreme geological environments necessary to produce geothermal energy;

- Model geothermal resource performance;
- Examine the environmental impacts of geothermal energy development, production and use, as well as technologies and practices to mitigate such impacts;
- Develop technologies to advance enhanced geothermal systems (sources of geothermal energy which require human invention to facilitate production) to the stage of commercial readiness;
- Establish at least five demonstration programs to develop geothermal energy stimulation techniques and technologies;
- Award five-year renewable grants to institutions of higher education to establish two Centers for Geothermal Technology Transfer to act as an information clearinghouse for industry on best practices to develop and manage hydrothermal resources and enhanced geothermal systems resources; and
- Expand the GeoPowering the West program to address the private market and institutional barriers of bringing geothermal energy to all areas of the United States.

Under the legislation, the federal share of such projects would be limited to 80 percent. Based on information from DOE, CBO expects that funds authorized to be appropriated by the bill would be used to establish new programs within DOE, as well as fund research projects already in existence. Assuming the appropriation of the specified funds, and based on the historical spending of DOE research and development programs, CBO estimates that implementing these provisions would cost \$44 million in 2008 and \$352 million over the 2008–2012 period.

OTHER GEOTHERMAL ENERGY PROGRAMS

H.R. 2304 would authorize the appropriation of \$10 million for each of fiscal years 2008 through 2012 for DOE to make grants to establish three demonstration projects that use geothermal techniques at oil and gas wells. Funds authorized by this legislation would also be used to support the research and development of techniques to produce energy from geopressured sources (rock deposits under high pressure and saturated with gas or methane) in and near the Gulf of Mexico. Based on information from DOE, CBO estimates that implementing these programs would cost \$6 million in 2008 and \$44 million over the 2008–2012 period.

Intergovernmental and private-sector impact: H.R. 2304 contains no intergovernmental or private-sector mandates as defined in UMRA and would benefit participating public institutions of higher education. The bill would authorize several grant programs for geothermal energy research, development, and demonstration. It would also authorize funding for information clearinghouses at institutions of higher education. Any costs incurred by public institutions applying to host the centers would be incurred voluntarily.

Estimate prepared by: Federal Costs: Daniel Hoople; Impact on State, Local, and Tribal Governments: Neil Hood; Impact on the Private Sector: Amy Petz.

Estimate approved by: Peter H. Fontaine, Deputy Assistant Director for Budget Analysis.

X. COMPLIANCE WITH PUBLIC LAW 104–4

H.R. 2304 contains no unfunded mandates.

XI. COMMITTEE OVERSIGHT FINDINGS AND RECOMMENDATIONS

The oversight findings and recommendations of the Committee on Science and Technology are reflected in the body of this report.

XII. STATEMENT ON GENERAL PERFORMANCE GOALS AND OBJECTIVES

Pursuant to clause (3)(c) of House Rule XIII, the goal of H.R. 2304 is to advance geothermal research and development through programs of hydrothermal research and development, general geothermal systems research and development, enhanced geothermal systems research and development; the establishment of centers for geothermal technology transfer; and a report on advanced uses of geothermal energy.

XIII. CONSTITUTIONAL AUTHORITY STATEMENT

Article I, section 8 of the Constitution of the United States grants Congress the authority to enact H.R. 2304.

XIV. FEDERAL ADVISORY COMMITTEE STATEMENT

H.R. 2304 does not establish nor authorize the establishment of any advisory committee.

XV. CONGRESSIONAL ACCOUNTABILITY ACT

The Committee finds that H.R. 2304 does not relate to the terms and conditions of employment or access to public services or accommodations within the meaning of section 102(b)(3) of the Congressional Accountability Act (Public Law 104–1).

XVI. EARMARK IDENTIFICATION

H.R. 2304 does not contain any congressional earmarks, limited tax benefits, or limited tariff benefits as defined in clause 9(d), 9(e), or 9(f) of rule XXI.

XVII. STATEMENT ON PREEMPTION OF STATE, LOCAL, OR TRIBAL LAW

This bill is not intended to preempt any state, local, or tribal law.

XVIII. CHANGES IN EXISTING LAW MADE BY THE BILL, AS REPORTED

The bill does not change existing law.

XIX. COMMITTEE RECOMMENDATIONS

On June 13, 2007, the Committee on Science and Technology favorably reported H.R. 2304, as amended, by a voice vote and recommended its enactment.

**XX. PROCEEDINGS OF THE MARKUP BY THE
SUBCOMMITTEE ON ENERGY AND ENVIRON-
MENT ON H.R. 2304, THE ADVANCED GEO-
THERMAL ENERGY RESEARCH AND DEVEL-
OPMENT ACT OF 2007**

WEDNESDAY, JUNE 6, 2007

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 9:44 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Nick Lampson [Chairman of the Subcommittee] presiding.

Chairman LAMPSON. Good morning. The Subcommittee on Energy and Environment will come to order. Pursuant to notice, the Subcommittee on Energy and Environment meets to consider the following measures: H.R. 906, the *Global Change Research and Data Management Act of 2007*; H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*; and H.R. 2313, the *Marine Renewable Energy Research and Development Act of 2007*.

We will now proceed with the markup beginning with opening statements, and I will begin.

Today the Subcommittee will consider three bills: H.R. 906, the *Global Change Research and Data Management Act*; H.R. 2304, the *Advanced Geothermal Energy Research and Development Act*; and H.R. 2313, the *Marine Renewable Energy Research and Development Act of 2007*.

First, we will take up H.R. 906, the *Global Change Research and Data Management Act of 2007*, which will re-orient the current interagency climate research program to produce information that supports efforts of resource managers, businesses and individuals to understand and reduce our vulnerability to extreme weather events and climate change.

The U.S. Global Change Research Program has been in existence in some form since the late 1970s. This important program has vastly expanded our knowledge of Earth's land, water and atmospheric systems. However, fires, droughts, hurricanes and other natural events have highlighted our increasing vulnerability to extreme weather and climate changes. With better planning and implementation adaptation strategies, these costs can be reduced.

Next, we will consider two pieces of legislation to expand our country's renewable energy portfolio in the areas of geothermal and ocean power. These resources are both potentially vast in size and have potential to provide clean power at competitive rates but they require support to advance to the stage of commercial viability.

H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, would reinvigorate geothermal research and development in this country. It would provide support and guidance for researchers to develop technologies capable of tapping into the vast quantities of thermal energy that is stored in the Earth's crust.

H.R. 2313, the *Marine Renewable Energy Research and Development Act of 2007*, would support renewable energy development by exploiting the energy of ocean tides and currents. Today this promising industry is at roughly the same development stage that wind was back 20 years ago. With the support provided by this bill, this industry is posed to grow into a significant contributor of clean electricity to our nation's power grid.

In short, these bills are about addressing overlooked opportunities in our collective efforts to create good American jobs, diversify our energy supply, increase our security and reduce the environmental impact of energy production. All three pieces of legislation are important to our environment and our economy. Therefore, I urge their passage and I look forward to getting them to the House Floor.

[The prepared statement of Chairman Lampson follows:]

PREPARED STATEMENT OF CHAIRMAN NICK LAMPSON

Today, the Subcommittee we will consider three bills, H.R. 906, the *Global Change Research and Data Management Act*; H.R. 2304, the *Advanced Geothermal Energy Research and Development Act*; and H.R. 2313, the *Marine Renewable Energy Research and Development Act*.

First, we will take up H.R. 906, the *Global Change Research and Data Management Act of 2007*, which will re-orient the current interagency climate research program to produce information that supports efforts of resource managers, businesses, and individuals to understand and reduce our vulnerability to extreme weather events and to climate change.

The U.S. Global Change Research Program has been in existence in some form since the late 1970s. This important program has vastly expanded our knowledge of Earth's land, water, and atmospheric systems.

However, fires, droughts, hurricanes, and other natural events have highlighted our increasing vulnerability to extreme weather and climate changes. With better planning and implementation of adaptation strategies these costs can be reduced.

Next, we will consider two pieces of legislation to expand our country's renewable energy portfolio in the areas of geothermal and ocean power. These resources are both potentially vast in size and have potential to provide clean power at competitive rates, but they require support to advance to the stage of commercial viability.

H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, would reinvigorate geothermal research and development in this country. It would provide support and guidance for researchers to develop technologies capable of tapping into the vast quantities of thermal energy that is stored in the Earth's crust.

H.R. 2313, the *Marine Renewable Energy Research and Development Act of 2007*, would support renewable energy development by exploiting the energy of ocean tides and currents.

Today, this promising industry is at roughly the same developmental stage that wind was at 20 years ago. With the support provided by this bill, this industry is posed to grow into a significant contributor of clean electricity to our nation's power grid.

In short, these bills are about addressing overlooked opportunities in our collective efforts to create good American jobs, diversify our energy supply, increase our security, and reduce the environmental impact of energy production.

All three pieces of legislation are important to our environment and our economy. Therefore, I urge their passage, and look forward to getting them to the House Floor.

Chairman LAMPSON. At this time I will recognize Mr. Inglis to present his opening remarks.

Mr. INGLIS. Thank you, Mr. Chairman, and thank you for holding this markup.

I am happy to be a co-sponsor of Mr. Udall's bill, the *Global Change Research and Data Management Act*. For a number of years, the U.S. Global Research Program has coordinated a successful interagency research program on global environmental change and implications of a changing climate for society. H.R. 906 continues support for this research and makes that research user-friendly for federal, State and local decision-makers who are tasked with the job of creating policies that address the challenges associated with climate change.

We also have an opportunity to address the development of clean, renewable energy sources in today's markup of H.R. 2304, the *Advanced Geothermal Energy Research and Development Act*, and H.R. 2313, the *Marine Renewable Energy Research and Development Act*. Geothermal and marine-related energy should be sources of energy for us and I am looking forward to promoting research that will make these alternatives commercially feasible. I hope we can build on what we have already learned and that experience scientists in that program have already achieved and move forward to even greater use of these sources of energy.

And Mr. Chairman, I hope that by the time that we have concluded opening statements, that more Members will appear from the Republican conference that is still underway, and when they do, I suppose we will have a quorum for votes on these bills.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF REPRESENTATIVE BOB INGLIS

Thank you for holding this markup, Mr. Chairman.

I'm happy to be a co-sponsor of Mr. Udall's bill, the *Global Change Research and Data Management Act*. For many years, the United States Global Research Program has coordinated a successful interagency research program on global environment change and implications of a changing climate for society. H.R. 906 continues support for this research, and makes that research "user-friendly" for federal, State, and local decision-makers who are tasked with the job of creating policies that address the challenges associated with climate change.

We also have an opportunity to address the development of clean, renewable energy sources in today's markup of H.R. 2304, the *Advanced Geothermal Energy Research and Development Act*, and H.R. 2313, the *Marine Renewable Energy Research and Development Act*. Geothermal and marine-related energy should be sources of energy for us, and I'm looking forward to promoting research that will make these alternatives commercially affordable. I hope that we can build on what we've already learned and that experienced scientists and other professionals are included so that duplication.

Thank you again, Mr. Chairman, and I look forward to working with you to advance this legislation.

Chairman LAMPSON. We will be ready for the votes when they come in. We may get a little ahead of them.

Without objection, Members may place statements in the record at this point.

We will now consider H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*. I yield Mr. McNerney five minutes to describe his bill.

Mr. McNERNEY. Thank you, Mr. Chairman, for your support of my bill, H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, and for holding this markup today.

Geothermal energy derived from the Earth's heat is an under-utilized renewable energy resource. Studies show that new geothermal sources known as enhanced geothermal energy systems, or EGS, offer the potential to generate as much as 100 gigawatts of power in the next 50 years. Utilizing EGS involves creating underground reservoirs that do not occur naturally but rather are mechanically or chemically engineered out of hot rock. Fluid is introduced to circulate and absorb the heat and then pumped out to extra energy. EGS is in the early stages of its maturation and federal support is necessary to ensure that full potential of this resource is utilized.

My bill authorizes further research, development, demonstration and commercial application of advanced technologies to develop more traditional geothermal sources and EGS. H.R. 2304 specifically authorizes the research and development of both the technologies and techniques necessary to fully utilize EGS. Geothermal energy should be an important component of our country's efforts to combat climate change and achieve energy independence. As a domestically produced energy source, expanding geothermal will also create high-paying jobs here at home. I hope that my colleagues here today will join me in supporting H.R. 2304 and I thank Mr. Lampson for holding this markup.

I yield back the balance of my time.

[The prepared statement of Mr. McNerney follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY MCNERNEY

Thank you, Chairman Lampson, for your support for my bill, H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, and for holding this markup today.

Geothermal energy derived from the Earth's heat is an under-utilized renewable energy source. Studies show that new geothermal resources, known as Enhanced Geothermal Systems, or EGS, offer the potential to generate as much as 100 Gigawatts of power in the next 50 years. Utilizing EGS involves creating underground reservoirs that do not occur naturally, but rather are mechanically or chemically engineered out of hot rock. Fluid is introduced to circulate and absorb the heat, and is then pumped out to extract the energy. EGS is in early stages of its maturation, and federal support is necessary to ensure that the full potential of this resource is realized.

My bill authorizes further research, development, demonstration, and commercial application of advanced technologies to develop both traditional geothermal sources and EGS. H.R. 2304 specifically authorizes the research and development of both the technologies and techniques necessary to fully utilize EGS.

Geothermal energy should be an important component of our country's efforts to combat climate change and achieve energy independence. As a domestically-produced energy source, expanding geothermal will also create high paying jobs at home. I hope that my colleagues here today will join me in supporting H.R. 2304, and I thank Chairman Lampson again for holding this markup. I yield back the balance of my time.

Chairman LAMPSON. Thank you, Mr. McNerney.

I now recognize Mr. Inglis to present any remarks on the bill.

Mr. INGLIS. As I said in my opening statement, Mr. Chairman, this too is a good bill and I am happy to be supporting it, and look forward to development of this resource.

Chairman LAMPSON. Thank you very much.

Does anyone else wish to be recognized?

I ask unanimous consent that the bill is considered as read and open to amendment at any point, and that the Members proceed with amendments in the order of the roster. Without objection, so ordered.

The first amendment on the roster is an amendment offered by the gentleman from California, Mr. McNerney. Are you ready to proceed with your amendment?

Mr. MCNERNEY. Yes, I am, Mr. Chairman.

Chairman LAMPSON. The Clerk will report the amendment.

The CLERK. Amendment to H.R. 2304 offered by Mr. McNerney of California.

Chairman LAMPSON. I ask unanimous consent to dispense with the reading. Without objection, so ordered.

I recognize Mr. McNerney for five minutes to explain the amendment.

Mr. MCNERNEY. Thank you, Mr. Chairman.

This amendment, like the prior one, takes into account suggestions made by our witnesses at legislative hearings held on May 17 as well as numerous comments from outside experts in geothermal energy, industry, researchers and the environmental community. Most of the changes are simple housekeeping measures intended to refine or clarify language but there are some substantive changes as well.

First among these is a revision to the instructions for establishing federal/non-federal cost-sharing ratios for the projects. Revision instructions are intended to make the process more flexible both for the administrators and the participants. The revised instructions provide greater leeway for program administrators to tailor cost-sharing levels to individual projects depending on the project's risk profile and the opportunities for commercial benefits. It allows for a competitive bidding process to play a role in determining the cost-sharing ratio for a project so as to encourage participating entities to invest as much of their own capital as they can.

The amendment also strengthens the environmental provisions of the bill considerably. It directs the Secretary to support an R&D program to develop technologies and techniques to mitigate or avoid adverse environmental impacts of geothermal energy production or use. It also directs the Secretary to coordinate with the Environmental Protection Agency to study the environmental impacts of geothermal energy development, production and use. In addition, the amendment directs the Secretary to give priority consideration for funding where appropriate to project proposals that include provisions to study the project's environmental impacts.

Finally, the amendment strengthens some geothermal technology transfer programs. It encourages the Enhanced Geothermal Systems Technology Transfer Center established in the bill to seek opportunities for coordination with appropriate international partners so we can benefit from lessons learned by other countries as they

are advancing the frontier of EGS technology. The amendment also expands the scope of an existing domestic geothermal technology transfer program from the Western United States to the entire country so as to encourage the transfer and adoption of appropriate geothermal energy technologies throughout the United States. As indicated before, this amendment is a product of close collaboration with witnesses and other experts and it makes some solid improvements in the original bill.

I strongly encourage my colleagues to vote for its passage, and I yield the balance of my time.

[The prepared statement of Mr. McNerney follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY MCNERNEY

Thank you, Mr. Chairman. This amendment takes into account suggestions made by our witnesses at the legislative hearing held on May 17, as well as numerous comments from outside experts in the geothermal industry, researchers, and the environmental community. Most of the changes are simple “housekeeping” measures intended to refine or clarify language, but there are a few substantive changes as well:

First among these is a revision to the instructions for establishing the federal/non-federal cost-sharing ratios for projects. The revised instructions are intended to make the process more flexible, both for administrators and participants. The revised instructions provide greater leeway for program administrators to tailor cost-sharing levels to individual projects, depending on the project’s risk profile and the opportunities for commercial benefits. It also allows for a competitive bidding process to play a role in determining the cost-share ratio for a project, so as to encourage participating entities to invest as much of their own capital as they can.

This amendment also strengthens the environmental provisions of the bill considerably. It directs the Secretary to support an R&D program to develop technologies and techniques to mitigate or avoid adverse environmental impacts of geothermal energy development, production, or use. It also directs the Secretary to coordinate with the Environmental Protection Agency to study the environmental impacts of geothermal energy development, production, and use. In addition, the amendment directs the Secretary to give priority consideration for funding—where appropriate—to project proposals that include provisions to study the project’s environmental impacts.

Finally, the amendment strengthens some geothermal technology transfer programs. It encourages the Enhanced Geothermal Systems Technology Transfer Center established in the bill to seek opportunities for coordination with appropriate international partners, so we can benefit from lessons learned by other countries that are advancing the frontier of EGS knowledge. The amendment also expands the scope of an existing, domestic geothermal technology transfer program from the western U.S. to the entire country, so as to encourage the transfer and adoption of appropriate geothermal energy technologies throughout the entire United States.

As indicated before, this amendment is the product of close collaboration with witnesses and other experts, and it makes some solid improvements to the original bill. I strongly encourage my colleagues to vote for its passage. I yield the balance of my time.

Chairman LAMPSON. Thank you. Is there further discussion on the amendment? Further discussion on the amendment? If not, the vote occurs on the amendment. All in favor say aye. Those opposed say no. The ayes have it and the amendment is agreed to.

Are there other amendments? Hearing none, the vote is on the bill, H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, as amended. All those in favor—yes, ma’am, Ms. Biggert?

Ms. BIGGERT. If I could ask a question on the bill. In section 8, the Centers for geothermal technology transfers, my concern with the two Centers is that it splits the Midwest into two by dividing it at the Mississippi River. Was there any reason for that designa-

tion? One is to be in the western and the other Center in the Eastern United States, and the poor Midwest gets split in two.

Mr. MCNERNEY. Thank you for the question. What this bill does is, it gives the Secretary quite a bit of flexibility in where these two Centers will go. We wanted to make sure that the western half of the country had a Center because of the geothermal properties in the West are significantly different than the East, so we didn't intend to split it exactly on the line but I think the Secretary will have a lot of flexibility in where those two Centers go.

Ms. BIGGERT. It won't necessarily be just where it leaves the Mississippi, they can't use that Center if you are on one side of the Mississippi?

Mr. MCNERNEY. No, it doesn't have that intent, and that wasn't the intent at all.

Ms. BIGGERT. Okay. Is there any difference in the geology in the Midwest versus the West or the East?

Mr. MCNERNEY. Well, in the western part of the country we have the most accessible geothermal energy. In the eastern, it is going to require more of the EGS technology so it is important that we develop that technology so that we can use this sort of energy source throughout the country because there is significant resource throughout the United States but the part in the western is more accessible with this existing technology, which is again why it is so important for us to develop the EGS within the bill, that is identified within the bill.

Ms. BIGGERT. Having been up in Iceland and seeing what they do up there, it is amazing, the geology up there, that this can then be created by—

Mr. MCNERNEY. That is right. In Iceland they have the resources really near the surface of the Earth. The rock formations are particularly well suited for geothermal. What is missing in most of our resources that the rock formations are not appropriate. They are little deeper so we have to develop technology to crack the rocks or to open up the reservoirs deep underground.

Ms. BIGGERT. Thank you. I yield back.

Chairman LAMPSON. Are there any other questions?

The vote then will be on the bill. All those in favor, say aye. Those opposed, no. In the opinion of the Chair, the ayes have it. I recognize Mr. Inglis to offer a motion.

Mr. INGLIS. Mr. Chairman, I move that the Subcommittee favorably report H.R. 2304 as amended to the Full Committee. Furthermore, I move that the staff be instructed to prepare the Subcommittee legislative report and make necessary technical and conforming changes to the bill as amended in accordance with the recommendations of the Subcommittee.

Chairman LAMPSON. The question is on the motion to report the bill favorably. Those in favor of the motion will signify by saying aye. Opposed, no. The ayes have it, and the bill is favorably reported.

Without objection the motion to reconsider is laid upon the table. Subcommittee Members may submit additional or minority views on the measure.

I want to thank the Members for their attendance, and this concludes our Subcommittee markup. We are adjourned.

[Whereupon, at 10:25 a.m., the Subcommittee was adjourned.]

Appendix:

H.R. 2304, SECTION-BY-SECTION ANALYSIS, AMENDMENT ROSTER

110TH CONGRESS
1ST SESSION

H. R. 2304

To direct the Secretary of Energy to conduct a program of research, development, demonstration, and commercial application for geothermal energy, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

MAY 14, 2007

Mr. MCNERNEY (for himself, Mr. GORDON of Tennessee, and Mr. LAMPSON) introduced the following bill; which was referred to the Committee on Science and Technology

A BILL

To direct the Secretary of Energy to conduct a program of research, development, demonstration, and commercial application for geothermal 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 “Advanced Geothermal
5 Energy Research and Development Act of 2007”.

6 **SEC. 2. FINDINGS.**

7 The Congress finds the following:

1 (1) The United States has a critical national in-
2 terest in developing clean, domestic, renewable
3 sources of energy in order to mitigate the causes of
4 climate change, reduce other environmental impacts
5 of energy production, increase national security, im-
6 prove public health, and bolster economic stability.

7 (2) Geothermal energy is a renewable energy re-
8 source.

9 (3) Geothermal energy is unusual among renew-
10 able energy sources because of its ability to provide
11 an uninterrupted supply of baseload electricity.

12 (4) Recently published assessments by rep-
13 utable experts, including the Massachusetts Institute
14 of Technology, the Western Governors Association,
15 and the National Renewable Energy Laboratory, in-
16 dicate that the Nation's geothermal resources are
17 widely distributed, vast in size, and barely tapped.

18 (5) Sustained and expanded research, develop-
19 ment, demonstration, and commercial application
20 programs are needed to locate and characterize geo-
21 thermal resources, and to develop the technologies
22 that will enable their widespread commercial devel-
23 opment.

24 (6) Federal support is critical to reduce the fi-
25 nancial risk associated with developing new geo-

1 thermal technologies, thereby encouraging the pri-
2 vate sector investment necessary to make geothermal
3 resources commercially viable as a source of electric
4 power and for other applications.

5 **SEC. 3. DEFINITIONS.**

6 For purposes of this Act:

7 (1) ENHANCED GEOTHERMAL SYSTEMS.—The
8 term “enhanced geothermal systems” means geo-
9 thermal reservoir systems that are engineered, as op-
10 posed to occurring naturally.

11 (2) GEOFLUID.—The term “geofluid” means
12 any fluid used to extract thermal energy from the
13 Earth which is transported to the surface for direct
14 use or electric power generation, except that such
15 term shall not include oil or natural gas.

16 (3) GEOTHERMAL.—The term “geothermal” re-
17 fers to heat energy stored in the Earth’s crust that
18 can be accessed for direct use or electric power gen-
19 eration.

20 (4) HYDROTHERMAL.—The term “hydro-
21 thermal” refers to naturally occurring subsurface
22 reservoirs of hot water or steam.

23 (5) SECRETARY.—The term “Secretary” means
24 the Secretary of Energy.

1 (6) SYSTEMS APPROACH.—The term “systems
2 approach” means an approach to solving problems
3 or designing systems that considers the entire sys-
4 tem, rather than a particular component of the sys-
5 tem.

6 **SEC. 4. HYDROTHERMAL RESEARCH AND DEVELOPMENT.**

7 (a) IN GENERAL.—The Secretary shall support pro-
8 grams of research, development, demonstration, and com-
9 mercial application to expand the use of geothermal en-
10 ergy production from hydrothermal systems, including the
11 programs described in subsection (b).

12 (b) PROGRAMS.—

13 (1) ADVANCED HYDROTHERMAL RESOURCE
14 TOOLS.—The Secretary, in consultation with other
15 appropriate agencies, shall support a program to de-
16 velop advanced geophysical, geochemical, and geo-
17 logic tools to assist in locating hidden hydrothermal
18 resources, and to increase the reliability of site char-
19 acterization before, during, and after initial drilling.
20 The program shall develop new prospecting tech-
21 niques to assist in prioritization of targets for char-
22 acterization. The program shall include a field com-
23 ponent.

24 (2) INDUSTRY COUPLED EXPLORATORY DRILL-
25 ING.—The Secretary shall support a program of

1 cost-shared field demonstration programs, to be pur-
2 sued, simultaneously and independently, in collabo-
3 ration with industry partners, for the demonstration
4 of technologies and techniques of exploratory drilling
5 for undiscovered resources in a variety of geologic
6 settings. The program shall include incentives to en-
7 courage the use of advanced technologies and tech-
8 niques.

9 **SEC. 5. GENERAL GEOTHERMAL SYSTEMS RESEARCH AND**
10 **DEVELOPMENT.**

11 (a) **SUBSURFACE COMPONENTS AND SYSTEMS.**—The
12 Secretary shall support a program of research, develop-
13 ment, demonstration, and commercial application of com-
14 ponents and systems capable of withstanding extreme geo-
15 thermal environments and necessary to cost-effectively de-
16 velop, produce, and monitor geothermal reservoirs and
17 produce geothermal energy. These components and sys-
18 tems shall include advanced casing systems (expandable
19 tubular casing, low-clearance casing designs, and others),
20 high-temperature cements, high-temperature submersible
21 pumps, and high-temperature packers, as well as tech-
22 nologies for under-reaming, multilateral completions,
23 high-temperature logging, and logging while drilling.

24 (b) **RESERVOIR PERFORMANCE MODELING.**—The
25 Secretary shall support a program of research, develop-

1 ment, demonstration, and commercial application of mod-
2 els of geothermal reservoir performance, with an emphasis
3 on accurately modeling performance over time. Models
4 shall be developed to assist both in the development of geo-
5 thermal reservoirs and to more accurately account for
6 stress-related effects in stimulated hydrothermal and en-
7 hanced geothermal systems production environments.

8 **SEC. 6. ENHANCED GEOTHERMAL SYSTEMS RESEARCH**
9 **AND DEVELOPMENT.**

10 (a) IN GENERAL.—The Secretary shall support a
11 program of research, development, demonstration, and
12 commercial application for enhanced geothermal systems,
13 including the programs described in subsection (b).

14 (b) PROGRAMS.—

15 (1) ENHANCED GEOTHERMAL SYSTEMS TECH-
16 NOLOGIES.—The Secretary shall support a program
17 of research, development, demonstration, and com-
18 mercial application of the technologies and knowl-
19 edge necessary for enhanced geothermal systems to
20 advance to a state of commercial readiness, includ-
21 ing advances in—

22 (A) reservoir stimulation;

23 (B) reservoir characterization, monitoring,
24 and modeling;

25 (C) stress mapping;

- 1 (D) tracer development;
 2 (E) three-dimensional tomography; and
 3 (F) understanding seismic effects of deep
 4 drilling and reservoir engineering.

5 (2) ENHANCED GEOTHERMAL SYSTEMS RES-
 6 ERVOIR STIMULATION.—

7 (A) PROGRAM.—In collaboration with in-
 8 dustry partners, the Secretary shall support a
 9 program of research, development, and dem-
 10 onstration of enhanced geothermal systems res-
 11 ervoir stimulation technologies and techniques.
 12 A minimum of 5 sites shall be selected in loca-
 13 tions that show particular promise for enhanced
 14 geothermal systems development. Each site
 15 shall—

16 (i) represent subsurface geological
 17 conditions; and

18 (ii) take advantage of an existing site
 19 where subsurface characterization has been
 20 conducted or existing drill holes can be uti-
 21 lized, if possible.

22 (B) CONSIDERATION OF EXISTING
 23 SITES.—The following 2 sites, where Depart-
 24 ment of Energy and industry cooperative en-
 25 hanced geothermal systems projects are already

1 underway, may be considered for inclusion
2 among the sites selected under subparagraph
3 (A):

4 (i) Desert Peak, Nevada.

5 (ii) Coso, California.

6 **SEC. 7. COST SHARING.**

7 (a) APPLICABILITY.—In carrying out the research,
8 development, demonstration, and commercial application
9 programs under this Act, the Secretary shall require cost-
10 sharing as follows:

11 (1) IN GENERAL.—For the programs described
12 in sections 4(b)(1), 5(a), 5(b), and 6(b)(1), except as
13 provided in paragraph (2) of this subsection, the
14 Secretary shall require that not less than 20 percent
15 of the cost of an activity be provided by non-Federal
16 sources. For the programs described in sections
17 4(b)(2) and 6(b)(2), except as provided in paragraph
18 (2) of this subsection, the Secretary shall require
19 that not less than 50 percent of the cost of an activ-
20 ity be provided by non-Federal sources.

21 (2) REDUCTION OF NON-FEDERAL SHARE.—
22 The Secretary may reduce or eliminate the require-
23 ment of paragraph (1) for an activity if the Sec-
24 retary determines that the reduction is necessary
25 and appropriate.

1 (b) NON-FEDERAL CONTRIBUTIONS.—Non-Federal
2 contributions required under subsection (a)—

3 (1) may include—

4 (A) personnel costs;

5 (B) the value of a service, other resource,
6 or third party in-kind contribution; and

7 (C) indirect costs or facilities and adminis-
8 trative costs; and

9 (2) shall not include—

10 (A) revenues or royalties from the prospec-
11 tive operation of an activity beyond the dura-
12 tion of the award; or

13 (B) proceeds from the prospective sale of
14 an asset of an activity.

15 (c) REPAYMENT OF FEDERAL SHARE.—The Sec-
16 retary shall not require repayment of the Federal share
17 of a cost-shared activity under this section as a condition
18 of making an award.

19 (d) ORGANIZATION AND ADMINISTRATION OF PRO-
20 GRAMS.—Programs under this Act shall incorporate the
21 following organizational and administrative elements:

22 (1) Non-Federal participants shall be chosen
23 through a competitive selection process.

24 (2) The request for proposals for each program
25 shall stipulate, at a minimum, the following:

1 (A) The non-Federal funding requirements
2 for projects.

3 (B) The funding mechanism to be used
4 (i.e. grants, contracts, or cooperative agree-
5 ments).

6 (C) Milestones and a schedule for comple-
7 tion.

8 (D) Criteria for evaluating proposals.

9 (3) In evaluating proposals, the Secretary shall
10 give priority to proposals that draw on relevant ex-
11 pertise from industry, academia, and the national
12 laboratories, as appropriate.

13 (4) In evaluating proposals, the Secretary shall
14 consult with relevant experts from industry, aca-
15 demia, and the national laboratories, as appropriate.

16 (5) In evaluating proposals, the Secretary shall
17 give priority to proposals that demonstrate clear evi-
18 dence of employing a systems approach.

19 (6) Data collected by the Secretary as a result
20 of any project supported with funds provided under
21 this Act shall be made available to the public, except
22 to the extent that they contain information that is
23 protected from disclosure under section 552(b) of
24 title 5, United States Code.

1 **SEC. 8. CENTERS FOR GEOTHERMAL TECHNOLOGY TRANS-**
2 **FER.**

3 (a) IN GENERAL.—The Secretary shall award grants
4 to institutions of higher education (or consortia thereof)
5 to establish 2 Centers for Geothermal Technology Trans-
6 fer.

7 (b) CENTERS.—

8 (1) HYDROTHERMAL CENTER.—The purpose of
9 one Technology Transfer Center shall be to serve as
10 an information clearinghouse for the geothermal in-
11 dustry, collecting and disseminating information on
12 best practices in all areas related to developing and
13 managing hydrothermal resources, including data
14 available for disclosure as provided under section
15 7(d)(6). This Center shall be based at the institution
16 west of the Mississippi River that the Secretary con-
17 siders to be best suited to the purpose. The Center
18 shall collect and disseminate information on all sub-
19 jects germane to the development of hydrothermal
20 systems, including—

- 21 (A) resource location;
22 (B) reservoir characterization, monitoring,
23 and modeling;
24 (C) drilling techniques; and
25 (D) reservoir management techniques.

1 (2) ENHANCED GEOTHERMAL SYSTEMS CEN-
2 TER.—The purpose of a second Technology Transfer
3 Center shall be to serve as an information clearing-
4 house for the geothermal industry, collecting and
5 disseminating information on best practices in all
6 areas related to developing and managing enhanced
7 geothermal systems resources, including data avail-
8 able for disclosure as provided under section 7(d)(6).
9 This Center shall be based at an academic institu-
10 tion east of the Mississippi River which, in the opin-
11 ion of the Secretary is best suited to provide na-
12 tional leadership on enhanced geothermal systems-
13 related issues.

14 (c) AWARD DURATION.—An award made by the Sec-
15 retary under this section shall be for an initial period of
16 5 years, and may be renewed for additional 5-year periods
17 on the basis of—

18 (1) satisfactory performance in meeting the
19 goals of the research plan proposed by the Center;
20 and

21 (2) other requirements as specified by the Sec-
22 retary.

1 **SEC. 9. STUDY ON ADVANCED USES OF GEOTHERMAL EN-**
2 **ERGY.**

3 Not later than 1 year, 3 years, and 5 years, after
4 the date of enactment of this Act, the Secretary shall re-
5 port to the Committee on Science and Technology of the
6 House of Representatives and the Committee on Energy
7 and Natural Resources of the Senate on advanced con-
8 cepts and technologies to maximize the geothermal re-
9 source potential of the United States. The reports shall
10 include—

11 (1) the use of carbon dioxide as an alternative
12 geofluid with potential carbon sequestration benefits;

13 (2) mineral recovery from geofluids;

14 (3) use of geothermal energy to produce hydro-
15 gen;

16 (4) use of geothermal energy to produce
17 biofuels;

18 (5) use of geothermal heat for oil recovery from
19 oil shales and tar sands;

20 (6) coproduction of geofluids for direct use or
21 electric power generation in conjunction with exist-
22 ing oil and gas extraction operations; and

23 (7) other advanced geothermal technologies, in-
24 cluding advanced drilling technologies and advanced
25 power conversion technologies.

1 **SEC. 10. AUTHORIZATION OF APPROPRIATIONS.**

2 There are authorized to be appropriated to the Sec-
3 retary to carry out this Act \$80,000,000 for each of the
4 fiscal years 2008 through 2012.

○

SECTION-BY-SECTION ANALYSIS OF H.R. 2304,
ADVANCED GEOTHERMAL ENERGY RESEARCH AND
DEVELOPMENT ACT OF 2007

Summary

H.R. 2304 directs the Secretary of Energy to support programs of research, development, demonstration, and commercial application in advanced geothermal energy technologies. It also establishes or expands several programs for technology transfer and information sharing on geothermal energy.

Section-by-Section

Section 1. Short Title

Act may be cited as the “Advanced Geothermal Energy Research and Development Act of 2007.”

Section 2. Findings

Geothermal energy is a renewable resource capable of providing baseload power generation (and other applications) with minimal environmental impact. The geothermal energy potential in the United States is widely distributed and vast in size, yet it remains barely tapped. Sustained and expanded funding for research, development, demonstration, and commercial application programs is needed to improve the technologies to locate, characterize, and develop geothermal resources.

Section 3. Definitions

Provides definitions for the following terms used in the Act: ‘Enhanced Geothermal Systems,’ ‘Geofluid,’ ‘Geothermal,’ ‘Hydrothermal,’ ‘Secretary,’ and ‘Systems Approach.’

Section 4. Hydrothermal Research and Development

Instructs the Secretary to support research, development, demonstration, and commercial application of technologies designed to assist in locating and characterizing undiscovered hydrothermal resources. Establishes an “industry-coupled exploratory drilling” program, which is a cost-shared program with industry partners to demonstrate and apply advanced exploration technologies.

Section 5. General Geothermal Systems Research and Development

Establishes a program of research, development, demonstration, and commercial application of system components and materials capable of withstanding the extreme environment (high temperatures and corrosiveness) in geothermal wells. Also establishes a program of RDD&CA of improved models of geothermal reservoir performance.

Section 6. Enhanced Geothermal Systems (EGS) Research and Development

Instructs the Secretary to support a program of RDD&CA of technologies necessary to advance EGS to a state of commercial readiness. Also establishes a cost-shared, field based program of research, development, and demonstration of technologies to create and stimulate EGS reservoirs.

Section 7. Cost Sharing

Establishes guidelines for the ratio of federal/non-federal contributions to cost-shared programs established under this Act. Also describes certain organizational and administrative elements to be integrated into the structure of cost-shared programs.

Section 8. Centers for Geothermal Technology Transfer

Provides for the creation of two Centers of technology transfer to function as information clearinghouses for the geothermal industry, dedicated to collecting and sharing industry-relevant information. One Center, to be located in the western U.S., shall be dedicated to hydrothermal-specific development information; the other Center, located in the eastern U.S., shall be dedicated to EGS-specific development information.

Section 9. Study on Advanced Uses of Geothermal Energy

Requires the Secretary to track technological advances impacting geothermal energy development and advanced uses of geothermal energy and fluids, and report

back to the Committee every other year for the next five years (a total of three times).

Section 10. Authorization of Appropriations

Authorizes appropriations of \$80,000,000 for each of the fiscal years 2008 through 2012.

**COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
SUBCOMMITTEE MARKUP
June 6, 2007**

**H.R. 2304 – the Advanced Geothermal Energy Research and Development
Act of 2007**

AMENDMENT ROSTER

No.	Sponsor	Description	Results
1	Mr. McNerney	Manager's amendment adds provisions for studying environmental impacts of geothermal energy development, revises the cost-sharing guidelines, adds technology transfer components, and makes other miscellaneous and clarifying changes.	Agreed to by voice vote.

AMENDMENTS TO H.R. 2304
OFFERED BY MR. MCNERNEY OF CALIFORNIA

Page 3, line 7, through page 4, line 1, redesignate paragraphs (1) through (6) as paragraphs (2) through (7), respectively.

Page 3, after line 6, insert the following new paragraph:

- 1 (1) ENGINEERED.—When referring to enhanced
2 geothermal systems, the term “engineered” means
3 subjected to intervention, including intervention to
4 address one or more of the following issues:
- 5 (A) Lack of effective permeability or poros-
6 ity or open fracture connectivity within the res-
7 ervoir.
- 8 (B) Insufficient contained geofluid in the
9 reservoir.
- 10 (C) A low average geothermal gradient,
11 which necessitates deeper drilling.

Page 4, line 3, strike “considers the entire” and insert “attempts to optimize the performance of the overall”.

Page 5, line 4, insert “siting and” after “techniques of”.

Page 6, after line 7, insert the following new subsection:

1 (c) ENVIRONMENTAL IMPACTS.—The Secretary
2 shall—

3 (1) support a program of research, develop-
4 ment, demonstration, and commercial application of
5 technologies and practices designed to mitigate or
6 preclude potential adverse environmental impacts of
7 geothermal energy development, production or use,
8 and seek to ensure that geothermal energy develop-
9 ment is consistent with the highest practicable
10 standards of environmental stewardship; and

11 (2) in conjunction with the Assistant Adminis-
12 trator for Research and Development at the Envi-
13 ronmental Protection Agency, support a research
14 program to identify potential environmental impacts
15 of geothermal energy development, production, and
16 use, and ensure that the program described in para-
17 graph (1) addresses such impacts, including effects
18 on groundwater and local hydrology.

Page 7, lines 3 and 4, amend subparagraph (F) to read as follows:

1 (F) understanding seismic effects of res-
2 ervoir engineering and stimulation.

Page 7, lines 16 and 17, amend clause (i) to read
as follows:

3 (i) represent a different class of sub-
4 surface geologic environments; and

Page 8, line 6, strike “**COST SHARING**” and insert
“**GUIDELINES FOR COST SHARING AND PROPOSAL
EVALUATION**”.

Page 8, line 21, redesignate paragraph (2) as para-
graph (3).

Page 8, lines 11 through 20, strike paragraph (1)
and insert the following:

5 (1) IN GENERAL.—Except as provided in para-
6 graphs (2) and (3), the Secretary shall require be-
7 tween 20 and 80 percent of the cost of a project de-
8 scribed in subsection (a) to be borne by a non-Fed-
9 eral entity or entities. The Secretary shall establish
10 guidelines for determining the cost-share ratios for
11 projects. The guidelines shall consider the relative
12 risk of projects and the potential for return on in-
13 vested capital. The guidelines shall also allow for a
14 competitive bidding process to play a role in deter-

4

1 mining the final cost-share ratio. The Secretary shall
2 have final discretion to establish the cost-share ratio
3 for any given project.

4 (2) EXCLUSION.—Research or development ac-
5 tivities of a basic or fundamental nature, as deter-
6 mined by the appropriate officer of the Department
7 of Energy, shall not be subject to any cost-share re-
8 quirement.

Page 10, line 19, redesignate paragraph (6) as para-
graph (7).

Page 10, after line 18, insert the following new
paragraph:

9 (6) In evaluating proposals for projects with a
10 field component, the Secretary shall, where appro-
11 priate, give priority consideration to proposals that
12 contain provisions to study local environmental im-
13 pacts of the technologies developed or the operations
14 undertaken.

Page 11, line 15, strike “7(d)(6)” and insert
“7(d)(7)”.

Page 11, line 19, insert “and use” after “the devel-
opment”.

Page 11, line 24, strike “and”.

Page 11, line 25, strike the period and insert “; and”.

Page 11, after line 25, insert the following new subparagraph:

1 (E) technologies for electric power conver-
2 sion or direct use of geothermal energy.

Page 12, line 8, strike “7(d)(6)” and insert “7(d)(7)”.

Page 12, at the end of line 8, insert the following:
“This Center is encouraged to seek opportunities to coordinate efforts and share information with international partners engaged in research and development of enhanced geothermal systems or engaged in collection of data related to enhanced geothermal systems development.”.

Page 12, line 11, insert a comma after “the Secretary”.

Page 12, line 13, insert “The Center shall collect and disseminate information on all subjects germane to the development and use of enhanced geothermal systems.” after “systems-related issues.”.

Page 13, line 1, and page 14, line 1, redesignate sections 9 and 10 as sections 10 and 12, respectively.

Page 13, before line 1, insert the following new section:

1 **SEC. 9. GEOPOWER AMERICA.**

2 The Secretary shall expand the Department of Ener-
3 gy's GeoPower the West program to extend its geothermal
4 technology transfer activities throughout the entire United
5 States. The program shall be renamed "GeoPower Amer-
6 ica". The program shall continue to be based in the De-
7 partment of Energy office in Golden, Colorado.

Page 13, after line 25, insert the following new section:

8 **SEC. 11. APPLICABILITY OF OTHER LAWS.**

9 Nothing in this Act shall be construed as waiving the
10 applicability of any requirement under any environmental
11 or other Federal or State law.

XXI. PROCEEDINGS OF THE FULL COMMITTEE MARKUP ON H.R. 2304, THE ADVANCED GEOTHERMAL ENERGY RESEARCH AND DEVELOPMENT ACT OF 2007

WEDNESDAY, JUNE 13, 2007

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Committee met, pursuant to call, at 10:12 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Bart Gordon [Chairman of the Committee] presiding.

Chairman GORDON. Pursuant to notice, the Committee meets to consider the following measures: H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, and H.R. 2313, the *Marine Renewable Energy Research and Development Act of 2007*.

We will now proceed with the markup. I begin with a brief statement.

Today the Committee will consider two bills, H.R. 2304, the *Advanced Geothermal Energy Research and Development Act*, introduced by Mr. McNerney, and H.R. 2313, the *Marine Renewable Energy Research and Development Act*, introduced by Ms. Hooley and co-sponsored by Mr. Rohrabacher who has had a great deal of input into this bill. Each of these two bills is designed to expand our country's renewable energy production portfolio. Both geothermal energy and marine energy are enormous resources that have great potential to make significant contributions to meeting our nation's energy needs at a competitive cost. But they require more support for research and development in order to advance to a state of commercial readiness.

Geothermal energy is the energy stored as heat in the Earth's crust. It is a resource of truly vast potential. Yet most of this potential goes untapped due to a lack of resources to develop the technologies that would make geothermal energy widely accessible.

H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, will build on and expand the existing geothermal energy programs and provide support to develop a wide range of hydrothermal and enhanced geothermal systems. In the process, the bill would reinvigorate geothermal research and development in the United States and elevate geothermal energy to a position as a major contributor to our nation's power production portfolio.

Marine renewable energy technologies today are at a stage of development similar to where wind power was about 20 years ago. The prototype technologies show great promise, and the resource is huge, potentially able to provide as much as 10 percent of our nation's energy needs. But here again, researchers and industry require more support if they are going to move these technologies from the experimental stage to commercial viability. H.R. 2313, the *Marine Renewable Energy Research and Development Act*, is designed to do just that.

Both of these bills are designed to address overlooked opportunities in our efforts to create a 21st century energy policy that emphasizes good American jobs, diversity of supply, increased national security, and reduced environmental impact.

I want to thank my colleagues, Mr. McNerney and Mrs. Hooley for introducing them. I urge their passage and look forward to getting them to the House Floor.

I would also like to make one final comment, and before we get down to business I want to offer my sincere thanks and appreciation to my friend and colleague and our Ranking Member, Mr. Hall, and his colleagues on the Minority side for proposing some very thoughtful, meaningful amendments to today's bills for our consideration.

I cannot guarantee that we will be supporting all of them, but we will definitely be supporting many of them; and the Committee staff informs me that the amendments have contributed significantly to the quality of this legislation.

I think this is another very good example of the bipartisan spirit with which we will strive to conduct the business of the Science and Technology Committee.

[The prepared statement of Chairman Gordon follows:]

PREPARED STATEMENT OF CHAIRMAN BART GORDON

Today, the Committee will consider two bills, H.R. 2304, the *Advanced Geothermal Energy Research and Development Act*, introduced by Mr. McNerney, and H.R. 2313, the *Marine Renewable Energy Research and Development Act*, introduced by Ms. Hooley and Mr. Rohrabacher.

Each of these two bills is designed to expand our country's renewable energy production portfolio. Both geothermal energy and marine energy are enormous resources that have great potential to make significant contributions to meeting our nation's energy needs at a competitive cost. But they require support for research and development in order to advance to a state of commercial readiness.

Geothermal energy is the energy stored as heat in the Earth's crust, and it is a resource of truly vast potential. Yet most of this potential goes untapped due to lack of resources to develop the technologies and techniques that would make geothermal energy widely accessible.

H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, will build on and expand the existing DOE geothermal energy program and provide the support to develop a wide range of Hydrothermal and Enhanced Geothermal Systems. In the process, the bill would reinvigorate geothermal research and development in the United States, and elevate geothermal energy to a position as major contributor to our nation's power production portfolio.

Marine renewable energy technologies today are at a stage of development similar to where wind power was about 20 years ago. The prototype technologies show great promise, and the resource is huge, potentially able to provide as much as 10 percent of our nation's electricity needs. But here again, researchers and industry require more support if they are going to move these technologies from the experimental stage to commercial viability. H.R. 2313, the *Marine Renewable Energy Research and Development Act of 2007*, is designed to do just that.

Both of these bills are designed to address overlooked opportunities in our efforts to create a 21st century energy policy that emphasizes good American jobs, diversity of supply, increased national security, and reduced environmental impact.

I want to thank my colleagues, Mr. McNerney and Ms. Hooley and Mr. Rohrabacher, for introducing them. I urge their passage, and look forward to getting them to the House Floor.

I would like to make one final comment before we get down to business. I want to offer my sincere thanks and appreciation to my friend and colleague, the Ranking Member Mr. Hall, and his colleagues on the Minority side for proposing some very thoughtful amendments to these bills for our consideration today.

I can't guarantee that we'll be supporting all of them, but we will definitely be supporting some of them, and the Committee staff informs me that the amendments have contributed significantly to the quality of this legislation.

I think this is another fine example of the bipartisan spirit with which we strive to conduct the business of the Science and Technology Committee.

Thank you to everyone for your thorough consideration of these important bills, and for your substantive contributions to make them even better.

Chairman GORDON. Now, I recognize Mr. Hall to present his opening statement.

Mr. HALL. Thank you, Mr. Chairman. The two renewable energy research and development bills before us today are two more ways that the Science Committee is going to help to further our country's effort to become energy independent. It is no secret, I am an oil and gas guy. I am from an oil and gas state, fossil fuel state; and for those that think we can do away with fossil fuels are just dreaming. These lights would go out, the stations would stop, roads would not be built. We cannot do without fossil fuels, and there is an attack on energy today in general; and certainly there is an attack on fossil fuels, there is an attack on nuclear, even on wind. I think I would like to see our country do this in conjunction with our renewable and alternative thrust. We still need affordable, reliable energy that comes from fossil fuels while we do research, such as that in the bills we are marking up today in order for our country to continue to be a leader in all the areas in the global community. Both bills are going to spur the use of domestic, renewable resources available to us within our borders and in our waters for the production of energy. While I support the thrust of these bills, I do have some concern with them that will be addressed through amendments.

I have one to the geothermal bill that will address the production of geothermal energy from oil and gas wells and production of geopressured gas resources. It is my understanding that the Chairman is prepared to accept this amendment. He spoke kindly about it, and whether the kind words are going to come into reality remains to be seen. To be continued, I guess. And I thank him for it. In addition, I will be offering an amendment to the ocean energy bill that will expand the areas of the country, parts of the country, that participate in research and development activities on marine renewable energy. I will go into these amendments in further detail as they are brought up for consideration. As always, I look forward to the ensuing debate, and I yield back the balance of my time.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF REPRESENTATIVE RALPH M. HALL

Thank you, Mr. Chairman. The two renewable energy research and development bills before us today are two more ways the Science Committee is helping to further our country's efforts to become energy independent. It's no secret that I'm an oil and gas guy, and that I fully support increasing our domestic supply of oil and gas. I

would like to see our country do this in conjunction with our renewable and alternatives thrust. We still need affordable, reliable energy that comes from fossil fuels, while we do research such as that in the bills we are marking up today, in order for our country to continue to be a leader in all areas in the global community. Both bills will spur the use of domestic, renewable resources available to us within our borders and in our waters for the production of energy. While I support the thrust of the bills, I do have some concerns with them that will be addressed through amendments.

I have one to the geothermal bill that will address the production of geothermal energy from oil and gas wells and production of geopressured gas resources. It is my understanding that the Chairman is prepared to accept this amendment and I thank him. In addition, I will be offering an amendment to the ocean energy bill that will expand the areas of the country eligible to participate in research and development activities on marine renewable energy. I will go into these amendments in further detail as they are brought up for consideration.

As always, I look forward to the ensuing debate, and I yield back the balance of my time.

Chairman GORDON. Thank you, Mr. Hall. I want to confirm two things. One is I am kind, and two, you are from fossil fuel country but you are not a fossil.

Without objection, Members may place statements in the record at this point.

We will now consider H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*.

I yield to the gentleman from California, Mr. McNerney five minutes to describe his bill.

Mr. MCNERNEY. Thank you, Mr. Chairman. I want to express my appreciation to both you and to Ranking Member Hall for supporting my bill, H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, and for holding a markup this morning.

Mr. Chairman, as you know, one of our highest priorities in Congress should be to encourage the development of clean domestic and renewable sources of energy.

Geothermal energy should be an important part of the equation, and unlike other renewable sources, geothermal provides uninterrupted base load power 365 days and nights a year. While it is one of the only renewable sources that can produce constantly available base-load power, geothermal relies on less accessible fuel than naturally occurring sunlight and wind. Current technology requires that in order to generate geothermal energy, we have to tap into visible sources of features and hope that we drill in the right place. However, recent study shows that potential for geothermal is vaster than we previously imagined. Now, geothermal sources, known as enhanced geothermal systems, or EGS, offer the potential to generate as much as 100 gigawatts of power over the next 50 years which can provide power to 75 million homes. Utilizing EGS involves creating manmade underground reservoirs that are engineered out of hot rock deep under the surface. Once the rock formations are engineered, fluid is injected to absorb heat which is then pumped out to extract energy.

EGS is in the very early stages of maturation, and federal support is needed to ensure that the full potential of this resource is realized. H.R. 2304 authorizes further research development, demonstration, and commercial application of advanced technologies in both traditional geothermal sources and EGS. This type of approach is exactly how we can and should be developing and ex-

panding R&D of the technologies necessary to utilize EGS. Geothermal energy should be an important component of our country's efforts to combat climate change and achieve energy independence. As a domestically produced energy source, expanding geothermal will create high-paying jobs at home.

I hope that my colleagues here today will join me in supporting H.R. 2304. I look forward to discussing the amendments, and again I thank the Chairman and the Ranking Member for holding this markup. I yield back the balance of my time.

[The prepared statement of Mr. McNerney follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY MCNERNEY

Thank you Mr. Chairman. I want to express my appreciation to both you, and Ranking Member Hall, for your support of my bill, H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*, and for holding today's markup.

Mr. Chairman, as you know, one of our foremost priorities in Congress should be to encourage the development of clean, domestic, and renewable sources of energy.

Geothermal should be an important part of the equation, and unlike other renewable resources, geothermal provides uninterrupted base-load power, day and night, 365 days a year.

While it is one of the only sources that produces constantly available power, geothermal relies on a less-accessible fuel than naturally occurring sunlight or wind.

Current technology requires that in order to generate geothermal energy, we have to tap into visible surface features and hope that we drill in the right place.

However, recent studies show that the potential for geothermal is more vast than we've previously imagined. New geothermal resources, known as Enhanced Geothermal Systems, or EGS, offer the potential to generate as much as 100 Gigawatts of power in the next 50 years, which can power 75 million homes.

Utilizing EGS involves creating man made underground reservoirs that are engineered out of hot rock. Fluid is injected to absorb the heat, which is then pumped out to extract energy.

EGS is in the very early stages of maturation, and federal support is needed to ensure that the full potential of this resource is realized.

H.R. 2304 authorizes further research, development, demonstration, and commercial application of advanced technologies to develop both traditional geothermal sources and EGS. This type of approach is exactly how we can, and should, be working to expand R&D of the technologies necessary to fully utilize EGS.

Geothermal energy should be an important component of our country's efforts to combat climate change and achieve energy independence. As a domestically-produced energy source, expanding geothermal will also create high paying jobs at home. I hope that my colleagues here today will join me in supporting H.R. 2304, and I again thank the Chairman for holding this markup. I yield back the balance of my time.

Chairman GORDON. Thank you, Mr. McNerney. Mr. Hall is recognized.

Mr. HALL. Mr. Chairman, this amendment——

Chairman GORDON. Mr. Hall tells me——

Mr. HALL. The bill is great.

Chairman GORDON. Are there similar remarks that anyone would like to make?

We need to move on today, but let me just quickly say that I have seen firsthand the benefit of geothermal. In Sumner County, a place called Portland started using geothermal and now it is over a lot of the areas in my district where the schools are using geothermal. What they are finding is within about three years, through lower rates of energy, they are paying for putting these systems in and then it is gravy from then on. This needs to be expanded. It is really a good program.

The other thing, just for your information, if I were you, I would be an advocate of this at home; but for your information, I have got a bill that is going through Resources Committee that will help really inventory our geophysical nature of our United States to better determine where are those areas where geothermal could be used, where could sequestration be used, all these sorts of things. So geothermal is something that I think we can all talk about at home. It is real and it is good.

Is there anyone else that would like to speak? Ms. Woolsey is recognized.

Ms. WOOLSEY. Thank you, Mr. Chairman, and thank you and Mr. McNerney for this great H.R. 2304 legislation.

Geothermal energy, as we all know, has huge potential to supply us with a clean, reliable, and renewable source of energy. And already in some parts of the country, geothermal energy is making a big contribution to meeting our energy needs.

Just outside of my district, north of Santa Rosa, are some of the largest and most readily available reserves in geothermal energy in the country. The geysers, as they are called, comprise 30 square miles along the Sonoma and Lake County border and provide enough electricity to meet the energy needs of one million homes. Imagine, one million households running on electricity produced by steam that naturally occurs in the ground.

What is even better for Northern California and for my district is that in order to produce more steam, the City of Santa Rosa, which is the largest city in my district, pumps treated wastewater out to the geysers to help create more steam, which then produces more electricity. It is a tremendous use of resources, and we are really proud of it in our district. It actually prevents Santa Rosa from having to put more wastewater in the Russian River which is the drinking water source for my entire district. And I mention this because in creating clean and renewable energy, we also can point out the possible geothermal connection, and I am 100 percent for this legislation and I really commend Mr. McNerney for introducing this bill. Aren't we glad he is on this committee?

[The prepared statement of Ms. Woolsey follows:]

PREPARED STATEMENT OF REPRESENTATIVE LYNN WOOLSEY

Mr. Chairman, thank you for bringing H.R. 2304, the *Advanced Geothermal Energy Research and Development Act*, before the Committee to be marked up.

Geothermal energy has huge potential to supply us with a clean, reliable, and renewable source of energy. Already in some parts of the country, geothermal energy is making a big contribution to meeting our energy needs.

Just outside of my district in northern California, are some of the largest and most readily available reserves of geothermal energy in the country. The geysers, as they are called, comprise 30 square miles along the Sonoma and Lake County border and provide enough electricity to meet the energy needs of one million homes. Imagine that . . . one million households running on electricity produced by steam that naturally occurs in the ground.

What's even better is that in order to produce more steam, the city of SANTA ROSA, which is the largest city in my district, pumps treated wastewater out to the geysers to help create more steam, which then produces more electricity. It's a tremendous use of resources that I'm really proud of.

I mention these things because I'm proud of what is being done to create clean and renewable energy in my own district, but also to point out what is possible with geothermal energy. For too long, geothermal energy has taken a back seat in the public's mind and in Congressional policy as an alternative source of energy.

Mr. Chairman, I commend Rep. McNerney for introducing this bill and I am proud to support it here today. The time has come to research and invest in geothermal energy and H.R. 2304 is a good start to get us on the right path.

Thank you and I yield back the balance of my time.

Chairman GORDON. Thank you, Ms. Woolsey. I want you to know that Mr. Hall thought you said geezer, but I told him that wasn't the case and so we can move along with a cordial markup here.

So I ask unanimous consent that the bill is considered as read and open to amendment at any point and that the Members proceed with amendments in the order of the roster. Without objection, so ordered.

The first amendment on the roster is an amendment offered by the distinguished Ranking Member, Mr. Hall. Are you ready to proceed with your amendment?

Mr. HALL. No, after I take my medicine I will. I am going to watch Ben Matlock.

Mr. Chairman, I have an amendment at the desk, I think.

The CLERK. Amendment to H.R. 2304 offered by Mr. Hall of Texas.

Chairman GORDON. The gentleman is recognized to explain the amendment.

Mr. HALL. Mr. Chairman, this amendment will fill a major gap in the pending legislation. In May of 2006, the National Renewable Energy Laboratory, I'll refer to it as NREL for brevity, held a workshop of national experts on geothermal energy. The workshop produced a report that estimates the potential of the full range of geothermal resources. Included in that estimate were two important resource categories that the pending legislation, H.R. 2304, would leave for future studies. That's oil field, co-production, and geopressed resources. The NREL workshop estimated that in the next 20 years, these two resources, co-production and geopressed, could provide as much as 70,000 megawatts of new power which would approach 10 percent of our total national electric power needs. In addition, substantial supplies of gas could be recovered from geopressed resources. This amendment proposes to establish a demonstration program to prove the feasibility of co-producing geothermal power from oil and gas fields. Based upon the work of scientists at Southern Methodist University and other research institutions, this has become an exciting, new area of research into new energy production. SMU researchers have documented that large numbers of hot water and great amounts of hot water are produced by existing oil and gas wells. In 2002, Texas produced over 12 billion barrels of wastewater, often hot, as a by-product of oil and gas extraction and re-injected the water into the ground at a cost to the producer. In West Texas, for example, for every barrel of oil produced, nearly 100 barrels of hot water are co-produced. To the oil industry, producing hot water is at best a nuisance. It is difficult to handle, costs money to pump, and has to be re-injected at an additional cost. Considering the hot water estimates of oil and gas wells throughout the country, Texas alone could produce between 400 and 2,200 megawatts of geothermal power assuming the average temperature produced is between 200 and 300 degrees Fahrenheit.

While the extent of oil field co-production is still being assessed, research to date has identified numerous other states where significant hot water is produced from oil and gas wells including California, Florida, West Virginia, Colorado, Wyoming, Montana, North Dakota, New Mexico, Oklahoma; and Utah and for the Chairman's benefit, I am sure it is also in Tennessee. I just didn't look there.

Geopressured resources, a combination of hot brine and trapped gas under high pressure, are present in several areas of the country ranging from California and the Dakotas to Texas, Louisiana, and Alabama. The prime resource is considered to be in the area around the Gulf of Mexico both onshore and offshore. From 1975 to 1990, the U.S. Department of Energy invested over \$200 million in geothermal research. In Texas and Louisiana, they built a power plant using a converted gas well in Brazoria County during 1989 and 1990. The project was successful, but after six months of operation, the power plant was dismantled because of the low price of oil and gas at that time made geothermal energy uncompetitive. Today, gas prices are much higher than in 1990, and we are now increasingly importing gas from overseas. The high cost is a burden on the economy, and the prospect of becoming dependent upon OPEC for major parts of our natural gas supplies has obvious national security implications. Yet, in the geopressured resources of the Gulf and elsewhere, we have enormous untapped energy potential. Estimates of recoverable gas from these resources range from 150 TCF to 5,000. That is 5,000 trillion cubic feet. The U.S. consumed 22.4 TCF of gas in 2002. The geopressured resources hold between seven and 225 years' supply of gas for the entire U.S. at 2002 levels of demand. To put the geopressured resource potential into another perspective, when DOE was actively examining the geopressured geothermal resource in the 1980s, a leading researcher estimated that for the northern Gulf of Mexico, recoverable resource could exceed 1,000 TCF of gas.

According to the latest United States Geological Survey estimate from 1995, the total technically recoverable volume of conventional and unconventional gas in the U.S. excluding geopressured brines and gas hydrates is at 1,073 TCF. If the effort envisioned by this amendment to bring new technology to bear on producing geopressured resources is successful, it could double the total recoverable natural gas in the United States.

This amendment, Mr. Chairman, directs the Secretary of Energy to hold a design competition to produce state-of-the-art approaches to recovering the energy in the geopressured resources. In addition to gas, these resources hold tens of thousands of megawatts of potential energy and hot geothermal fluids and hydraulic pressures. From the designs submitted, DOE will support completion of the full engineering and other technical design work. Then, based upon the evaluation of the final designs, the Secretary will be authorized to move forward to build a cost-shared demonstration plan using the best technology and design.

I urge my colleagues to support this amendment that helps to further not only our renewable energy portfolio but also our domestic supply of natural gas. And I yield back my time.

Chairman GORDON. Thank you, Mr. Hall. Is there further discussion on the amendment? Mr. McNerney is recognized.

Mr. MCNERNEY. I thank the Ranking Member for this amendment. Using oil field co-production, geopressured methods does seem to be a good addition to the intent of the bill, and I think it will increase the output and energy content, energy development, energy sources for the country, so I fully support the bill and thank the Ranking Member for this addition.

Chairman GORDON. Thank you, Mr. McNerney. Let me just quickly conclude by saying this started off as a good bill. It has been well-vetted, and it is a better bill because it took an oil-and-gas man to—

Mr. HALL. Fossil. Fossil.

Chairman GORDON. A fossil fuel man to show us a new way to look at this. And again, this a better bill for vetting this, and we thank you for it.

And if there are no other—

Mr. HALL. Would you like another reading of my opening statement?

Chairman GORDON. I will take it to bed with me, thank you.

Mr. GINGREY. Mr. Chairman, it is your yield. Did you refer to him as a fossil man? Is that what I thought?

Chairman GORDON. We were trying to determine that earlier today, but we decided it was fossil fuel, not fossil man.

If there is no further discussion, the vote occurs on the amendment. All in favor say aye, opposed no. The ayes have it. The amendment is agreed to.

The next three amendments on the roster are offered by the gentleman from Maryland, Mr. Bartlett.

The Chair supports all these amendments, and in the interest of time, I ask unanimous consent to consider these amendments en bloc. Without objection, so ordered.

The gentleman is recognized for five minutes to explain his amendment.

Mr. BARTLETT. Thank you, Mr. Chairman. I want to thank the Members and staff on both sides of the aisle for helping to work through these three, simple common-sense amendments. The first one, amendment 2, simply replaces study with reports to make sure that the information is disseminated. The second one is a clarifying amendment which changes geopower to geopowering America. The third amendment, amendment 4, is a very common-sense amendment. Obviously we will not be able to access geothermal energy without some insult to the environment. This amendment simply says that you must weigh that minimal—hopefully minimal impact on the environment with the enormous positive environmental effects of producing energy that provides—that produces no greenhouse gases. These are three very simple, common-sense amendments; and I want to thank the Majority very much for working with us.

Chairman GORDON. Is there further discussion on these three amendments? If no, we say thank you to Mr. Bartlett for the additions, and the vote occurs on the amendments. All in favor say aye, those opposed say no. The ayes have it. The amendment is agreed to.

The fifth amendment on the roster and I guess it is really the fifth and sixth is from the gentleman from Texas, Mr. McCaul. And

I will also ask unanimous consent if it is to his satisfaction that these two amendments be taken en bloc and he will be allowed to describe them.

Mr. MCCAUL. Thank you, Mr. Chairman, and I will be very brief given the late night we had last night and time constraints. I appreciate the opportunity to offer these two amendments. The first really requires amending Section 7 to require the Secretary to coordinate with the other DOE R&D programs that focus on drilling and related activities. It is good government and cost efficient, and then of course the second, amendment 6, amends Section 6 by adding laser-based drilling technology to the EGS program.

And with that, Mr. Chairman, I will yield back my time.

Chairman GORDON. Thank you. And the Clerk will please report this amendment and the prior amendment.

The CLERK. Amendments to H.R. 2304 offered by Mr. McCaul.

Chairman GORDON. I ask unanimous consent that we dispense with the reading. Without objection, so ordered.

The gentleman has explained his amendments. Is there any comment on the amendments? If not, all those in favor of the amendments say aye, those opposed no. The ayes have it. The amendment is agreed to.

All right. The seventh amendment on the roster is offered by the gentlelady from Illinois, Ms. Biggert. Are you ready to proceed with your amendment?

Ms. BIGGERT. I have an amendment at the desk.

Chairman GORDON. The Clerk will report the amendment.

The CLERK. Amendment to H.R. 2304 offered by Mrs. Biggert.

Chairman GORDON. I ask unanimous consent to dispense with the reading. Without objection, so ordered.

The gentlelady is recognized for five minutes to explain her amendment.

Ms. BIGGERT. Thank you, Mr. Chairman. In 2000, the distinguished Senate Majority Leader, Harry Reid, joined the Department of Energy in launching a new technology transfer outreach initiative called Geopowering the West or GPW. The purpose of the GPW program is to use public/private partnerships to bring geothermal heat and power to millions of homes and businesses through technology transfer and technical assistance. In partnership with states and local agencies, utilities, universities, geothermal developers, consumer and environmental groups said GPW complements the Department of Energy's Research and Development programs by helping to get geothermal energy technologies out of the lab and into the marketplace. And by all accounts, this program has been successful which is why the bill before us today would expand the program to encompass not just the western states but the entire United States and rename the program Geopowering America, or GPA. And there was a change at the Subcommittee to add Section 9. But this bill also duplicates much of the good this proven program is doing with the creation of two Geothermal Tech Transfer Centers, one east and one west of the Mississippi River. And that is why my amendment would strike the section of the bill, creating these two Centers and make the Geopowering America program explicitly responsible for performing

these exactly the same tech transfer and technical assistance functions were supposed to do.

Existing for seven years now, the GPW program already serves as a link between DOE's geothermal research programs and industry as well as others interested in geothermal energy. Using the information that GPW program managers have collected and disseminated over the course of the last seven years, the DOE can quickly and effectively transform the Geopowering America program into a true information clearing house for the geothermal energy industry. Therefore, the Department won't waste a lot of time, energy, or money bringing two new Centers on line.

And finally, by using the existing GPW structure, DOE will be able to engage more than just two universities and tech transfer activities relating to the geothermal energy. In addition to engaging numerous universities all over the country, the GPA program could partner with states, cities, utilities, developers, entrepreneurs, and businesses large and small to facilitate the development and use of geothermal energy. So rather than create a new, let us expand and build on a tried and trusted program that works. I hope my colleagues see the value of this approach and will support my amendment.

I yield back the balance of my time.

[The prepared statement of Ms. Biggert follows:]

PREPARED STATEMENT OF REPRESENTATIVE JUDY BIGGERT

Thank you, Mr. Chairman.

In the year 2000, the distinguished Senate Majority Leader, Harry Reid, joined the Department of Energy in launching a new technology transfer and outreach initiative, called GeoPowering the West, or GPW.

The purpose of the GPW program is to use public-private partnerships to bring geothermal heat and power to millions of homes and businesses through technology transfer and technical assistance.

In partnership with states and local agencies, utilities, universities, geothermal developers, consumer and environmental groups, the GPW complements the Department of Energy's (DOE) research and development programs by helping get geothermal energy technologies out of the lab and into the marketplace.

By all accounts, this program has been successful, which is why the bill before us today would expand the program to encompass not just the western states, but the entire United States, and rename the program GeoPowering America, or GPA.

But this bill also duplicates much of the good this proven program is doing with the creation of two geothermal tech transfer centers—one east and one west of the Mississippi River.

That's why my amendment would strike the section of the bill creating these two centers, and make the GeoPowering America program explicitly responsible for performing exactly the same tech transfer and technical assistance functions the centers were supposed to.

Existing for seven years now, the GPW program already serves as a link between the DOE's geothermal research programs and industry, as well as others interested in geothermal energy.

Using the information that GPW program managers have collected and disseminated over the course of the last seven years, the DOE can quickly and effectively transform the GeoPowering America program into a true information clearinghouse for the geothermal energy industry. Therefore, the Department won't waste a lot of time, energy, or money bringing two new Centers online.

Finally, by using the existing GPW structure, DOE will be able to engage more than just two universities in tech transfer activities related to geothermal energy. In addition to engaging numerous universities all over the country, the GPA program could partner with states, cities, utilities, developers, entrepreneurs and businesses large and small to facilitate the development and use of geothermal energy.

Rather than create anew, let's expand and build on a tried and tested program that works. I hope my colleagues see the value in this approach, and will support my amendment. I yield back the balance of my time.

Chairman GORDON. Thank you, Ms. Biggert. I understand the gentlelady's concerns, but her amendment, at least in my opinion, is not a good substitute for the university-centered program in this bill. First, the existing Geopowering the West Program, which the gentlelady proposes to task with the scientific data collection, among the other activities, has a different and more narrow mission than the intended Centers. We don't want to try to fit a square peg into a round hole.

In addition, during the hearings we heard on H.R. 2304 there was discussion about developing the next generation of scientists, engineers, and technicians specializing in geothermal technologies. Dr. Jeff Tester, the lead author of the MIT report, *The Future of Geothermal Energy*, stated in his testimony that the prospects for geothermal development would be enhanced by connecting the National Research and Development and Demonstration Program to education in science and engineering at the college and university level as well as professional levels. Making universities a key component of the geothermal helps fulfill this goal. It helps to ensure that we have an educated workforce to understand and deploy geothermal technologies.

Finally, rather than tasking the Federal Government with reinventing the wheel, as the gentlelady suggests in her amendment, the bill seeks to capitalize on longstanding geothermal research, data collection, and tech transfer expertise at universities around the country. For example, Southern Methodist University in Texas, the University of Utah, Boise State University, MIT, the Oregon Institute for Technology, the University of Oklahoma, and several universities in the University of California system. For these reasons, I do not support the gentlelady's amendment. However, if the gentlelady would like to withdraw her amendment, I would be willing to continue to work to address her concerns.

Are there any additional comments on the gentlelady's amendments? Mr. McNerney.

Mr. MCNERNEY. Mr. Chairman, I would like to strike the last word. I, like the Chairman, I do understand the gentlelady's concerns, but my intent was to create two Centers, one in each of the very different geophysical characters of the country. On the east side of the country, the geothermal sources are much different than on the western side. I think it is important to establish a separate entity east of the Mississippi or east of the Rockies anyway that will look at developing that particular source, that particular kind of geothermal energy; and I also like the idea of having competitive bidding or within the Department of Energy to decide what is the best location. So I oppose the amendment and—

Ms. BIGGERT. Will the gentleman yield?

Mr. MCNERNEY. Yes.

Ms. BIGGERT. I do think that, you know, education is very important and I think that the GPW, that it is engaged in the tech transfer activities but it also is very much a part of it is the education facility. And I think it is important to remind my colleagues that this committee already passed the H.R. 85, the *Energy Technology*

Transfer Bill, which was sponsored by Mr. Miller of North Carolina and me and was then approved by the House. And I think that rather than creating the transfer Centers to serve the country for each specific energy technology, that this directed to consider all of these. I just think more Centers just to focus on one is not what we need, but we already have the means to do that and that if President Bush, in the *Energy Policy Act of 2005*, created a consortium which utilizes comprehensive multi-disciplinary approach to geothermal research and education, focusing on exploration, full-scale utilization, and transfer training of the next generation of geothermal professionals, and that was in the *Energy Policy Act of 2005*.

Mr. HALL. Will the gentlelady yield?

Ms. BIGGERT. It is not—

Chairman GORDON. The gentleman from California has the time, but certainly Mr. Hall is recognized for five minutes.

Mr. HALL. I just want to say I totally agree with the author of this, and we support it on this side. And if she decides not to proceed with it or to withdraw it, we certainly want to be a part of working toward something that is favorable and acceptable to the author. But we on this side of the docket urge passage of this amendment.

Chairman GORDON. Is there further discussion on the amendment? If no, the vote occurs on the amendment. All in favor say aye, opposed no. The no's appear to have it. The amendment is not agreed to.

Ms. BIGGERT. Mr. Chairman, I have an amendment at the desk.

Chairman GORDON. All right. The Clerk will report the amendment.

The CLERK. Amendment to H.R. 2304 offered by Mrs. Biggert of Illinois.

Chairman GORDON. I ask unanimous consent to dispense with the reading. Without objection, so ordered.

The gentlelady is recognized for five minutes to describe her amendment.

Ms. BIGGERT. Thank you, Mr. Chairman. This amendment addresses an issue that I raised during the Subcommittee markup about Section 8 of the bill which creates two new Geothermal Tech Transfer Centers, one east and one west of the Mississippi River. I am concerned that by using the Mississippi River as the dividing line this section of the bill splits the Midwest in an awkward way. According to the Illinois State Geological Survey, the geology of the Great Plains between the Mississippi River and the Rocky Mountains is more like the geology of the Midwest than the geology of the Rocky Mountains. And while there are few if any hydrothermal resources in the Great Plains or the Midwest, this region is home to unconventional geothermal energy resources that could be tapped using enhanced geothermal systems. That is why I believe that any university east of the Rocky Mountains rather than east of the Mississippi should be eligible to compete to host the enhanced geothermal system center that this bill would establish. And that is what my amendment would do. Schools in North and South Dakota, Minnesota, Nebraska, Iowa, Kansas, Missouri, Oklahoma, Arkansas, and Texas that would otherwise have no chance

of I think landing the hydrothermal tech transfer center but would have a real chance to host the Enhanced Geothermal System Tech Transfer Center if my amendment passes. I wish I could say that this amendment was my idea but it is actually based on a recommendation by the Director of the Geothermal Laboratory at Southern Methodist University.

So I would urge my colleagues to support this amendment. I yield back the balance of my time.

[The prepared statement of Ms. Biggert follows:]

PREPARED STATEMENT OF REPRESENTATIVE JUDY BIGGERT

This amendment addresses an issue I raised during the Subcommittee markup about Section 8 of this bill, which creates two new geothermal tech transfer centers—one east and one west of the Mississippi River.

I am concerned that by using the Mississippi River as the dividing line, this section of the bill splits the Midwest in an awkward way.

According to the Illinois State Geological Survey, the geology of the Great Plains of the Mississippi River and the Rocky Mountains is more like the geology of the Midwest than the geology of the Rocky Mountains.

And while there are few, if any hydrothermal resources in the Great Plains or the Midwest, this region is home to unconventional geothermal energy resources that could be tapped using enhanced geothermal systems.

That's why I believe any university east of the Rocky Mountains—rather than east of the Mississippi River—should be eligible to compete to host the Enhanced Geothermal Systems Center that this bill would establish.

That's what my amendment would do. Schools in North and South Dakota, Minnesota, Nebraska, Iowa, Kansas, Missouri, Oklahoma, Arkansas and Texas that would otherwise have no chance of landing the hydrothermal tech transfer center would have a real chance to host the enhanced geothermal system tech transfer center if my amendment passes.

I wish I could say this amendment was my idea, but it is actually based on a recommendation by the Director of the Geothermal Laboratory at Southern Methodist University.

I urge my colleagues to support this amendment, and I yield back the balance of my time.

US Geothermal Potential

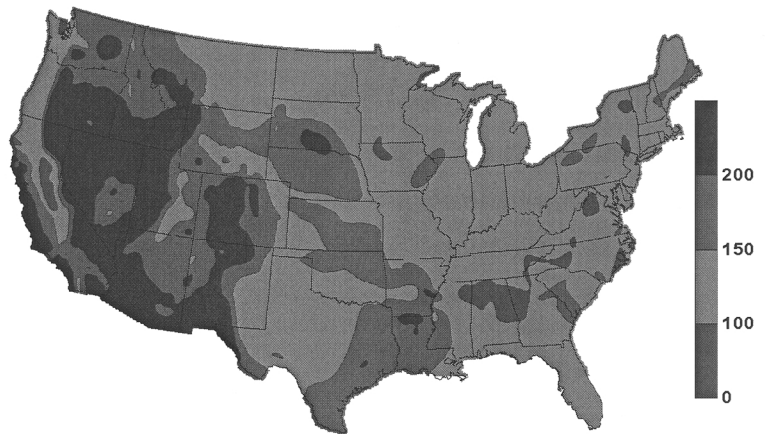


Figure 1: Estimated Earth Temperatures (°C) at 6 km Depth

What is the potential for geothermal energy? The heat in the earth is a huge resource. Figure 1 shows the expected heat in the earth at a depth of 6 kilometers (19,685 feet). Existing geothermal power technology can produce electricity from resources at temperatures as low as 90degrees C. Oil and gas drilling technology has allowed successful drilling to depths of 6km and more, the drilling depth record for the Gulf of Mexico was 33,200 feet on January 2004 (Shell Oil.) Conventional geopressurized resources require an intersection of underground heat, water and fractured rock, which this map does not show. Enhanced Geothermal Systems technology seeks to develop the technology to engineer geothermal systems where natural conditions do not exist and expand the economically recoverable resource to depths approaching oil and gas.

(From the Geothermal Energy Association Website 6/12/2007)

Chairman GORDON. I thank the gentlelady. You know, we traditionally think of east of the Mississippi, west of the Mississippi. It took a Midwesterner to break us out of this mindset. You have a good amendment, and we thank you for it. And I would recommend its passage.

Is there further discussion on the amendment? If no, the vote occurs on the amendment. All in favor say aye, opposed no. The aye's have it. The amendment is agreed to.

Are there other amendments?

Mr. MATHESON. Mr. Chairman, I have an amendment at the desk.

Chairman GORDON. Mr. Matheson is recognized.

Mr. MATHESON. Are we going to dispense with the reading of the amendment or—

Chairman GORDON. The Minority has not had adequate time to see the amendment—

Mr. MATHESON. I understand.

Chairman GORDON [continuing]. So it will not be read.

Mr. MATHESON. Let me just give about 30 seconds, and I will yield back to the Chairman. This is an amendment that has to do with recognizing the importance of the Intermountain West Geothermal Consortium. It was initially authorized in the *Energy Policy Act of 2005*. It is focused on providing science and technology to discover and develop new geothermal resources in the Intermountain West.

My amendment would simply authorize \$5 million annually through 2012 for this consortium. And I yield to the Chairman.

Chairman GORDON. Thank you, Mr. Matheson. Let me just put things in context here. Mr. Matheson and his staff have put together what appears to be a good amendment and a good-faith amendment, but like all of us, it sometimes takes things to get them together. We did not receive this until just really a few moments ago. The Minority has not had the time to fully vet it, and I think to a good process that has made a good bill today and I appreciate you getting it on the table. We are going to now vet it and I hope that this will be a part of the manager's amendment when it comes to the Floor at a later date.

Mr. MATHESON. I appreciate that, and Mr. Chairman, with that, I understand and I am happy to withdraw the amendment.

Chairman GORDON. I thank you, Mr. Matheson. Are there other amendments? If not, the vote is on the bill, H.R. 2304 as amended.

Mr. DIAZ-BALART. Mr. Chairman?

Chairman GORDON. All those—

Mr. DIAZ-BALART. Mr. Chairman, I believe I have an amendment.

Chairman GORDON. Who seeks recognition? Oh, excuse me.

Mr. DIAZ-BALART. I believe I have an amendment on the desk, Mr. Chairman.

Chairman GORDON. I think it's on the next bill.

Mr. DIAZ-BALART. I stand corrected, Mr. Chairman. My apologies.

Chairman GORDON. Okay. That's all right. I'll try again. If there are no further amendments, all those in favor of H.R. 2304 say aye. All those opposed say no. In the opinion of the Chair, the ayes have it.

I recognize Mr. Hall to offer a motion.

Mr. HALL. Mr. Chairman, I move that the Committee favorably report H.R. 2304 as amended to the House with a recommendation that the bill as amended do pass. Furthermore, I move that the staff be instructed to prepare the legislative report, make necessary technical and conforming changes, and that the Chairman take all necessary steps to bring the bill before the House for consideration.

I yield back.

Chairman GORDON. The question is on the motion to report the bill favorably. Those in favor of the motion will signify by saying aye, opposed no. The ayes have it. The bill is favorably reported.

Without objection, the motion to reconsider is laid upon the table. The Members will have two subsequent calendar days in which to submit supplemental Minority or additional views on the measure, ending Monday, June 18, at 9:00 a.m. I move pursuant to clause 1 of Rule 22 of the Rules of the House of Representatives that the Committee authorize the Chairman to offer such motions as may be necessary in the House to adopt and pass H.R. 2304, the *Ad-*

vanced Geothermal Energy Research and Development Act of 2007, as amended. Without objection, so ordered.

That's a good bill. Everybody should go home and take credit for it.

I want to thank the Members for their attendance, and this concludes our markup.

[Whereupon, at 11:25 a.m., the Committee was adjourned.]

Appendix:

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT MARKUP REPORT;
H.R. 2304, AS AMENDED BY THE SUBCOMMITTEE ON ENERGY AND
ENVIRONMENT; AMENDMENT ROSTER

COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
REPORT FROM SUBCOMMITTEE MARKUP
JUNE 6, 2007

H.R. 2304, THE ADVANCED GEOTHERMAL ENERGY
RESEARCH AND DEVELOPMENT ACT OF 2007

I. Purpose

The purpose of the H.R. 2304 is to direct the Secretary of Energy to conduct a program of research, development, demonstration, and commercial application for geothermal energy, and establish technology transfer centers to disseminate related knowledge.

II. Background and Need for Legislation

Geothermal energy is heat from the Earth's core that is trapped in the earth's crust. It can be tapped and used either to generate electricity or for direct use (e.g., heating buildings, greenhouses, or aquaculture operations). It is very attractive as an energy resource because it is not only clean and renewable, but it can also provide continuously dispatchable, base load power, day and night, 365 days a year. Geothermal is also a domestic resource, creating domestic jobs and increasing national security.

In locations where high temperatures coincide with naturally-occurring, underground, fluid-filled reservoirs, the resulting hot water or steam can be tapped directly to run a geothermal power plant. Such locations are referred to as hydrothermal (hot water) resources, and they have been the focus of traditional geothermal energy development. The United States is the world's largest producer of electric power from geothermal energy with about 2,800 megawatts (MW) of geothermal electrical generating capacity is connected to the grid, mostly in California and the Intermountain West, where high grade hydrothermal systems have been found close to the surface. However, significant hydrothermal potential remains untapped. The U.S. Geological Survey (USGS) estimates there is between 95,000 MW and 127,000 MW of hydrothermal resources sufficient for electrical power generation in the United States. However, many of these resources remain undiscovered and unconfirmed.

Even that large number, however, pales in comparison to the potential of Enhanced Geothermal Systems (EGS). EGS differ from hydrothermal systems in that they lack either a natural reservoir (i.e., the cracks and spaces in the rock through which fluid can circulate), the fluid to circulate through the reservoir, or both. In EGS development, sometimes referred to as "heat mining," an injection well is drilled to a depth where temperatures are sufficiently high; if necessary, a reservoir is created, or "cracked," in the rock by using one of various methods of applying pressure; and a fluid is introduced to circulate through the reservoir and absorb the heat. The fluid is extracted through a production well, the heat is used to run a geothermal power plant or for some direct use application, and the fluid is reinjected to start the loop all over again.

Although it has been the subject of preliminary investigations in the United States, Europe, and Australia, the EGS concept has yet to be demonstrated as commercially viable. However, experts familiar with the resource and the associated technologies believe the technical and economic hurdles are surmountable. In January, 2007, a panel led by the Massachusetts Institute of Technology produced a report entitled *The Future of Geothermal Energy*, which contained an updated assessment of EGS potential in the United States. The authors of the report conservatively estimate that two percent of the EGS resource could be economically recoverable—an amount more than 2,000 times larger than all the primary energy consumed in the United States in 2005.¹ If the technological and economic hurdles to EGS development can be overcome, the potential of the resource is enormous.

The United States has been involved in geothermal energy R&D since the 1970s. The program reached a high point in FY 1980 with funding of approximately \$310 million (2006 dollars). Since then, funding has gradually declined to its present level of \$5 million (2006 dollars) in FY 2007. The Administration has attempted to phase out the geothermal program entirely, requesting zero dollars in FY 2007 and FY 2008.

¹Ibid, p. 1-17.

As justification for terminating the geothermal program, the Administration has claimed that geothermal technologies are mature—a claim strongly disputed by researchers and the geothermal industry. Proponents point out that geothermal is not a single technology, but a complex resource, available in different grades in different places. While the technologies to tap the highest grade resources may indeed be mature (some have provided electric power at competitive rates for decades) these high grade locations represent a very small fraction of the total resource. To develop technologies capable of tapping lower grade resources, further R&D is essential. Recent indications suggest DOE officials may be open to re-examining investment in geothermal R&D, particularly in light of the opportunities in Enhanced Geothermal Systems that were highlighted in the recent MIT report: *The Future of Geothermal Energy*.

H.R. 2304 is intended to reinvigorate geothermal energy R&D in the United States and unlock the potential of this vast resource, across the full spectrum of grades, for the benefit of the Nation.

III. Subcommittee Actions

On May 14, 2007, Rep. Jerry McNerney, for himself and Science and Technology Committee Chairman Bart Gordon, and Energy and Environment Subcommittee Chairman Nick Lampson, introduced H.R. 2304, the *Advanced Geothermal Energy Research and Development Act of 2007*.

The Energy and Environment Subcommittee held a hearing on Thursday, May 17, 2007 to hear testimony on H.R. 2304 (and also H.R. 2313, the *Marine Renewable Energy Research and Development Act of 2007*) from the following witnesses:

- **Dr. Jefferson Tester**, the HP Meissner Professor of Chemical Engineering at the Massachusetts Institute of Technology, an internationally recognized expert in Enhanced Geothermal Systems and Chair of the MIT-led panel that produced the report: *The Future of Geothermal Energy*, released in January, 2007.
- **Mr. Paul Thomsen**, Public Policy Manager for Ormat Technologies, Inc., a leading provider of geothermal exploration, development, and power conversion technologies. Mr. Thomsen testified on behalf of both Ormat and the Geothermal Energy Association.
- **Mr. Nathanael Greene**, a Sr. Energy Policy Specialist with the Natural Resources Defense Council with expertise in utility regulation, renewable energy, energy taxes, energy efficiency, and the environmental impacts of energy production.
- **Dr. Annette von Jouanne**, Professor of Energy Systems and Power Electronics in the School of Electrical Engineering and Computer Science at Oregon State University (OSU). Dr. von Jouanne also leads the Wave Energy program at OSU.
- **Mr. Sean O'Neill**, President of the Ocean Renewable Energy Coalition (OREC), a trade association representing the marine renewable energy industry.

The Subcommittee on Energy and Environment met to consider H.R. 2304 on June 6, 2007 and consider the following amendment to the bill:

1. On behalf of Mr. McNerney which, in addition to changes of a technical nature, revises instructions for establishing the federal/non-federal cost-sharing ratios for projects funded under the Act to provide greater leeway to tailor cost-sharing levels to individual projects; allows for a competitive bidding process to play a role in determining the cost-share ratio for a projects; eliminates cost-sharing requirements for research that is of a “fundamental or basic nature”; establishes an R&D program to develop technologies and techniques to mitigate or avoid adverse environmental impacts of geothermal energy development, production, or use; directs the Secretary to coordinate with the Environmental Protection Agency to study the environmental impacts of geothermal energy development, production, and use. directs the Secretary to give priority consideration for funding, where appropriate, to project proposals that include provisions to study the project’s environmental impacts; encourages the Enhanced Geothermal Systems Technology Transfer Center established in the bill to seek opportunities for coordination with appropriate international partners; and expands the scope of an existing, domestic geothermal technology transfer program from the western U.S. to the entire country. The amendment was agreed to by voice vote.

Mr. Inglis moved that the Subcommittee favorably report the bill, H.R. 2304, to the Full Committee on Science and Technology. The motion was agreed to by a voice vote.

IV. Summary of Major Provisions of the Bill

H.R. 2304 authorizes \$80 million a year for each of the fiscal years 2008–2012 (\$400 million total) for research, development, demonstration, and commercial application of technologies to locate, characterize, and develop geothermal resources, both hydrothermal systems and enhanced geothermal systems. The bill also establishes a research program, to be coordinated with EPA, to identify potential environmental impacts of geothermal energy production, and a program of RDD&CA of technologies to mitigate or avoid adverse environmental impacts. The bill provides guidance for the Secretary to use in evaluation of project proposals and for the establishment of federal/non-federal cost-sharing ratios for said projects. The bill establishes or expands several technology transfer programs to promote dissemination of information and best practices on geothermal energy development, both within the geothermal industry and to appropriate State agencies. Finally, the bill requires that DOE follow the development of more advanced concepts and technologies related to geothermal energy development and report back to the Congress every other year on the current state of such advanced technologies.

V. Section by Section Analysis of the Bill, as reported by the Subcommittee

Section 1. Short Title

Act may be cited as the “Advanced Geothermal Energy Research and Development Act of 2007.”

Section 2. Findings

Geothermal energy is a renewable resource capable of providing base-load power generation (and other applications) with minimal environmental impact. The geothermal energy potential in the United States is widely distributed and vast in size, yet it remains barely tapped. Sustained and expanded funding for research, development, demonstration, and commercial application programs is needed to improve the technologies to locate, characterize, and develop geothermal resources.

Section 3. Definitions

Provides definitions for the following terms used in the Act: ‘Engineered’ (as it pertains to enhanced geothermal systems), ‘Enhanced Geothermal Systems,’ ‘Geofluid,’ ‘Geothermal,’ ‘Hydrothermal,’ ‘Secretary,’ and ‘Systems Approach.’

Section 4. Hydrothermal Research and Development

Instructs the Secretary to support research, development, demonstration, and commercial application of technologies designed to assist in locating and characterizing undiscovered hydrothermal resources.

The specification of programs in subsection (b) should not be construed as constraining the prerogative of the Secretary to use authority granted under this section to support other types of hydrothermal RDD&CA. For example, it would be within the purview of this section to support projects designed to demonstrate the geothermal potential of co-produced water (water that is produced as a byproduct of oil & gas production), of abandoned oil & gas wells no longer in production, or of geopressured resources.

This section also establishes an “industry-coupled exploratory drilling” program, which is a cost-shared program with industry partners to demonstrate and apply advanced exploration technologies in the field. This is not intended as a program of research and development of drilling technologies; rather, it is intended as a demonstration program to apply existing technologies—especially the most advanced technologies available—in a practical setting.

Section 5. General Geothermal Systems Research and Development

The programs under Section 5 are intended to support the development of technologies applicable to the development of all geothermal systems, whether they be considered hydrothermal systems, enhanced geothermal systems, or some hybrid. Subsection (a) establishes a program of research, development, demonstration, and commercial application of system components and materials capable of withstanding the extreme environment (high temperatures and corrosiveness) in geothermal wells. Such components for RDD&CA shall include, but not be limited to those listed in the subsection. In practice, any subsurface component that is essential to drilling to extreme depths and temperatures shall qualify for RDD&CA under this section.

Subsection (b) establishes a program of RDD&CA of improved models of geothermal reservoir performance. The models can be of any useful type, whether numerical, computer-based, or other.

Subsection (c) establishes a program of RDD&CA of technologies to mitigate or preclude adverse environmental impacts from geothermal energy development, production or use. It also directs the Secretary, in conjunction with the Office of Research and Development at EPA, to study what such impacts of geothermal energy development might be, and ensure that the program in (c)(1) addresses such impacts.

Section 6. Enhanced Geothermal Systems Research and Development

Subsection (a) instructs the Secretary to support a program of RDD&CA of technologies necessary to advance EGS to a state of commercial readiness.

Subsection (b) establishes a cost-shared, field-based program of research, development, and demonstration of technologies to create and stimulate EGS reservoirs. The purpose of this subsection is to promote RD&D of functional EGS systems capable of producing hot geofluid that could be used for electric power production or direct use. (However, this section deliberately stops short of authorizing demonstration of the actual power conversion step. The aim is strictly to create a producing reservoir.) The subsection stipulates that a minimum of five sites, representing different geologic conditions, be selected to ensure that demonstration is conducted under different conditions. More than five sites can be selected as long as funds are available.

Section 7. Guidelines for Cost Sharing and Proposal Evaluation

Establishes certain guidelines for the Secretary to use in evaluating proposals and for determining the federal/non-federal cost-share ratios of projects funded under this Act. The intent of this section is that the Secretary establish, in writing, the criteria that are used for determining project selections, and the cost-share ratios.

Section 8. Centers for Geothermal Technology Transfer

Provides for the creation of two Centers of technology transfer to function as information clearinghouses for the geothermal industry, dedicated to collecting and sharing industry-relevant information. One Center, to be located in the western U.S., shall be dedicated to hydrothermal-specific development information; the other Center, located in the eastern U.S., shall be dedicated to EGS-specific development information. Although the section specifies a western Center and an eastern Center, both centers are intended to serve the entire Nation with regard to their respective areas of expertise. To the extent that those areas of expertise overlap, it is okay, and useful, for the two Centers to concern themselves with duplicate information. The eastern Center, dedicated to Enhanced Geothermal Systems, is specifically encouraged to seek opportunities for international cooperation since there is significant research happening in this area in Europe, Asia, and Australia, and other countries may establish programs in the future.

Section 9. GeoPower America

Expands the scope of an existing, domestic geothermal technology transfer program from the western U.S. to the entire country, so as to encourage the transfer and adoption of appropriate geothermal energy technologies throughout the entire United States.

Section 10. Study on Advanced Uses of Geothermal Energy

Requires the Secretary to track technological advances impacting geothermal energy development and advanced uses of geothermal energy and fluids, and report back to the Committee every other year for the next five years (a total of three times). The report is not intended to be limited to the topics listed here. This report is intended to focus on areas of potential future interest for the geothermal program, but these areas are not considered appropriate candidates for federal RDD&CA support at the current time, owing to their early stages of development and speculative nature. The bi-annual tracking study is intended to highlight when these technologies become less speculative and therefore more appropriate candidates for federal support.

Section 11. Applicability of Other Laws

Affirms the applicability of all requirements under federal and State laws, including environmental laws, to projects undertaken under this Act.

Section 12. Authorization of Appropriations

Authorizes appropriations of \$80,000,000 for each of the fiscal years 2008 through 2012.

**H.R. 2304, AS AMENDED BY THE SUBCOMMITTEE
ON ENERGY AND ENVIRONMENT**

On June 6, 2007

1 SECTION 1. SHORT TITLE.

2 This Act may be cited as the “Advanced Geothermal
3 Energy Research and Development Act of 2007”.

4 SEC. 2. FINDINGS.

5 The Congress finds the following:

6 (1) The United States has a critical national in-
7 terest in developing clean, domestic, renewable
8 sources of energy in order to mitigate the causes of
9 climate change, reduce other environmental impacts
10 of energy production, increase national security, im-
11 prove public health, and bolster economic stability.

12 (2) Geothermal energy is a renewable energy re-
13 source.

14 (3) Geothermal energy is unusual among renew-
15 able energy sources because of its ability to provide
16 an uninterrupted supply of baseload electricity.

17 (4) Recently published assessments by rep-
18 utable experts, including the Massachusetts Institute
19 of Technology, the Western Governors Association,
20 and the National Renewable Energy Laboratory, in-

1 dicate that the Nation's geothermal resources are
2 widely distributed, vast in size, and barely tapped.

3 (5) Sustained and expanded research, develop-
4 ment, demonstration, and commercial application
5 programs are needed to locate and characterize geo-
6 thermal resources, and to develop the technologies
7 that will enable their widespread commercial devel-
8 opment.

9 (6) Federal support is critical to reduce the fi-
10 nancial risk associated with developing new geo-
11 thermal technologies, thereby encouraging the pri-
12 vate sector investment necessary to make geothermal
13 resources commercially viable as a source of electric
14 power and for other applications.

15 **SEC. 3. DEFINITIONS.**

16 For purposes of this Act:

17 (1) **ENGINEERED.**—When referring to enhanced
18 geothermal systems, the term “engineered” means
19 subjected to intervention, including intervention to
20 address one or more of the following issues:

21 (A) Lack of effective permeability or poros-
22 ity or open fracture connectivity within the res-
23 ervoir.

24 (B) Insufficient contained geofluid in the
25 reservoir.

1 (C) A low average geothermal gradient,
2 which necessitates deeper drilling.

3 (2) ENHANCED GEOTHERMAL SYSTEMS.—The
4 term “enhanced geothermal systems” means geo-
5 thermal reservoir systems that are engineered, as op-
6 posed to occurring naturally.

7 (3) GEOFLUID.—The term “geofluid” means
8 any fluid used to extract thermal energy from the
9 Earth which is transported to the surface for direct
10 use or electric power generation, except that such
11 term shall not include oil or natural gas.

12 (4) GEOTHERMAL.—The term “geothermal” re-
13 fers to heat energy stored in the Earth’s crust that
14 can be accessed for direct use or electric power gen-
15 eration.

16 (5) HYDROTHERMAL.—The term “hydro-
17 thermal” refers to naturally occurring subsurface
18 reservoirs of hot water or steam.

19 (6) SECRETARY.—The term “Secretary” means
20 the Secretary of Energy.

21 (7) SYSTEMS APPROACH.—The term “systems
22 approach” means an approach to solving problems
23 or designing systems that attempts to optimize the
24 performance of the overall system, rather than a
25 particular component of the system.

1 **SEC. 4. HYDROTHERMAL RESEARCH AND DEVELOPMENT.**

2 (a) **IN GENERAL.**—The Secretary shall support pro-
3 grams of research, development, demonstration, and com-
4 mercial application to expand the use of geothermal en-
5 ergy production from hydrothermal systems, including the
6 programs described in subsection (b).

7 (b) **PROGRAMS.**—

8 (1) **ADVANCED HYDROTHERMAL RESOURCE**
9 **TOOLS.**—The Secretary, in consultation with other
10 appropriate agencies, shall support a program to de-
11 velop advanced geophysical, geochemical, and geo-
12 logic tools to assist in locating hidden hydrothermal
13 resources, and to increase the reliability of site char-
14 acterization before, during, and after initial drilling.
15 The program shall develop new prospecting tech-
16 niques to assist in prioritization of targets for char-
17 acterization. The program shall include a field com-
18 ponent.

19 (2) **INDUSTRY COUPLED EXPLORATORY DRILL-**
20 **ING.**—The Secretary shall support a program of
21 cost-shared field demonstration programs, to be pur-
22 sued, simultaneously and independently, in collabo-
23 ration with industry partners, for the demonstration
24 of technologies and techniques of siting and explor-
25 atory drilling for undiscovered resources in a variety
26 of geologic settings. The program shall include in-

1 centives to encourage the use of advanced tech-
2 nologies and techniques.

3 **SEC. 5. GENERAL GEOTHERMAL SYSTEMS RESEARCH AND**
4 **DEVELOPMENT.**

5 (a) **SUBSURFACE COMPONENTS AND SYSTEMS.**—The
6 Secretary shall support a program of research, develop-
7 ment, demonstration, and commercial application of com-
8 ponents and systems capable of withstanding extreme geo-
9 thermal environments and necessary to cost-effectively de-
10 velop, produce, and monitor geothermal reservoirs and
11 produce geothermal energy. These components and sys-
12 tems shall include advanced casing systems (expandable
13 tubular casing, low-clearance casing designs, and others),
14 high-temperature cements, high-temperature submersible
15 pumps, and high-temperature packers, as well as tech-
16 nologies for under-reaming, multilateral completions,
17 high-temperature logging, and logging while drilling.

18 (b) **RESERVOIR PERFORMANCE MODELING.**—The
19 Secretary shall support a program of research, develop-
20 ment, demonstration, and commercial application of mod-
21 els of geothermal reservoir performance, with an emphasis
22 on accurately modeling performance over time. Models
23 shall be developed to assist both in the development of geo-
24 thermal reservoirs and to more accurately account for

1 stress-related effects in stimulated hydrothermal and en-
2 hanced geothermal systems production environments.

3 (e) ENVIRONMENTAL IMPACTS.—The Secretary
4 shall—

5 (1) support a program of research, develop-
6 ment, demonstration, and commercial application of
7 technologies and practices designed to mitigate or
8 preclude potential adverse environmental impacts of
9 geothermal energy development, production or use,
10 and seek to ensure that geothermal energy develop-
11 ment is consistent with the highest practicable
12 standards of environmental stewardship; and

13 (2) in conjunction with the Assistant Adminis-
14 trator for Research and Development at the Envi-
15 ronmental Protection Agency, support a research
16 program to identify potential environmental impacts
17 of geothermal energy development, production, and
18 use, and ensure that the program described in para-
19 graph (1) addresses such impacts, including effects
20 on groundwater and local hydrology.

21 **SEC. 6. ENHANCED GEOTHERMAL SYSTEMS RESEARCH**
22 **AND DEVELOPMENT.**

23 (a) IN GENERAL.—The Secretary shall support a
24 program of research, development, demonstration, and

1 commercial application for enhanced geothermal systems,
2 including the programs described in subsection (b).

3 (b) PROGRAMS.—

4 (1) ENHANCED GEOTHERMAL SYSTEMS TECH-
5 NOLOGIES.—The Secretary shall support a program
6 of research, development, demonstration, and com-
7 mercial application of the technologies and knowl-
8 edge necessary for enhanced geothermal systems to
9 advance to a state of commercial readiness, includ-
10 ing advances in—

11 (A) reservoir stimulation;

12 (B) reservoir characterization, monitoring,
13 and modeling;

14 (C) stress mapping;

15 (D) tracer development;

16 (E) three-dimensional tomography; and

17 (F) understanding seismic effects of res-
18 ervoir engineering and stimulation.

19 (2) ENHANCED GEOTHERMAL SYSTEMS RES-
20 ERVOIR STIMULATION.—

21 (A) PROGRAM.—In collaboration with in-
22 dustry partners, the Secretary shall support a
23 program of research, development, and dem-
24 onstration of enhanced geothermal systems res-
25 ervoir stimulation technologies and techniques.

1 A minimum of 5 sites shall be selected in loca-
2 tions that show particular promise for enhanced
3 geothermal systems development. Each site
4 shall—

5 (i) represent a different class of sub-
6 surface geologic environments; and

7 (ii) take advantage of an existing site
8 where subsurface characterization has been
9 conducted or existing drill holes can be uti-
10 lized, if possible.

11 (B) CONSIDERATION OF EXISTING
12 SITES.—The following 2 sites, where Depart-
13 ment of Energy and industry cooperative en-
14 hanced geothermal systems projects are already
15 underway, may be considered for inclusion
16 among the sites selected under subparagraph
17 (A):

18 (i) Desert Peak, Nevada.

19 (ii) Coso, California.

20 **SEC. 7. GUIDELINES FOR COST SHARING AND PROPOSAL**
21 **EVALUATION.**

22 (a) **APPLICABILITY.**—In carrying out the research,
23 development, demonstration, and commercial application
24 programs under this Act, the Secretary shall require cost-
25 sharing as follows:

1 (1) IN GENERAL.—Except as provided in para-
2 graphs (2) and (3), the Secretary shall require be-
3 tween 20 and 80 percent of the cost of a project de-
4 scribed in subsection (a) to be borne by a non-Fed-
5 eral entity or entities. The Secretary shall establish
6 guidelines for determining the cost-share ratios for
7 projects. The guidelines shall consider the relative
8 risk of projects and the potential for return on in-
9 vested capital. The guidelines shall also allow for a
10 competitive bidding process to play a role in deter-
11 mining the final cost-share ratio. The Secretary shall
12 have final discretion to establish the cost-share ratio
13 for any given project.

14 (2) EXCLUSION.—Research or development ac-
15 tivities of a basic or fundamental nature, as deter-
16 mined by the appropriate officer of the Department
17 of Energy, shall not be subject to any cost-share re-
18 quirement.

19 (3) REDUCTION OF NON-FEDERAL SHARE.—
20 The Secretary may reduce or eliminate the require-
21 ment of paragraph (1) for an activity if the Sec-
22 retary determines that the reduction is necessary
23 and appropriate.

24 (b) NON-FEDERAL CONTRIBUTIONS.—Non-Federal
25 contributions required under subsection (a)—

10

1 (1) may include—

2 (A) personnel costs;

3 (B) the value of a service, other resource,
4 or third party in-kind contribution; and

5 (C) indirect costs or facilities and adminis-
6 trative costs; and

7 (2) shall not include—

8 (A) revenues or royalties from the prospec-
9 tive operation of an activity beyond the dura-
10 tion of the award; or

11 (B) proceeds from the prospective sale of
12 an asset of an activity.

13 (c) REPAYMENT OF FEDERAL SHARE.—The Sec-
14 retary shall not require repayment of the Federal share
15 of a cost-shared activity under this section as a condition
16 of making an award.

17 (d) ORGANIZATION AND ADMINISTRATION OF PRO-
18 GRAMS.—Programs under this Act shall incorporate the
19 following organizational and administrative elements:

20 (1) Non-Federal participants shall be chosen
21 through a competitive selection process.

22 (2) The request for proposals for each program
23 shall stipulate, at a minimum, the following:

24 (A) The non-Federal funding requirements
25 for projects.

1 (B) The funding mechanism to be used
2 (i.e. grants, contracts, or cooperative agree-
3 ments).

4 (C) Milestones and a schedule for comple-
5 tion.

6 (D) Criteria for evaluating proposals.

7 (3) In evaluating proposals, the Secretary shall
8 give priority to proposals that draw on relevant ex-
9 pertise from industry, academia, and the national
10 laboratories, as appropriate.

11 (4) In evaluating proposals, the Secretary shall
12 consult with relevant experts from industry, aca-
13 demia, and the national laboratories, as appropriate.

14 (5) In evaluating proposals, the Secretary shall
15 give priority to proposals that demonstrate clear evi-
16 dence of employing a systems approach.

17 (6) In evaluating proposals for projects with a
18 field component, the Secretary shall, where appro-
19 priate, give priority consideration to proposals that
20 contain provisions to study local environmental im-
21 pacts of the technologies developed or the operations
22 undertaken.

23 (7) Data collected by the Secretary as a result
24 of any project supported with funds provided under
25 this Act shall be made available to the public, except

1 to the extent that they contain information that is
2 protected from disclosure under section 552(b) of
3 title 5, United States Code.

4 **SEC. 8. CENTERS FOR GEOTHERMAL TECHNOLOGY TRANS-**
5 **FER.**

6 (a) **IN GENERAL.**—The Secretary shall award grants
7 to institutions of higher education (or consortia thereof)
8 to establish 2 Centers for Geothermal Technology Trans-
9 fer.

10 (b) **CENTERS.**—

11 (1) **HYDROTHERMAL CENTER.**—The purpose of
12 one Technology Transfer Center shall be to serve as
13 an information clearinghouse for the geothermal in-
14 dustry, collecting and disseminating information on
15 best practices in all areas related to developing and
16 managing hydrothermal resources, including data
17 available for disclosure as provided under section
18 7(d)(7). This Center shall be based at the institution
19 west of the Mississippi River that the Secretary con-
20 siders to be best suited to the purpose. The Center
21 shall collect and disseminate information on all sub-
22 jects germane to the development and user of hydro-
23 thermal systems, including—

24 (A) resource location;

- 1 (B) reservoir characterization, monitoring,
2 and modeling;
3 (C) drilling techniques;
4 (D) reservoir management techniques; and
5 (E) technologies for electric power conver-
6 sion or direct use of geothermal energy.

7 (2) ENHANCED GEOTHERMAL SYSTEMS CEN-
8 TER.—The purpose of a second Technology Transfer
9 Center shall be to serve as an information clearing-
10 house for the geothermal industry, collecting and
11 disseminating information on best practices in all
12 areas related to developing and managing enhanced
13 geothermal systems resources, including data avail-
14 able for disclosure as provided under section 7(d)(7).
15 This Center is encouraged to seek opportunities to
16 coordinate efforts and share information with inter-
17 national partners engaged in research and develop-
18 ment of enhanced geothermal systems or engaged in
19 collection of data related to enhanced geothermal
20 systems development. This Center shall be based at
21 an academic institution east of the Mississippi River
22 which, in the opinion of the Secretary, is best suited
23 to provide national leadership on enhanced geo-
24 thermal systems-related issues. The Center shall col-
25 lect and disseminate information on all subjects ger-

1 mane to the development and use of enhanced geo-
2 thermal systems.

3 (c) AWARD DURATION.—An award made by the Sec-
4 retary under this section shall be for an initial period of
5 5 years, and may be renewed for additional 5-year periods
6 on the basis of—

7 (1) satisfactory performance in meeting the
8 goals of the research plan proposed by the Center;
9 and

10 (2) other requirements as specified by the Sec-
11 retary.

12 **SEC. 9. GEOPOWER AMERICA.**

13 The Secretary shall expand the Department of Ener-
14 gy's GeoPower the West program to extend its geothermal
15 technology transfer activities throughout the entire United
16 States. The program shall be renamed "GeoPower Amer-
17 ica". The program shall continue to be based in the De-
18 partment of Energy office in Golden, Colorado.

19 **SEC. 10. STUDY ON ADVANCED USES OF GEOTHERMAL EN-**
20 **ERGY.**

21 Not later than 1 year, 3 years, and 5 years, after
22 the date of enactment of this Act, the Secretary shall re-
23 port to the Committee on Science and Technology of the
24 House of Representatives and the Committee on Energy
25 and Natural Resources of the Senate on advanced con-

1 cepts and technologies to maximize the geothermal re-
2 source potential of the United States. The reports shall
3 include—

4 (1) the use of carbon dioxide as an alternative
5 geofluid with potential carbon sequestration benefits;

6 (2) mineral recovery from geofluids;

7 (3) use of geothermal energy to produce hydro-
8 gen;

9 (4) use of geothermal energy to produce
10 biofuels;

11 (5) use of geothermal heat for oil recovery from
12 oil shales and tar sands;

13 (6) coproduction of geofluids for direct use or
14 electric power generation in conjunction with exist-
15 ing oil and gas extraction operations; and

16 (7) other advanced geothermal technologies, in-
17 cluding advanced drilling technologies and advanced
18 power conversion technologies.

19 **SEC. 11. APPLICABILITY OF OTHER LAWS.**

20 Nothing in this Act shall be construed as waiving the
21 applicability of any requirement under any environmental
22 or other Federal or State law.

1 **SEC. 12. AUTHORIZATION OF APPROPRIATIONS.**

2 There are authorized to be appropriated to the Sec-
3 retary to carry out this Act \$80,000,000 for each of the
4 fiscal years 2008 through 2012.

COMMITTEE ON SCIENCE AND TECHNOLOGY
FULL COMMITTEE MARKUP
JUNE 13, 2007

AMENDMENT ROSTER

H.R. 2304 – the Advanced Geothermal Energy Research and Development Act of 2007

No.	Sponsor	Description	Results
1	Mr. Hall	Adds new sections relating to co-production and geopressured resources; Adds \$10 million in authorization for these sections; and streamlines cost-share requirements.	Agreed to by voice vote.
2	Mr. Bartlett	Amends section 10 by replacing "Study" on Uses of Advanced Geothermal Energy with "Reports" on Uses of Advanced Geothermal Energy.	Agreed to by voice vote en bloc with 3 and 4.
3	Mr. Bartlett	Amends section 9 by replacing "Geopower" America with "Geopowering" America.	Agreed to by voice vote en bloc with 2 and 4.
4	Mr. Bartlett	Amends section 5 to require environmental impacts from geothermal energy production be measured and examined against the potential for greenhouse gas emissions offsets.	Agreed to by voice vote en bloc with 2 and 3.
5	Mr. McCaul	Amends section 7 to require the Secretary to coordinate with other DOE R&D programs focused on drilling and related activities.	Agreed to by voice vote en bloc with 6.
6	Mr. McCaul	Amends section 6 by adding "laser-based drilling technology" to the EGS program.	Agreed to by voice vote en bloc with 5.
7	Ms. Biggert	Strikes section 8, which establishes geothermal centers, and amends section 9 to make these activities eligible under the Geopowering America program.	Defeated by voice vote.
8	Ms. Biggert	Amends section 8 by changing the dividing line for the geothermal centers from the Mississippi River to the Rocky Mountains.	Agreed to by voice vote.
9	Mr. Matheson	Amends section 12 by authorizing appropriations for the Intermountain West Geothermal Consortium	Offered and withdrawn.

AMENDMENT TO H.R. 2304
OFFERED BY MR. HALL OF TEXAS

Page 3, after line 11, insert the following new paragraph:

1 (4) GEOPRESSURED RESOURCES.—The term
2 “geopressured resources” mean geothermal deposits
3 found in sedimentary rocks under higher than nor-
4 mal pressure and saturated with gas or methane.

Page 3, lines 12 through 21, redesignate paragraphs (4) through (7) as paragraphs (5) through (8), respectively.

Page 8, line 20, through page 16, line 1, redesignate sections 7 through 12 as sections 8 through 13, respectively.

Page 8, after line 19, insert the following new section:

1 **SEC. 7. GEOTHERMAL ENERGY PRODUCTION FROM OIL**
2 **AND GAS FIELDS AND RECOVERY AND PRO-**
3 **DUCTION OF GEOPRESSURED GAS RE-**
4 **SOURCES.**

5 (a) IN GENERAL.—The Secretary shall establish a
6 program of research, development, demonstration, and
7 commercial application to support development of geo-
8 thermal energy production from oil and gas fields and pro-
9 duction and recovery of energy from geopressured re-
10 sources. In addition, the Secretary shall conduct such sup-
11 porting activities including research, resource character-
12 ization, and technology development as necessary.

13 (b) GEOTHERMAL ENERGY PRODUCTION FROM OIL
14 AND GAS FIELDS.—The Secretary shall implement a
15 grant program in support of geothermal energy production
16 from oil and gas fields. The program shall include grants
17 for a total of not less than three demonstration projects
18 of the use of geothermal techniques such as organic
19 rankine cycle systems at marginal, unproductive, and pro-
20 ductive oil and gas wells. The Secretary shall, to the extent
21 practicable and in the public interest, make awards that—

22 (1) include not less than five oil or gas well
23 sites per project award;

24 (2) use a range of oil or gas well hot water
25 source temperatures from 150 degrees Fahrenheit to
26 300 degrees Fahrenheit;

1 (3) cover a range of sizes up to one megawatt;

2 (4) are located at a range of sites;

3 (5) can be replicated at a wide range of sites;

4 (6) facilitate identification of optimum tech-
5 niques among competing alternatives;

6 (7) include business commercialization plans
7 that have the potential for production of equipment
8 at high volumes and operation and support at a
9 large number of sites; and

10 (8) satisfy other criteria that the Secretary de-
11 termines are necessary to carry out the program and
12 collect necessary data and information.

13 The Secretary shall give preference to assessments that
14 address multiple elements contained in paragraphs (1)
15 through (8).

16 (c) GRANT AWARDS.—Each grant award for dem-
17 onstration of geothermal technology such as organic
18 rankine cycle systems at oil and gas wells made by the
19 Secretary under subsection (b) shall include—

20 (1) necessary and appropriate site engineering
21 study;

22 (2) detailed economic assessment of site specific
23 conditions;

24 (3) appropriate feasibility studies to determine
25 whether the demonstration can be replicated;

1 (4) design or adaptation of existing technology
2 for site specific circumstances or conditions;

3 (5) installation of equipment, service, and sup-
4 port;

5 (6) operation for a minimum of one year and
6 monitoring for the duration of the demonstration;
7 and

8 (7) validation of technical and economic as-
9 sumptions and documentation of lessons learned.

10 (d) GEOPRESSURED GAS RESOURCE RECOVERY AND
11 PRODUCTION.—(1) The Secretary shall implement a pro-
12 gram to support the research, development, demonstra-
13 tion, and commercial application of cost-effective tech-
14 niques to produce energy from geopressured resources sit-
15 uated in and near the Gulf of Mexico.

16 (2) The Secretary shall solicit preliminary engineer-
17 ing designs for geopressured resources production and re-
18 covery facilities.

19 (3) Based upon a review of the preliminary designs,
20 the Secretary shall award grants, which may be cost-
21 shared, to support the detailed development and comple-
22 tion of engineering, architectural and technical plans need-
23 ed to support construction of new designs.

24 (4) Based upon a review of the final design plans
25 above, the Secretary shall award cost-shared development

1 and construction grants for demonstration geopressured
2 production facilities that show potential for economic re-
3 covery of the heat, kinetic energy and gas resources from
4 geopressured resources.

5 (e) COMPETITIVE GRANT SELECTION.—Not less than
6 90 days after the date of the enactment of this Act, the
7 Secretary shall conduct a national solicitation for applica-
8 tions for grants under the programs outlined in sub-
9 sections (b) and (d). Grant recipients shall be selected on
10 a competitive basis based on criteria in the respective sub-
11 section.

12 (f) WELL DRILLING.—No funds may be used under
13 this section for the purpose of drilling new wells.

Page 8, line 20, strike “**GUIDELINES FOR**”.

Page 8, line 22 through page 10, lines 16, strike
subsections (a) through (c) and insert the following new
subsection:

14 (a) FEDERAL SHARE.—(1) The Federal share of
15 costs of projects funded under this Act shall be in accord-
16 ance with section 988 of the Energy Policy Act of 2005.

17 (2) The Secretary may waive the Federal cost share
18 requirement for grants awarded to universities, national
19 laboratories, or similar noncommercial entities awarded
20 grants under this Act.

1 (3) The Secretary shall allow for a competitive bid-
2 ding process to play a role in determining the final cost-
3 share ratio.

Page 12, line 18, strike “7(d)(7)” and insert
“8(b)(7)”.

Page 13, line 14, strike “7(d)(7)” and insert
“8(b)(7)”.

Page 14, lines 19 and 20, strike “**STUDY ON AD-
VANCED USES OF GEOTHERMAL ENERGY**” and insert
“**REPORTS**”.

Page 14, line 21, insert “(a) STUDY ON ADVANCED
USES OF GEOTHERMAL ENERGY.—” before “Not later
than”.

Page 15, after line 18, insert the following new sub-
section:

4 (b) PROGRESS REPORTS.—(1) Not later than 36
5 months after the date of enactment of this Act, the Sec-
6 retary shall submit to the Committee on Science and Tech-
7 nology of the House of Representatives and the Committee
8 on Energy and Natural Resources of the Senate an in-
9 terim report describing the progress made under this Act.
10 At the end of 60 months, the Secretary shall submit to
11 Congress a report on the results of projects undertaken

1 under this Act and other such information the Secretary
2 considers appropriate.

3 (2) As necessary, the Secretary shall report to the
4 Congress on any legal, regulatory, or other barriers en-
5 countered that hinder economic development of these re-
6 sources, and provide recommendations on legislative or
7 other actions needed to address such impediments.

Page 15, line 12, insert “and” after the semicolon.

Page 15, lines 13 through 15, strike paragraph (6).

Page 15, line 16, redesignate paragraph (7) as para-
graph (6).

Page 16, lines 3 and 4, strike “\$80,000,000 for each
of the fiscal years 2008 through 2012” and insert
“\$90,000,000 for each of the fiscal years 2008 through
2012, of which \$10,000,000 for each fiscal year shall be
for carrying out section 7”.

AMENDMENT TO H.R. 2304
OFFERED BY Rep. BARTLETT(MD)

Page 14, line 19, strike "**STUDY**" and insert "**RE-
PORTS**".

AMENDMENT TO H.R. 2304

OFFERED BY Rep. Bartlett (MD)

Page 14, line 12, strike "**GEOPOWER**" and insert "**GEOPOWERING**".

Page 14, line 16, strike "GeoPower" and insert "GeoPowering".

AMENDMENT TO H.R. 2304

OFFERED BY Rep. Bartlett (MD)

Page 6, after line 20, insert the following:

1 Any potential environmental impacts identified as part of
2 the development, production, and use of geothermal en-
3 ergy shall be measured and examined against the potential
4 emissions offsets of greenhouses gases gained by geo-
5 thermal energy development, production, and use.

AMENDMENT TO H.R. 2304
OFFERED BY Mr. McCaul

Page 11, lines 11 through 23, redesignate paragraphs (4) through (7) as paragraphs (5) through (8), respectively.

Page 11, after line 10, insert the following new paragraph:

1 (4) The Secretary shall coordinate with, and
2 where appropriate may provide funds in furtherance
3 of the purposes of this Act to, other Department of
4 Energy research and development programs focused
5 on drilling, subsurface characterization, and other
6 related technologies.

Page 12, line 18, strike “7(d)(7)” and insert “7(d)(8)”.

Page 13, line 14, strike “7(d)(7)” and insert “7(d)(8)”.

AMENDMENT TO H.R. 2304

OFFERED BY Mr McCaul

Page 7, line 16, strike “and”.

Page 7, line 18, strike the period and insert “; and”.

Page 7, after line 18, insert the following new sub-paragraph:

1 (G) laser-based drilling technology.

AMENDMENT TO H.R. 2304
OFFERED BY MRS. BIGGERT OF ILLINOIS

Page 12, line 4, through page 14, line 11, strike section 8.

Page 14, line 12, through page 16, line 1, redesignate sections 9 through 12 as sections 8 through 11, respectively.

Page 14, line 13, insert “(a) IN GENERAL.—” before “The Secretary shall”.

Page 14, after line 18, insert the following new subsections:

1 (b) ADDITIONAL PURPOSES.—In addition to the
2 other duties of GeoPowering the West, the new
3 GeoPowering America program is authorized to serve as
4 an information clearinghouse for the geothermal industry,
5 collecting and disseminating information on best practices
6 in all areas related to developing and managing hydro-
7 thermal resources, geothermal resources from oil and gas
8 fields, enhanced geothermal systems resources, and
9 geopressured resources, including data available for disclo-
10 sure as provided under section 7(d)(7). GeoPowering
11 America shall collect and disseminate information on all

1 subjects germane to the development and use of hydro-
2 thermal systems, geothermal systems from oil and gas
3 fields, enhanced geothermal systems, and geopressured
4 systems. Information for hydrothermal systems shall at a
5 minimum include—

- 6 (1) resource location;
- 7 (2) reservoir characterization, monitoring, and
8 modeling;
- 9 (3) drilling techniques;
- 10 (4) reservoir management techniques; and
- 11 (5) technologies for electric power conversion or
12 direct use of geothermal energy.

13 (c) INTERNATIONAL RESEARCH AND DEVELOP-
14 MENT.—In regards to enhanced geothermal systems,
15 GeoPowering America is encouraged to seek opportunities
16 to coordinate efforts and share information with inter-
17 national partners engaged in research and development of
18 enhanced geothermal systems or engaged in collection of
19 data related to enhanced geothermal systems development.

AMENDMENT TO H.R. 2304
OFFERED BY MRS. BIGGERT

Page 13, line 21, strike "Mississippi River" and insert "Rocky Mountains".

AMENDMENT TO H.R. 2304
OFFERED BY MR. MATHESON OF UTAH

Page 16, line 4, insert “There are also authorized to be appropriated to the Secretary for the Intermountain West Geothermal Consortium \$5,000,000 for each of the fiscal years 2008 through 2012.” after “through 2012”.