Next-Generation Geothermal Power

Pathway to Commercial Liftoff

Geothermal power technology has advanced significantly and is poised to become a key source of secure, domestic, decarbonized power for the U.S. "Next-generation" technologies greatly expand the available resource and commercial potential by leveraging advances in drilling and hydraulic fracturing techniques to create geothermal resources in more common geological environments. The industry can grow rapidly by leveraging existing oil and gas technology, supply chains, and workforces, and recent field-scale pilots indicate promising cost reductions crucial for widespread adoption. With favorable market conditions, commercial liftoff could be achieved by 2030.

Next-generation geothermal offers unique advantages: minimal workforce and supply chain risk, low land use, and flexible generation capability. It can be dispatched flexibly and could support variable renewables via emerging long-duration energy storage capabilities. The cost of decarbonizing the grid is substantially reduced by deploying firm resources like geothermal alongside variable resources, as they reduce the need to overbuild variable renewables capacity. To meet increased demand and build a decarbonized grid, modeling suggests the U.S. will need an additional 700-900 GW of firm capacity.

Conventional geothermal is cost-competitive but constrained by the need for specific geologic conditions, of which the U.S. has ~40 GW of total potential. Next-generation technologies are viable in a broader range of geologies and could expand geothermal potential to 5,500 GW nationwide, which – depending on factors like land availability, flexible power integration, and other emerging technologies – could drive over 300 GW of deployment by 2050.

Next-generation geothermal is also exhibiting significant technological and economic progress. Recent field demonstrations of enhanced geothermal systems (EGS), a specific next-generation technology approach, have cut estimated development costs by nearly 70%. Technical advancements could bring nationwide costs down to $60-70/MWh by 2030, offering profit margins of $10-30 per MWh at current prices. These reductions would put advanced geothermal on track to meet the DOE's target of $45/MWh by 2035. At the DOE's FORGE site, drilling speeds improved by over 500% in 3 years, and recent commercial well development costs dropped from $13 million to under $5 million per well.

To achieve commercial liftoff, next-generation geothermal developers must demonstrate market viability. A "validation suite" of successful projects in 5-10 different geologic settings would validate reduced technological and resource risks, highlighting market potential and unlocking early debt financing. Deploying 2-5 GW across 4-6 states, with an investment of $20-25 billion, would provide the necessary validation to reduce development risks in new locations.

Market Status

Metric	Value	2030 Target
Next-generation Geothermal Capacity Active & in Development Source: DOE 2024	~22 MW	2000 - 5000 MW
Number of States with Next-generation Geothermal Active & in Development Source: DOE 2024	4	7
LCOE ($/MWh) Source: Fervo Tech Day, NREL ATB 2024	$65 - $141/MWh	$60 - $70/MWh

Possible Near-term Actions

Challenges	Potential Solutions
High up-front costs & risks	• $5 billion in early development capital to finance a validation suite • Market signals, such as high-value PPAs • In-field testing and innovation • New financial products to reduce drilling costs, such as drilling insurance programs
Perceived & actual operability risk	• Strategic siting and data dissemination from 10+ early deployments to show sustained power production
Long & unpredictable development lifecycles	• Combining and streamlining of specific steps in permitting process, where authorized • Technology changes that allow streamlining • Centralization of expertise, where authorized
Existing business models undervaluing firm	• Planning policies that incentivize higher-cost, higher-value power • Flexible geothermal operations • New offtake models