THIRD WAY

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Status Report: America's Competitive Advantage in Geothermal Energy

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Geothermal energy—heat energy that is extracted from the earth—is a reliable, baseload energy source that provides critical support for intermittent sources like wind and solar. By providing continuous energy when other clean sources cannot, geothermal energy can help guarantee a steady flow of 100% clean energy at all times.

Geothermal can also help cut emissions in some hard-to-decarbonize sectors, like heavy industry, by producing clean heat—a feature that most renewables like wind and solar cannot offer. Additionally, producing geothermal energy generates lithium as a by-product–a critical component for energy storage and electric vehicle batteries. By helping produce lithium domestically, geothermal energy enables greater adoption of clean energy technologies and further strengthens our domestic supply chains.

The worldwide technical potential of geothermal energy is staggering—ranging from 200 to 5,000 GW. [1] But actually taking advantage of the Earth's capacity to generate geothermal energy will be challenging. Geothermal projects face longer development timelines, higher upfront capital costs, and significant early-phase risks compared to other clean energy technologies. Overcoming these hurdles is critical for any country hoping to claim a substantial share of a $1.5 trillion global export market by mid-century.

US firms are uniquely positioned to capitalize on this growing geothermal market. With substantial federal investments accelerating the commercialization of geothermal systems, US companies are poised to boost their competitiveness and lead the industry. Leveraging this momentum will help the US lead the global geothermal sector. This memo highlights the critical federal policies helping the US build its edge in the growing geothermal industry.

How Federal Investments are Boosting America's Geothermal Industry

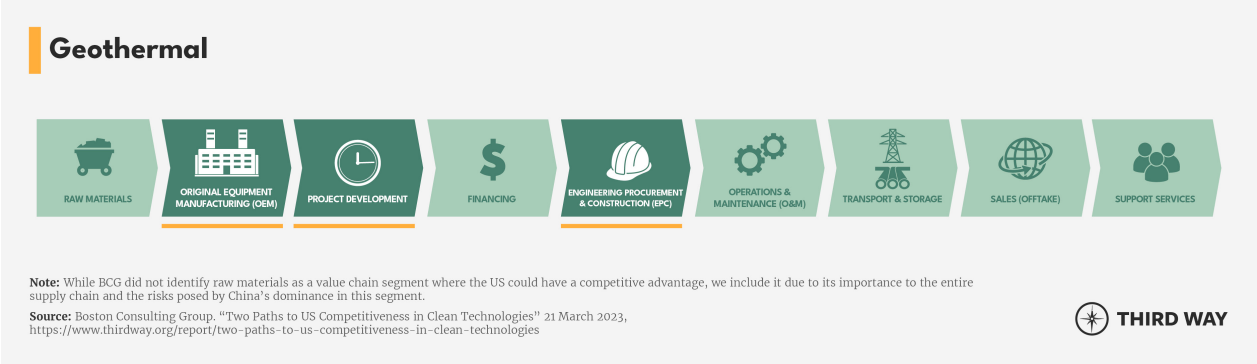
Geothermal technologies emerged in the US over a century ago, but progress stalled in recent decades due to high costs, significant risks, a shortage of experts, and lack of federal interest. [2] Now, landmark provisions in the Bipartisan Infrastructure Law (BIL), CHIPS and Science Act, Inflation Reduction Act (IRA), and Energy Act of 2020 are breathing new life into the American geothermal industry. By reducing financial and operational risk, these laws are providing the necessary stability and support that the private sector needs to plan and invest with confidence.

These incentives and programs, which are designed to be distributed over several years, will provide long-term stability, strengthen America's supply chain dominance, and help the US secure its position as a leader in the global geothermal industry. Some of the most impactful federal incentives include:

- $84 million to support enhanced geothermal systems pilot demonstration projects; [3]
- $51 billion in Production Tax Credits to support production of clean electricity from qualifying sources like geothermal energy; [4]
- Over $60 billion in Investment Tax Credits to incentivize investment in clean energy projects including geothermal; [5] and
- $10 billion in Manufacturing Tax Credits to support re-equipping, expanding, or establishing manufacturing facilities for the production geothermal and other clean energy equipment. [6]

These federal investments will be distributed over the next decade and will continue to pay dividends long after. And based on our analysis of Rhodium Group and MIT CEEPR's Clean Investment Monitor, it's clear that these policies are already working. Public and private investment in geothermal technologies in just the past three years has reach over $1.8 billion. [7]

Road to Victory: Building on US Leadership in Geothermal Technologies



After decades of slow growth, the American geothermal industry is finally gaining momentum. The US is well-positioned to compete in this industry by leveraging our existing advantages. We're firmly in the race—but our lead is far from guaranteed. Countries like New Zealand, Indonesia, Turkey, and Kenya are rapidly innovating and investing, eager to capitalize on the same opportunities the US is.

Third Way's landmark analysis, in partnership with Breakthrough Energy and Boston Consulting Group, found that there are three segments of the geothermal value chain where the US should make the most effort to build or maintain its advantage. These segments were identified based on their market size and the potential for American leadership—and we're already seeing significant progress in these key areas. Let's break this down:

Original Equipment Manufacturing

The US holds a distinct advantage in manufacturing and assembling geothermal technology components, like turbines, drilling equipment, piping, mineral extraction rigs, and heat-resistant downhole equipment. Although the US lags behind China, Japan, and South Korea in terms of patent activity, we rank second in research publications and lead in emerging technologies like binary turbines, deep drilling equipment, and heat-resistant downhole materials. As the global market shifts from mature technologies to emerging ones, the US has the opportunity to seize leadership in this segment—securing a major portion of a $175 billion global market and create nearly 5,000 jobs through 2050. Here's how we're already racking in wins in this segment:

- **Awarding American Ingenuity:** The Department of Energy awarded $500,000 in cash and up to $200,000 in vouchers to winners of the American-Made Geothermal Manufacturing Prize, aimed at addressing challenges in operating sensitive equipment in harsh geothermal environments. Team Downhole Emerging Technologies, for instance, developed a new packer system for high temperatures and pressures, and Team Ultra-High Temperature Logging Tool developed technology to extend the lifespan of electronics in extreme conditions. These innovations in additive manufacturing support the identification of high-performance materials, creation of complex components, and rapid prototype development, leading to swift advances in US geothermal manufacturing. These investments are paving the way for next-generation geothermal technologies made in America, reinforcing our global leadership.

- **Building on Innovation:** The Biden Administration is investing $44 million in 13 projects aimed at developing new technologies to reduce the cost of drilling and creating geothermal wells. These research projects will build on existing research conducted by the Department of Energy's Frontier Observatory for Research in Geothermal Energy (FORGE) field laboratory in Utah. While the US currently lags behind China and other East Asian countries in intellectual property generation, this investment in innovation is closing that gap. By fostering new technologies developed and manufactured in the US, we are positioning ourselves to lead globally and export these advanced solutions around the world.

Project Development

Exploration and drilling for geothermal energy involve challenging and expensive processes like geological mapping, geochemical analysis, and geophysical techniques, requiring advanced capabilities and technology. Given the complexity, risk, and capital costs, developers with proven track records and economies of scale can dominate this segment. The US—with experience in drilling and exploration from the oil and gas industry—holds a distinct advantage here. By leveraging our existing experience in managing complex exploration and drilling processes, and continuing to build on them, the US can capture a significant portion of a $460 billion market and create over 8,500 jobs annually through 2050. Here's how we're already stacking wins in this segment:

- **Pioneering Expertise:** Houston-based startup Fervo Energy successfully used lateral drilling—a technique developed by the oil and gas industry—to establish an enhanced geothermal well supplying clean, firm electricity to Nevada. This project, financed by Google, highlights how innovations like lateral drilling and expertise from the oil and gas sector can make geothermal feasible in more parts of the country, giving American geothermal companies a competitive edge in developing these new technologies.

- **Streamlining Permitting Processes:** Permitting and regulations can add years to geothermal project timelines, increasing risks and financing costs. [8] The Bureau of Land Management is working to cut through this red tape by adopting a categorical exclusion for geothermal exploratory drilling on public lands. This will shorten the timeline for environmental review and make projects more economically viable. More project development means more US geothermal companies can expand their expertise, boosting our competitive advantage on the world stage.

- **Developing Innovative Solutions:** Two projects in Utah have successfully created geothermal reservoirs from scratch. The Department of Energy's Frontier Observatory for Research in Geothermal Energy (FORGE) used stimulation activities to enable water to move through non-porous hot granite. Nearby, Fervo Energy discovered that the process produced enough heat for electricity generation, reducing drilling times by 70% and cutting costs nearly in half. These projects demonstrate the potential to harness geothermal energy in previously untappable areas, giving American companies a leading edge in these technologies.

- **Showcasing American Ingenuity:** Geothermal startup Sage Geosystems used novel fracturing technology to create an underground reservoir at the site of an abandoned gas exploration well in South Texas, capable of storing water at high pressure for later electricity generation. This "earthen battery" can provide dispatchable power to balance the grid. Following successful pilot tests, Sage is now building a first-of-its-kind utility-scale geothermal storage project, which will provide enough electricity to power 600 homes during peak demand.

- **Flexing our Development Muscles:** The Bureau of Land Management held a competitive geothermal lease sale in November 2023, where eight geothermal companies won a total of 33 parcels of land. More lease sales like this will create opportunities to develop projects on public land, allowing American companies to continue developing expertise and building a competitive advantage.

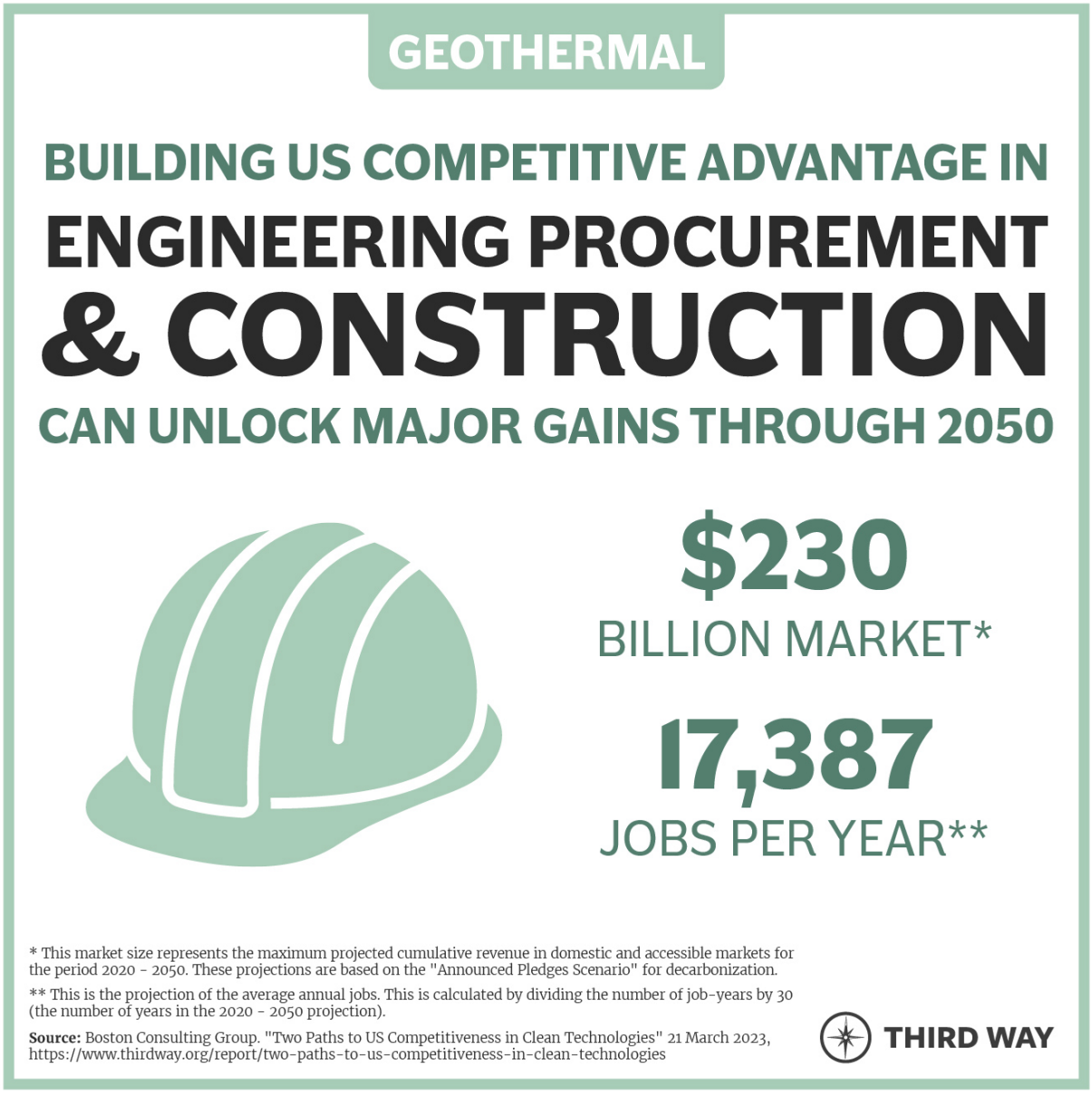
Engineering, Procurement, and Construction

Construction of large facilities for geothermal activities is complex, requiring custom-designs and site-specific engineering to meet the unique geologic and technologic features of each project, as well as the integration with electrical systems. As such, high-quality engineering is essential and provides firms with a distinct competitive edge. The US is well-positioned to lead in this segment, leveraging its mature domestic market and extensive experience with hybrid plants. By cultivating and building on these existing strengths, the US can establish a leadership position in the global geothermal industry, capturing the majority of a $230 billion market and creating over 17,000 jobs a year through 2050 in the process.

- **Building an American Workforce:** The Department of Energy and the National Science Foundation have launched the first cohort of geothermal interns who will work with geothermal companies, national labs, and state agencies to advance geothermal technologies. This federal program provides graduate students with in-the-field experience, training the next generation of engineers, geologists, and project developers, and ensuring a skilled workforce to sustain US leadership in the geothermal industry.

- **Building Foundation for Innovation:** Controlled Thermal Resources Holdings (CTR) has broken ground on an integrated geothermal power plant and lithium production facility at the Salton Sea in California, which the Department of Energy recently confirmed is one of the largest lithium brine resources in the world. The first of seven project stages, CTR is actively expanding a "Lithium Valley Campus" to ultimately provide clean baseload power and clean lithium to co-located battery material manufacturers, onshoring and reducing emissions in the battery supply chain.

- **Leveraging Government Procurement:** Two Department of Defense installations—the US Military Academy at West Point in New York and the US Army Garrison Detroit Arsenal in Michigan—will be the first federal sites to receive technical assistance under the Federal Geothermal Partnerships (FedGeo) initiative. The Department of Energy will provide resource characterization, site surveys, and geothermal system design, helping the DoD assess geothermal potential at these locations. As the nation's largest energy user, the federal government's commitment provides new opportunities for EPC firms and project developers, enhancing US geothermal expertise and reducing costs.



Other Value Chain Segments

Broadly, the US has achieved significant progress in the geothermal energy sector. Here are some standout projects:

- **Expanding Partnerships:** The Department of Defense is furthering its commitment to geothermal energy by inviting Fervo Energy, GreenFire Energy, and Sage Geosystems to explore new geothermal technologies at military installations in Nevada, California, and Texas. Military procurement offers new opportunities for American firms to develop geothermal expertise, building a durable competitive advantage and demonstrating US leadership in innovative geothermal solutions.

- **Pioneering Analysis:** The Department of Energy released groundbreaking analysis quantifying the potential of enhanced geothermal systems (EGS) as a widespread clean energy option. Conducted by the National Renewable Energy Laboratory (NREL), the Enhanced Geothermal Shot Analysis found that significantly expanding EGS deployment by cutting costs 90% to $45 per megawatt-hour by 2035 is ambitious *but* achievable given technological advances. This new Earthshot initiative elevates decades of research, development, and demonstration efforts, including DOE's flagship EGS research at the Frontier Observatory for Geothermal Energy Research (FORGE) in Utah, showcasing US commitment to geothermal innovation.

- **Driving Economic Viability:** The Department of Energy has opened funding opportunities for enhanced geothermal systems (EGS) demonstrations, as authorized by the Bipartisan Infrastructure Law. Through these funding initiatives, DOE is supporting competitively selected pilot projects that collectively demonstrate EGS in wide range of geologic settings, using a variety of development techniques and well orientations. By advancing the economic viability of EGS—while improving technologies and gaining a deeper understanding of subsurface geologic qualities and permeability—the US is positioning itself at the forefront of geothermal advancements and securing its leadership in this critical energy sector.

So, What's Next?

By acting as a firm and reliable power source that complements the intermittency of clean sources like wind and solar, geothermal energy could play a pivotal role in our clean energy transition. The US currently holds a strong advantage across the geothermal value chain. But with other countries rapidly developing their own geothermal strategies, maintaining our competitive edge requires persistence, focus, and a commitment to leading development and deployment of this nascent technology.

TOPICS

COMPETITIVENESS AND COMMERCIAL DIPLOMACY 30

ENDNOTES

1. IRENA and IGA (2023), Global geothermal market and technology assessment, International Renewable Energy Agency, Abu Dhabi; International Geothermal Association, The Hague. Accessed 12 July 2024.

2. Lund, John W., et al. "The United States of America direct utilization update 2019." *World Geothermal Congress 2020*. Vol. 1. 2020.

3. This includes $84 million to support geothermal energy projects, as enacted in the Energy Act of 2020 and reauthorized by Section 41007 of the Bipartisan Infrastructure Act.

4. This includes $51.062 billion in production tax credits under Section 45 of the Internal Revenue Code, extended and expanded by Section 13101 of the Inflation Reduction Act.

5. This includes $50.858 billion in tax credits for clean electricity generation as authorized through Section 13702 of the Inflation Reduction Act and $13.962 in tax credits for certain energy property, including geothermal heat pumps, as extended and modified by Section 13102 of the Inflation Reduction Act.

6. This includes $10 billion in tax credits allocated for qualifying investments in clean energy projects, as authorized by Section 48C of the Internal Revenue Code and extended by Section 13501 of the Inflation Reduction Act.

7. Sourced from Rhodium Group/MIT-CEEPR Clean Investment Monitor data spanning from Q1 2021 to Q1 2024.

8. Finger, John Travis, and Douglas A. Blankenship. *Handbook of best practices for geothermal drilling*. No. SAND2011-6478. Sandia National Lab.(SNL-NM), Albuquerque, NM (United States), 2012.