COMMITTEE ON
SCIENCE, SPACE AND TECHNOLOGY
CHAIRMAN BRIAN BABIN

ENERGY SUBCOMMITTEE

HEARING CHARTER

"Subsurface Science and Technology: American Energy and Mineral Dominance"

Thursday, April 16, 2026
10:15 a.m.
2318 Rayburn House Office Building

PURPOSE

The purpose of this hearing is to explore the current state of next-generation energy production, subsurface science and technology, and critical minerals innovation in the United States. It will assess the federal government's role in advancing research and development in these areas, with a focus on how the Department of Energy (DOE) is addressing key challenges. The discussion will also help inform potential legislation to authorize DOE's work, as appropriate.

WITNESSES

- **Mr. Carlos Araque**, President and Chief Executive Officer, Quaise Energy
- **Dr. Elizabeth Holley**, Professor, Mining Engineering, Colorado School of Mines
- **Dr. Thomas A. Lograsso**, Director, Critical Materials Innovation Hub, Ames National Laboratory
- **Mr. Joel Edwards**, Co-Founder and Chief Technology Officer, Zanskar Geothermal & Minerals

KEY QUESTIONS

- How has the Department of Energy's creation of the Hydrocarbons and Geothermal Energy Office helped advance the deployment of new geothermal energy production?
- How has the Department of Energy's Office of Critical Minerals and Energy Innovation furthered innovation and development in subsurface sciences?
- What can Congress do to help facilitate the development of next-generation geothermal systems and critical mineral development?
- How have the Department of Energy's digitization efforts for subsurface maps improved the development of these sites and technologies?
- Is the United States leading in this technological area, or are we falling behind adversaries like the CCP?

BACKGROUND

Subsurface Sciences

Subsurface sciences integrate expertise from physical, chemical, and biological processes occurring within the Earth's upper crust.[1] This field represents a critical facet of U.S. national security and, over the last few years, has only grown in importance. To address this research area, the Department of Energy established the Subsurface Science, Technology and Engineering Research, and Development Crosscut (SubTER) to facilitate collaboration across the DOE enterprise.[2]

The U.S. extracts most of its energy from the subsurface. According to Lawrence Berkeley National Laboratory, approximately 80 percent of the nation's energy still comes from the Earth's subsurface.[3] To maintain our energy independence and safeguard our energy leadership, subsurface sciences will play a key role in ensuring our success in this endeavor. As the U.S. has moved to reshore critical mineral supply chains, subsurface sciences will play a vital part in identifying and extracting these elements domestically.

Geothermal Energy

Historically, geothermal energy production has been limited to areas where the required water, heat, and porosity aligned. These areas were typically near Earth's surface, and the production of geothermal energy was extremely limited to certain geographic locations. However, due to innovations in the oil and gas industry, including new drilling techniques and hydraulic fracturing, the industry no longer faces such strict limitations, allowing this baseload power source to be used in areas far outside its historical geographic footprint. In the U.S., geothermal has the potential to generate 90 gigawatts of electricity by 2050, as well as more than 17,000 district heating systems and geothermal heat pumps, equivalent to 28 million homes.[4]

Geothermal Systems

There are four types of geothermal systems that can be grouped into two categories. The first category is the traditional geothermal systems that rely on near-surface sources and are called Conventional Hydrothermal Systems (CHS). CHS relies on very specific water, heat, and porosity conditions. These exact requirements mean that few geographic areas can support geothermal energy production.

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[1] "Subsurface Energy Materials Characterization and Analysis Laboratory." *Subsurface Energy Materials Characterization and Analysis Laboratory | School of Earth Sciences*, 27 Oct. 2016, https://earthsciences.osu.edu/facilities/subsurface-energy-materials-characterization-and-analysis-laboratory.

[2] "Subsurface Science, Technology, Engineering, and R&D Crosscut (Subter)." *U.S. Department of Energy*, 14 Apr. 2018, https://www.energy.gov/subsurface-science-technology-engineering-and-rd-crosscut-subter.

[3] Bentley, Kady. "Digging Deep: How Berkeley Lab Advances Subsurface Research for Energy, Water, and More." *Berkeley Lab News Center*, 19 Aug. 2025, https://newscenter.lbl.gov/2025/05/27/digging-deep-how-berkeley-lab-advances-subsurface-research-for-energy-water-and-more/.

[4] "Geothermal Basics." *U.S. Department of Energy*, 22 June 2015, www.energy.gov/hgeo/geothermal/geothermal-basics.

The other three systems are next-generation geothermal power generation technologies that have eliminated the barriers faced by traditional CHS systems. Enhanced Geothermal Systems (EGS) are systems that have the right amount of heat and water but lack the permeability required to use the available resources effectively. By leveraging technologies such as hydraulic fracturing, the permeability of the rock can be altered to enable heat extraction.[5] Advanced Geothermal Systems (AGS), or closed-loop geothermal, do not require a constant water supply. Instead, a man-made fluid is circulated through a piping system to absorb the heat at the target depth and is transported to the surface, where the heat energy is released as steam and spins a turbine. This causes the fluid to cool, after which it is recirculated through the piping system.[6] Supercritical Hot Rock (SHR) is another type of next-generation geothermal power system that is drilled to depths where temperatures exceed 375 degrees Celsius.[7] Water is injected into this environment, where it becomes so hot that it exhibits properties of both liquids and gases, allowing the superheated water to gather a large volume of heat energy. As a result of this critical state, the power density is several times higher when transmitted to the surface compared to more traditional methods.[8] SHR can incorporate EGS or AGS system technologies; the main difference is the operating temperature of these systems.[9]

Critical Minerals and Critical Materials

As required by the Energy Act of 2020, the Secretary of Energy assists the Secretary of the Interior in creating a list of critical minerals. The Secretary also maintains a critical materials list that specifically targets materials for energy technologies.[10] Critical minerals are defined as those commodities that are essential to the economic or national security of the United States, have a supply chain that is vulnerable to disruption, and serve an essential function in the manufacturing of a product, the absence of which would have significant consequences for the economic and national security of the U.S.[11] A critical material is defined as any non-fuel mineral, element, substance, or material that the Secretary of Energy determines has a high risk of supply chain disruption, serves an essential function in one or more energy technologies, including technologies that produce, transmit, store, and conserve energy, or a critical mineral as defined by the Secretary of the Interior.[12]

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[5] "Enhanced Geothermal Systems." *U.S. Department of Energy*, 2 Sept. 2022, www.energy.gov/hgeo/geothermal/enhanced-geothermal-systems.

[6] "Geothermal Power Production." *Geothermal Rising*, 26 May 2023, geothermal.org/resources/geothermal-power-production.

[7] *Id*.

[8] *Supra 5*.

[9] *Supra 6*.

[10] "What Are Critical Minerals and Materials?" *U.S. Department of Energy*, 16 Feb. 2024, www.energy.gov/cmm/what-are-critical-minerals-and-materials.

[11] "About the 2025 List of Critical Minerals." USGS, 6 Nov. 2025, www.usgs.gov/programs/mineral-resources-program/science/about-2025-list-critical-minerals.

[12] *Supra 10*.

The list of critical minerals is required to be updated every three years, with the most recent update occurring last year. In the 2025 List of Critical Minerals assembled by the United States Geological Service (USGS), 60 total critical minerals were identified, with 10 new minerals added to the list. While some minerals, like the 15 rare earth elements on the list, are often highlighted for their critical role, the list also includes minerals that are just as important but are not often considered critical, such as aluminum, copper, nickel, silver, and tin.[13]

The United States was once a leader in the mining and refining of rare earth elements. Rare earths are a set of 17 metallic elements that have unusual fluorescent, conductive, and magnetic properties.[14] However, these elements are not rare; they are just rarely found in significant deposits alone to make them economically viable.[15]

Competition with the Chinese Communist Party

While the Chinese Communist Party (CCP) leads the world in geothermal energy for direct heating and cooling (district heating), it dramatically lags the rest of the world in generating electricity from this energy source.[16] Geothermal energy, unlike solar and wind energy, does not receive the same level of support from the CCP. Recent laws, such as the 2020 Resource Tax Law, reclassify geothermal energy as an energy mineral, subjecting it to higher tax rates.[17] The CCP's 15th Five-Year Plan, adopted earlier this year, continued the trend with a lack of concrete initiatives in geothermal energy compared to wind and solar.[18]

The CCP's state-owned chemical company Sinopec has a joint venture with Iceland's Arctic Green Energy to continue its district heating and cooling build-out. This partnership is also reported to have facilitated the transfer of advanced technology and expertise in areas such as drilling and reservoir modeling, enabling the CCP to rapidly scale up district heating and become the world leader. With the "Unnamed Record-Breaking Deep Well," the CCP has shown it continues to advance in drilling technology, which is critical for next-generation geothermal energy production.[19]

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[13] *Supra 10*.

[14] "History and Future of Rare Earth Elements." *Science History Institute*, 28 Jan. 2026, www.sciencehistory.org/education/classroom-activities/role-playing-games/case-of-rare-earth-elements/history-future/.

[15] Hsu, Jeremy. "Don't Panic About Rare Earth Elements." *Scientific American*, 20 Feb. 2024, www.scientificamerican.com/article/dont-panic-about-rare-earth-elements/.

[16] "Geothermal Energy Database." *International Geothermal Association*, 26 Nov. 2024, worldgeothermal.org/geothermal-data/geothermal-energy-database.

[17] Ottinger, Lily. "Why Geothermal Failed in China." ChinaTalk, 31 Mar. 2026, www.chinatalk.media/p/why-geothermal-failed-in-china.

[18] *Id*.

[19] Eren, Erhan. "China's Top 10 Geothermal Projects for 2025." *EnkiAI*, 8 Apr. 2026, enkiai.com/geothermal/chinas-top-10-geothermal-projects-for-2025.

During the 1980s and 1990s, the CCP made an economic pivot, which resulted in much of the world becoming reliant on a single country for multiple critical minerals. During this time, producers in the U.S., long the world leader in rare-earth production, began struggling to remain profitable. The CCP was subsidizing the development and capability of its rare earth elements production. As a result, within just a couple of decades, the CCP controlled nearly 70% of mining, 90% of processing, and 94% of magnet production.[20]

In the decades since offshoring to the CCP, rare earths have become increasingly essential for numerous applications, including but not limited to permanent magnets, batteries, quantum computing, materials science, and medical applications. These applications are essential to the national security of the United States, and with the CCP establishing a chokepoint that ensures the world is dependent on them, the U.S. and allies have begun working together to break the CCP's grip.

Department of Energy Reorganization

In November 2025, the DOE announced a reorganization. As part of this reorganization, several new offices were established to streamline the Department and achieve the Administration's goals. New offices include the Hydrocarbons and Geothermal Energy Office and the Office of Critical Minerals and Energy Innovation.

Hydrocarbons and Geothermal Energy Office

The Hydrocarbons and Geothermal Energy Office (HGNO) was established to replace the Office of Fossil Energy and Carbon Management. Offices under HGNO include the Office of Operations, the Office of Strategic Resources, the National Energy Technology Laboratory (NETL), and the Office of Subsurface Energy (SSE). The Office of Subsurface Energy leads and supports the research, development, and demonstration of upstream, midstream, and downstream subsurface energy technologies.[21]

The Office of Subsurface Energy has four sub-program offices: the Office of Coal, which leads research, development, and demonstration (RD&D) in the American coal industry; the Office of Oil and Gas, which leads RD&D to ensure the resilience of the U.S. oil and natural gas production and infrastructure; the Office of Geothermal, which leads and supports RD&D to accelerate the discovery and development of gigawatt-scale geothermal energy and position geothermal as a competitive domestic source for reliable baseload energy; and the Office of Analysis, which provides technical, economic, and market analysis to support the departmental and programmatic priorities and decision-making on key issues that impact subsurface energy RD&D.[22]

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[20] Kim, Tae-Yoon, et al. "With New Export Controls on Critical Minerals, Supply Concentration Risks Become Reality." *IEA*, 23 Oct. 2025, www.iea.org/commentaries/with-new-export-controls-on-critical-minerals-supply-concentration-risks-become-reality.

[21] "About The Hydrocarbons and Geothermal Energy Office." *U.S. Department of Energy*, 1 Apr. 2026, www.energy.gov/hgeo/about-hydrocarbons-and-geothermal-energy-office.

[22] "Office of Subsurface Energy." *U.S. Department of Energy*, 31 Mar. 2026, www.energy.gov/hgeo/office-subsurface-energy.

Office of Critical Minerals and Energy Innovation

The Office of Critical Minerals and Energy Innovation (CMEI) was established during the November reorganization.[23] This office includes program activity from the Office of Energy Efficiency and Renewable Energy (EERE), the Office of Manufacturing and Energy Supply Chains (MESC), the Office of Clean Energy Demonstrations (OCED), the Office of State and Community Energy Program (SCEP), and the Office of Federal Energy Management Program (FEMP), as well as the Mineral Production and Processing Technologies program from the former Office of Fossil Energy and Carbon Management (FECM).[24] CMEI's goal is to advance America's critical mineral supply chains and accelerate the development of next-generation energy technologies to strengthen the nation's energy security.[25]

To accomplish these efforts, the office is divided into three suboffices: the Office of Critical Minerals, Materials, and Manufacturing, the Office of Energy Technology, and the Office of Innovation, Affordability, and Consumer Choice.[26] The Office of Critical Minerals, Materials, and Manufacturing focuses on accelerating mining activities, diversifying supply chains for critical minerals and metals, battery and magnet R&D, processing and metallurgy, and recycling of black mass, battery materials, and other critical minerals. The Office of Energy Technology continues research and development on cutting-edge energy technologies, fuels, chemicals, and hydropower, and drives the commercialization and deployment of these technologies to enhance energy networks across the U.S. and reduce energy costs for ratepayers. The Office of Innovation, Affordability, and Consumer Choice will oversee DOE's appliance standards and building codes authorities, manage multiple state and community energy and weatherization programs, and promote innovation and the adoption of new and beneficial technologies for building and industrial applications.[27]

Presidential Budget Request

The budget request for the Geothermal Technologies Office in Fiscal Year (FY) 2027 is $150 million. In FY 2026, the enacted level was $150 million, maintaining funding at current levels but down from the FY 2025 level of $487.909 million. Though DOE does not have a single specific office dedicated exclusively to critical minerals, several offices support the effort. In the FY 2027 budget request, approximately $408 million is requested to cover this space. In FY 2026, the enacted level was approximately $83, and in FY 2025, approximately $126 million.[28]

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[23] "Energy Department Announces Organizational Realignment to Strengthen Efficiency and Unleash American Energy." *U.S. Department of Energy*, 20 Nov. 2025, www.energy.gov/articles/energy-department-announces-organizational-realignment-strengthen-efficiency-and-unleash.

[24] "Critical Minerals and Energy Innovations." *U.S. Department of Energy*, 4 Apr. 2026, https://www.energy.gov/documents/doe-fy-2027-volume-2-cmei.

[25] "Office of Critical Minerals and Energy Innovation." *U.S. Department of Energy*, 7 Apr. 2026, www.energy.gov/cmei/office-critical-minerals-and-energy-innovation.

[26] "Energy Department Announces Realignment of Critical Minerals and Energy Innovation Programs." *U.S. Department of Energy*, 28 Jan. 2026, www.energy.gov/cmei/articles/energy-department-announces-realignment-critical-minerals-and-energy-innovation.

[27] *Id.*

[28] "DOE FY 2027 Budget in Brief." *U.S. Department of Energy*, 3 Apr. 2026, www.energy.gov/documents/doe-fy-2027-budget-brief.

DOE Activities

Within the Department of Energy, the Frontier Observatory for Research in Geothermal Energy (FORGE) program has played a critical role in next-generation geothermal energy development. FORGE focuses on research and development for Enhanced Geothermal Systems (EGS) technology, including innovative drilling techniques, flow testing, and related efforts to better initiate and sustain fracture networks in basement rock formations.[29] Achievements at this site include a sevenfold decrease in on-bottom drilling time using physics-based drilling approaches developed in the oil and gas industry, as well as the successful creation of a geothermal reservoir from scratch.[30]

Directed by the Infrastructure Investment and Jobs Act (IIJA), DOE established the Enhanced Geothermal Systems (EGS) Pilot Demonstrations project.[31] As part of this demonstration, three projects were selected to demonstrate EGS in a variety of geographic locations, geologic formations, and subsurface conditions. In February 2024, the first round of awardees were selected and covered research and development topics such as using innovative drilling and stimulation techniques to access geothermal energy near an existing geothermal field, producing at least 8 megawatts of power from each of three wells at a site with no existing commercial geothermal power production, and demonstrating super-hot EGS on the western flank of Newberry Volcano in Oregon.[32]

The Department has also been active in addressing the U.S. dependence on the CCP for critical minerals by working to reestablish a domestic supply chain. In 2025, the DOE, through its Office of Fossil Energy, now the Office of Critical Minerals and Energy Innovation, established the Mine of the Future initiative to accelerate next-generation mining technologies and to help secure critical mineral and material supply chains.[33] Within the initiative, two programs are being stood up. The first is the Mining Technology Proving Grounds. This will help establish field sites for real-world testing, optimization, and deployment of the developed technologies, as well as train the next generation of skilled American miners. The second is federal funding for the National Laboratories to conduct critical research, development, and demonstration activities to advance and strengthen our domestic critical mineral supply chain.

[29] "FORGE." *U.S. Department of Energy*, 11 Apr. 2023, www.energy.gov/hgeo/geothermal/forge.
[30] *Id.*
[31] "Enhanced Geothermal Systems Demonstration Projects." *U.S. Department of Energy*, 25 Feb. 2026, www.energy.gov/hgeo/geothermal/enhanced-geothermal-systems-demonstration-projects.
[32] "Enhanced Geothermal Systems (EGS) Pilot Demonstrations." *U.S. Department of Energy*, 25 Feb. 2026, www.energy.gov/hgeo/geothermal/enhanced-geothermal-systems-egs-pilot-demonstrations.
[33] "U.S. Department of Energy Launches Mine of the Future Initiatives to Bolster the U.S. Mining Industry." *U.S. Department of Energy*, 26 Sept. 2025, www.energy.gov/hgeo/articles/us-department-energy-launches-mine-future-initiatives-bolster-us-mining-industry.

Last year, DOE, through the Office of Technology Commercialization, announced the National Laboratories had developed several technologies to extract critical minerals and rare earth elements from coal byproducts such as ash and slag. These innovations were made available through the Lab Partnering Service and were technologies that companies could further develop, refine, and scale.[34] These methods covered an array of processes but, importantly, introduced a new way to generate revenue from materials typically discarded and treated as waste.

On March 13, 2026, CMEI announced a Notice of Funding Opportunity for up to $500 million to expand U.S. critical mineral and material processing and derivative battery manufacturing and recycling.[35] This NOFO aims to increase U.S. processing capacity from raw feedstocks and to increase the recovery of battery-critical minerals through recycling of manufacturing scrap or end-of-life batteries.

[34] "A New Chapter for Coal: Commercialization Opportunities from DOE Labs." *U.S. Department of Energy*, 16 July 2025, www.energy.gov/technologycommercialization/articles/new-chapter-coal-commercialization-opportunities-doe-labs.

[35] "Energy Department Announces $500 Million to Strengthen Domestic Critical Materials Processing and Manufacturing." *U.S. Department of Energy*, 13 Mar. 2026, www.energy.gov/articles/energy-department-announces-500-million-strengthen-domestic-critical-materials-processing.