# Geothermal Energy Has Growing Potential In The US

By **Steven Lorch, Humzah Yazdani and Irina Tsveklova** (May 20, 2024)

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Geothermal energy is bringing the heat to the low-carbon energy mix. As the U.S. looks to reduce its carbon footprint, the viability of geothermal energy appears to be attracting attention from members of Congress who have sought to ease certain restrictions on geothermal development under the National Environmental Policy Act, or NEPA.

This recent bipartisan action, together with government incentives, technological advancements and support from a diverse set of energy industry participants — from Chevron to Google — are generating tailwinds for the geothermal industry's expansion in the U.S.

**Benefits of Geothermal Energy and Its Potential**

One of the key benefits of geothermal energy is that its generation produces minimal life cycle greenhouse gas emissions — approximately 10% of that of natural gas plants and 4% of coal plant emissions.

No combustion, i.e., burning of fuel, is involved in the operation of a geothermal power plant, so the amount of greenhouse gas emissions — including sulfur dioxide and carbon dioxide — that is released during geothermal power generation is significantly lower when compared to fossil fuel power plants. In fact, some next-generation geothermal technologies release essentially zero emissions.

Geothermal power is also "firm," meaning it can provide consistent baseload power — i.e., it is always on and does not require energy storage to operate — with geothermal facilities averaging over 90% capacity factors, compared to approximately 25% for solar and 35% for wind.

In addition, a Princeton University-led study published in January[1] found that there is also significant value to the grid in operating new geothermal plants flexibly, i.e., using the enhanced geothermal reservoirs as energy storage that can generate power as and when necessary. This flexibility can pair well with the growing intermittent energy resources on the grid.

Remarkably, although the U.S. has the highest installed geothermal power generation capacity in the world, it only accounts for 0.4%, or 3.7 gigawatts[2] of the domestic electricity generation.

Geothermal's potential, however, is significant.

The U.S. Department of Energy estimates that 5.5 terawatts[3] of geothermal energy may be accessible for next-generation geothermal projects, and by 2050, it might account for over 10% of U.S. energy capacity.

**Recent Legislative Action**

One of the challenges for geothermal development are permitting timelines and the need for federal and state regulatory alignment and support.

The U.S. House Energy and Commerce Committee approved a bipartisan bill[4] earlier this year, that, if enacted, could have a significant effect on the geothermal industry.[5]

Many geothermal projects are ordinarily subject to NEPA because of either being situated on public land or subjected to federal decisions on approvals, permits or funding required for the project.[6] The average time to complete the NEPA process across all energy types is three years,[7] with geothermal taking anywhere between a few months to several years to complete, depending on the specific facts of the project.

The bill aims to amend the Energy Policy Act of 2005 by allowing for a new categorical exclusion for geothermal drilling under NEPA in situations where (1) drilling previously has occurred in the prior five years or (2) will occur in an area for which an approved environmental document or evaluation, that considered drilling, was completed pursuant to NEPA within the last five years.

This exclusion would put geothermal development on par with oil and gas, which already enjoys a categorical exclusion from the stringent NEPA regulations, by fast-tracking permitting of geothermal projects.

**Government Incentives**

Development of geothermal projects requires large upfront capital that, in addition to permitting challenges, represents a significant headwind for the geothermal industry. Government incentives therefore play an important role in encouraging and financing geothermal development.

If the bipartisan NEPA amendment, or a similar bill reducing permitting requirements for geothermal, passes Congress, it will be the latest geothermal win in a series of recent federal legislative efforts to rejuvenate the industry. These efforts have included the Bipartisan Infrastructure Law allocating $84 million for geothermal research and development, and the Inflation Reduction Act, which entitles geothermal developers to significant incentives in the form of federal income tax credits.

Under the IRA, a project owner can claim an investment tax credit or a production tax credit in connection with a qualifying geothermal project. The investment tax credit provides a base credit equal to 30% of eligible investment in a geothermal project.

Alternatively, developers may opt for the production tax credit, which equals $27.50, adjusted for inflation, for each megawatt hour of electricity generated during a geothermal power plant's first 10 years of operation.

Considering bonus credits, which are available for projects located in energy communities and/or produced with specified amounts of U.S.-derived components and materials, investment tax credit rates can reach 50% and current production tax credit rates can reach $33, adjusted for inflation, per MW hour.[8]

These tax credits, along with the value of a project's federal income tax depreciation, can provide an important financing tool. Energy transition tax credits are available as a dollar-

for-dollar offset of the project owner's federal income tax liability, in which case the credits provide access to capital in the form of reduced cash tax obligations.

However, the typical geothermal developer — particularly developers in startup posture — do not have sufficient tax liability to absorb the tax credits and depreciation generated by their projects. In this case, developers can seek capital investment from a tax equity investor and utilize the tax credits and depreciation as currency to pay the investor's preferred economic return or, since the enactment of the IRA, sell the tax credits for cash.

It is important to note that geothermal projects that begin construction during or after 2025 — as determined for federal income tax purposes — are subject to a significant limitation. These projects will only be eligible for the investment tax credit under Section 48E or the production tax credit under Section 45Y,[9] which credits are generally available for electricity produced by any generation technology, so long as the anticipated life cycle greenhouse gas emissions rate for the project does not exceed zero.

Although certain next-generation geothermal technologies, such as closed loop geothermal systems, have been observed to generate zero greenhouse gas emissions, based on the statutory language of the IRA, a geothermal project for which even a modicum of greenhouse gas emissions is anticipated would not be eligible for these credits.[10]

Geothermal developers could turn to carbon capture and storage technology to reduce the greenhouse gas emissions during the geothermal electricity production. However, if attributable to the same facility, neither the investment tax credit under Section 48E nor the production tax credit under Section 45Y can be stacked with the credit for carbon capture and storage under Section 45Q.

So at present, it appears that geothermal projects beginning construction during or after 2025 that require carbon capture and storage technology to reduce the greenhouse gas emissions rate will have to opt for the investment tax credit or production tax credit, on the one hand, or the Section 45Q credit, on the other hand, but not both, which could affect the economic viability of these projects.

By contrast, geothermal projects that begin construction before 2025 are eligible to claim the investment tax credit or production tax credit regardless of a project's greenhouse gas emissions rate, which should give geothermal sponsors and developers significant incentive to accelerate construction schedules into 2024.

The U.S. Department of the Treasury and the IRS have not provided guidance on the investment tax credit under Section 48E or the production tax credit under Section 45Y, the anti-stacking rule with Section 45Q, or the opportunity to reduce greenhouse gas emissions with carbon capture and storage technology for geothermal projects. This guidance is eagerly awaited by the geothermal community and will have a significant effect on the development of geothermal projects in the near future.

**Advances in Technology**

Traditionally, the location of geothermal power plants was geographically restricted based on the presence of specific subsurface conditions, including rock type, porosity and the presence of water.

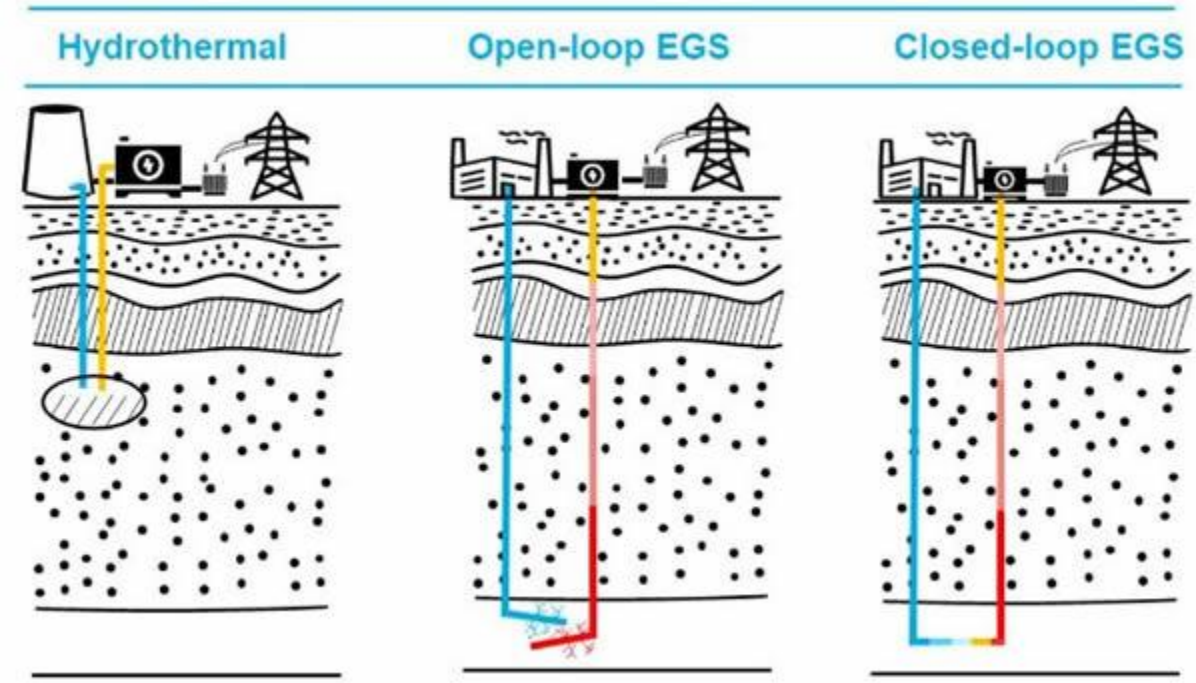
Next-generation geothermal technologies like enhanced geothermal systems and closed loop geothermal systems, sometimes referred to as "hot dry rock" systems, have expanded

availability of geothermal energy by lifting some of these geographic restrictions. Geothermal power generation can now be built in many locations and therefore become scalable, which is necessary if geothermal were to provide over 10% of U.S. energy capacity by 2050.

The conventional geothermal technology involves extracting hot water or steam from hot springs or geysers through naturally occurring fractures in hot rock to drive turbines and generate power, i.e., conventional development was confined to areas where underground heat is easily accessible.

By contrast, next-generation geothermal technology allows developers to drill down to 12,000 feet vertically and expand horizontally by utilizing directional drilling, and in the case of enhanced geothermal systems, hydraulic fracturing techniques, honed by the oil and gas industry. Cold fluid is then pumped underground, heated up by Earth's temperature and brought back to the surface where it is used to produce electricity.

***Figure 1: Geothermal Energy Production Technologies***




*Source: U.S. DOE Pathways to Commercial Liftoff: Next-Generation Geothermal Power[11]*

Sophisticated drilling and engineering expertise is required to develop next-generation geothermal energy. This makes geothermal a good case for bipartisan collaboration, given that this decarbonizing resource relies on the know-how and experience of traditional oil and gas companies, including oilfield services providers as well as power and renewables developers.

As an example, Houston-based geothermal startup Fervo Energy has raised over $400 million since it was founded in 2017 from a wide range of investors, including Devon Energy, Mitsubishi Heavy Industries, SLB, Galvanize Climate Solutions and Breakthrough Energy Ventures.

In 2021, Fervo Energy partnered with Google to develop Fervo Energy's first full-scale enhanced geothermal systems commercial pilot to power the local grid that services Google's data centers in Nevada.[12] This pilot was the first geothermal project to drill a horizontal pair of bores that stretches approximately 3,250 feet, or 990 meters, laterally.

Last year, Fervo Energy broke ground on a 400 MW next-generation geothermal project in Utah, which is scheduled to begin delivering power to the grid in 2026 and reach full production in 2028.

**Conclusion**

Geothermal energy can be an elegant solution toward global decarbonization efforts: It has a small footprint and low supply chain risk, and can draw on the skills of existing highly specialized oil and gas workers and power and renewables specialists. It is no surprise that the industry enjoys bipartisan support.

Geothermal power generation is nonetheless still nascent, and in order to thrive it will need regulatory action, significant financial investment, predictable government incentives, as well as support from utilities, commercial and industrial customers, and other large corporations that drive demand for low-carbon power.

The industry will also need to successfully navigate macro market conditions such as high interest rates and cost of capital and interconnection queues.

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[1] https://engineering.princeton.edu/news/2024/02/16/flexible-geothermal-power-approach-combines-clean-energy-built-battery.

[2] https://www.eia.gov/energyexplained/geothermal/use-of-geothermal-energy.php.

[3] https://liftoff.energy.gov/wp-content/uploads/2024/03/LIFTOFF_DOE_NextGen_Geothermal_v14.pdf.

[4] https://steel.house.gov/media/press-releases/committee-passes-bipartisan-boost-geothermal-energy-production.

[5] A similar bipartisan bill, S.3954 – the Geothermal Energy Optimization Act, has been introduced in the Senate and referred to the Senate Committee on Energy and Natural Resources: https://www.congress.gov/bill/118th-congress/senate-bill/3954?s=2&r=12.

[6] NEPA, which was signed into law on January 1, 1970, requires federal agencies to

assess the environmental effects of their proposed actions prior to making decisions. Using the NEPA process, agencies evaluate the environmental and related social and economic effects of their proposed actions. Agencies also provide opportunities for public review and comment on those evaluations.

[7] https://www.thecgo.org/research/nepa-timelines-for-clean-energy-projects-understanding-delays-in-clean-energy-development/.

[8] The credit rates described here generally are available for projects that satisfy certain requirements relating to the payment of prevailing wages to laborers and mechanics and the use of apprentices, in each case, during the construction, alteration, or repair of the project.

[9] All "Section" references are intended to refer to sections of the Internal Revenue Code of 1986, as amended.

[10] The geothermal industry has taken note of this issue. In comment letters relating to Section 45Y and Section 48E, one commenter requested that all geothermal projects be deemed to have an anticipated GHG emissions rate of zero. Another requested that geothermal projects be subject to a de minimis rule such that projects with GHG emissions below a certain threshold would be deemed to have a GHG emissions rate of not greater than zero for purposes of Section 45Y and 48E.

[11] https://liftoff.energy.gov/wp-content/uploads/2024/03/LIFTOFF_DOE_NextGen_Geothermal_v14.pdf.

[12] https://blog.google/outreach-initiatives/sustainability/google-fervo-geothermal-energy-partnership/.