Next-Generation Geothermal at Scale: A State Action Framework

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CLEAN AIR TASK FORCE

This report is part of a broader effort at Clean Air Task Force (CATF) to address technical and policy barriers to next-generation geothermal development.[1] CATF's Next-Generation Geothermal at Scale report series[2] maps the barriers that next-generation geothermal energy faces and the policy actions that U.S. states, the U.S. federal government, and other governments across the globe can take to remove those barriers. This report provides state-level policy recommendations.

Acknowledgements

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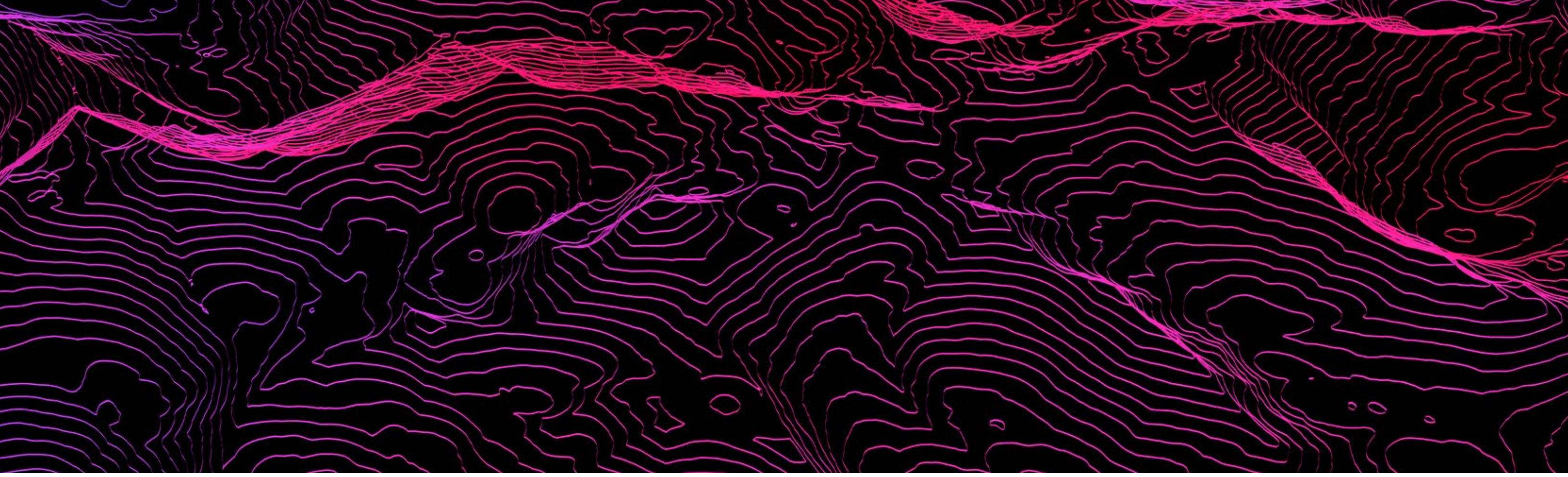
1 *See* Clean Air Task Force. (n.d.). Bridging the Gaps: A Survey of Methods, Challenges, and Pathways Forward for Superhot Rock Geothermal Energy. https://www.catf.us/superhot-rock/bridging-gaps/ *and* Clean Air Task Force. (n.d.). The Heat Beneath our Feet: Mapping the potential of superhot rock geothermal. https://www.catf.us/superhot-rock/heat-mapping/

2 *See* Clean Air Task Force. (n.d.). *Next-Generation Geothermal at Scale.* https://www.catf.us/resource/next-generation-geothermal-at-scale/



Executive Summary

Recent innovations are unlocking geothermal energy in regions where it was once thought impossible. Instead of searching for subterranean pockets of hot water, “next-generation geothermal” can produce power wherever subsurface rocks are hot. It has the potential to generate vast amounts of clean firm energy across the western U.S., which can support grid resilience, help meet projected growth in energy demand, and enable affordable decarbonization. Attracted by this promise, state policymakers in recent years have made dozens of policy changes across a wide range of topics related to geothermal energy. However, many of these actions – from funding programs that are too small to make a difference to regulatory updates that do not clarify the most important questions – have not yet translated into wide-scale deployment. More state-level policy work is needed to meaningfully advance geothermal energy, and the first states to complete that work will reap the benefits of this transformative new energy resource.

Next-generation geothermal technologies are poised to scale across the West, but states can do more to help the industry overcome challenges associated with early-stage financing and deployment. Developing early projects comes with higher costs and greater uncertainty, necessitating large amounts of capital. At the same time, the suppliers of such capital have a low appetite for risk. Detailed subsurface data, critical for derisking project development, is lacking in many regions. Uncertainty about transmission access and permitting timelines adds additional risk. With thoughtful and targeted policy, state governments can address these barriers, helping geothermal projects deploy and generating learnings that will reduce costs and risk for the whole industry.

Realizing next-generation geothermal’s full potential requires state action across five deployment levers: key areas that collectively represent the full spectrum of barriers to deployment. Targeted policy interventions in these areas will derisk development, attract private capital, and unlock geothermal energy in the states that take action.

1. Characterize: Mapping geothermal's subsurface resource potential is a crucial lever to lowering the cost and risk of projects in new regions. Collecting and sharing information about key subsurface characteristics – such as temperature at depth, the distribution and properties of rock formations, and the structure and connectivity of natural fracture networks – will derisk geothermal projects and crowd in private investment.

2. Govern: Establishing a regulatory system that works for industry and communities is necessary to ensure that geothermal can scale efficiently and safely. States can develop clearer and more predictable regulations for leasing and permitting all phases of a geothermal project. Also critical is clarifying ownership and definitions for geothermal, as well as improving coordination and communication among and between regulatory agencies.

3. Finance: Incentivizing exploration and demonstration through targeted funding programs will ensure that geothermal projects can deploy, attracting private investment and bringing costs down through iterative cycles of "learning-by-doing."

4. Connect: Developing supportive infrastructure is necessary for the geothermal industry to scale. States can improve access to transmission, facilitate the transition of oil and gas workers to the geothermal industry, ensure companies have access to robust supply chains for key materials, and educate the public about geothermal energy.

5. Innovate: Sustaining research and development (R&D) is necessary to help next-generation geothermal reach hotter temperatures and deeper depths, making it scalable and affordable in more locations. Targeted R&D and global coordination can advance superhot rock geothermal and ultra-deep drilling, helping create a world of terawatt-scale geothermal deployment.

While innovation is crucial to expand the geographic range of geothermal energy, there are many geothermal approaches that are already commercially viable and poised to scale today. State action is crucial to enable large-scale, near-term deployment of geothermal energy while simultaneously advancing innovation. Among the policy interventions outlined in this report, a few stand out as especially high impact:

- *Improving transmission access,* which would address the single largest barrier to deployment that geothermal projects currently face (recommendations 4A, 4D, and 4K)
- *Digitizing historical well logs* to expand subsurface knowledge (recommendation 1B)
- Derisking projects in new regions by *establishing procurement standards* and/or *milestone-based convertible loans* for geothermal energy (recommendations 3A and 3B)
- Improving permitting processes through *updated regulations and increased agency capacity* (recommendations 2R, 2S, and 2A)

Each of these policy recommendations is targeted to address the most important conditions that currently hamper geothermal development. Implementing these recommendations, as well as the rest of the recommendations laid out below,[3] will require information sharing and coordination among relevant stakeholders as well as funding for implementation by state agencies. Considering the energy and economic benefits of next-generation geothermal deployment, targeted state policy can lead to outsized benefits.

With thoughtful implementation, states can advance next-generation geothermal to its full potential – producing abundant clean firm energy, providing economic opportunities for workers and communities, and delivering affordable and reliable energy.

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[3] For a list of all policy recommendations in this report, *see* Appendix A: Policy Recommendations.

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SECTION 1

Introduction

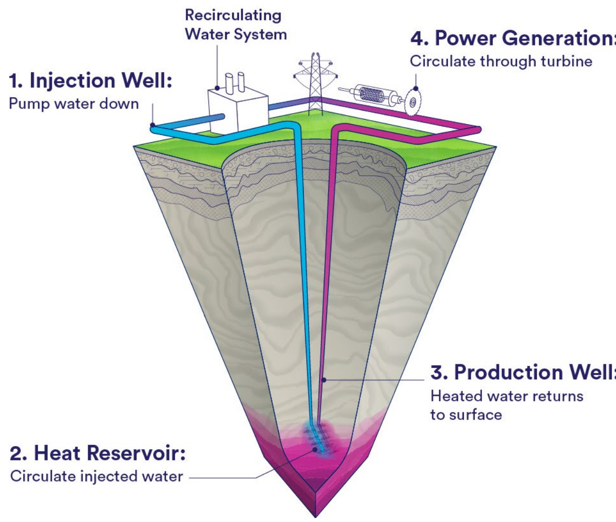
Geothermal can deliver clean firm power at unprecedented scale

Geothermal energy requires three components: hot subsurface rocks, fluid to transfer the rocks' heat, and permeability (small pathways in the rock) so the fluid can travel through the rock and collect the heat (see Figure 1). For many years, geothermal energy was limited to locations where all three of these factors occurred naturally – reservoirs of hot subsurface water known as conventional geothermal systems. Though the United States is a leader in conventional geothermal, it makes up only 0.4% of U.S. utility-scale electricity generation,[4] with a nameplate capacity of less than 4 gigawatts (GW).[5]

Technological advancements over the last decade have enabled the development of game-changing next-generation geothermal systems.[6] Rather than requiring heat, fluid, and permeability to all occur naturally, next-generation geothermal relies on only naturally occurring heat; the other two elements are introduced by the developer.[7]

Figure 1: Schematic of next-generation geothermal production

For a representation of different types of next-generation geothermal systems, see Figure 2.[8]



4 International Energy Agency. (2024). *The Future of Geothermal Energy.* https://www.iea.org/reports/the-future-of-geothermal-energy

5 Akindipe, D., Smith, F. M., Witter, E., Pauling, H., Oh, H., Podgorny, S., Rane, J., Harmon, J., Javed, S., Simpson, J., Shlosberg, D., Holt, E., Trainor-Guitton, W., Levine, A, Schmidt, B., & Pedersen, A. (2025). *2025 U.S. Geothermal Market Report.* National Laboratory of the Rockies. https://docs.nlr.gov/docs/fy26osti/91898.pdf

6 These advancements include faster drilling, the ability to access higher subsurface temperatures, and faster water flow through geothermal systems. Innovations in hydraulic fracturing and horizontal drilling from the oil and gas sector have also been modified to make geothermal possible in "dry rock" conditions. See Lipton, J., & Seligman, A. (2025). *Powering the future: What 50 years of enhanced geothermal teaches us today.* Clean Air Task Force. https://www.catf.us/wp-content/uploads/2025/08/CATF-EGS-Trend-Analysis-Report.pdf. Hydraulic fracturing is also known as "fracking"; it is used in some geothermal systems. Fracking for geothermal energy is different from – and significantly less risky than – fracking for oil and gas, but still carries some risk. Safety protocols developed by leading independent scientists have been used for years to help ensure that geothermal projects that use fracking can be developed and operated safely. See McLaughlin, K., Jaeger, J., Womble, J., Bird, L., Hausker, K. (2024). (p.16-17). *Next-generation geothermal: Considerations and opportunities for responsible development.* World Resources Institute. https://doi.org/10.46830/wriib.24.00015.

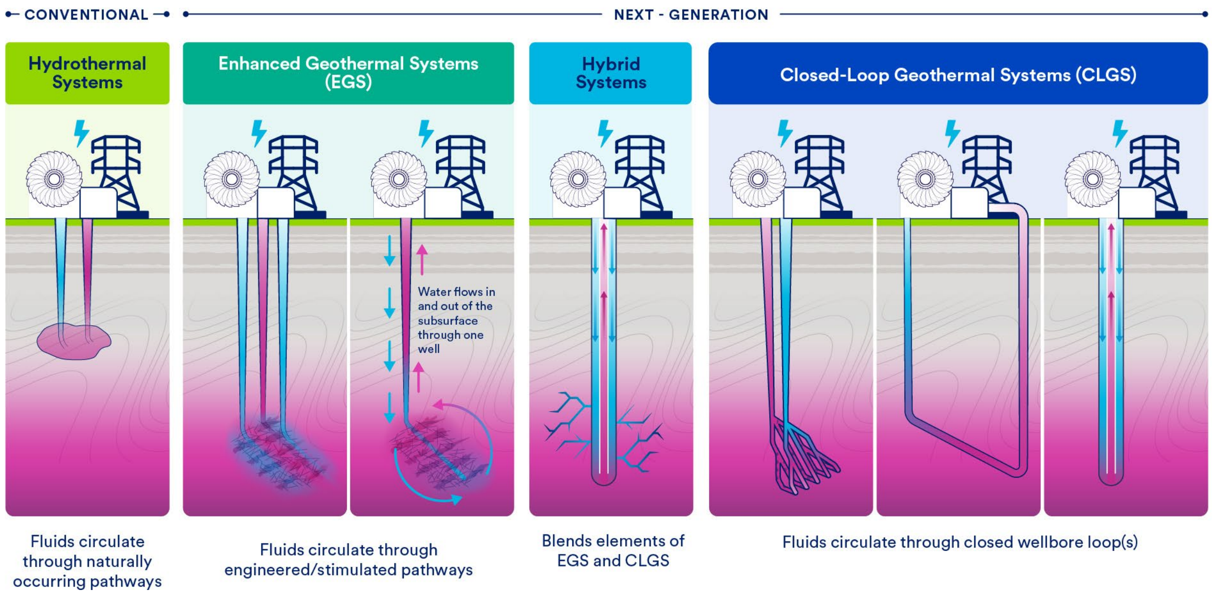
7 Projects often use brackish water or municipal wastewater rather than freshwater.

8 Note: Not to scale. Underground flow conduits for water may involve fracture networks (pictured) or subsurface piping.

There are multiple types of next-generation geothermal (e.g., enhanced geothermal systems, closed-loop geothermal systems, and hybrid systems), which work in slightly different ways (see Figure 2). In the U.S., these systems are primarily used to generate electricity, but they can also produce heat for industrial processes and district heating, either separately or as a cascading benefit from electricity generation.[9]

Figure 2: Types of geothermal systems

Each type can produce geothermal energy at varying temperatures, from low to superhot.



Next-generation geothermal has significant growth potential. The International Energy Agency (IEA) estimates that global geothermal power generation could increase 60-fold by 2050,[10] ultimately providing as much as 8% of global electricity.[11] Geothermal energy in the U.S. currently produces 4 GW of electricity,[12] but the U.S. Department of Energy (DOE) suggests that next-generation geothermal could provide up to 300 GW of power by 2050 across the U.S., depending on the availability of other emerging technologies.[13]

9 For example, one next-generation geothermal project in Germany is expected to produce 8.2 MW of electricity and 64 MW of district heating; this model could be used in the U.S. as well. Geothermal energy can also be used as a source of heat for residential, commercial, and industrial sectors. *See* Gallucci, M. (2025, October 28). Eavor is about to bring its first-of-a-kind geothermal project online. Canary Media. https://www.canarymedia.com/articles/geothermal/eavor-is-about-to-bring-its-first-of-a-kind-geothermal-project-online

10 IEA estimates geothermal's potential at over 6,000 TWh of power, compared to 97 TWh produced from geothermal in 2022. *See* International Energy Agency. (2024). *The Future of Geothermal Energy.* https://www.iea.org/reports/the-future-of-geothermal-energy *and* International Renewable Energy Agency. (2024). *Renewable energy highlights* [Fact sheet]. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2024/Jul/Renewable_energy_highlights_FINAL_July_2024.pdf

11 International Energy Agency. (2024). *The Future of Geothermal Energy.* https://www.iea.org/reports/the-future-of-geothermal-energy

12 Akindipe, D., Smith, F. M., Witter, E., Pauling, H., Oh, H., Podgorny, S., Rane, J., Harmon, J., Javed, S., Simpson, J., Shlosberg, D., Holt, E., Trainor-Guitton, W., Levine, A, Schmidt, B., & Pedersen, A. (2025). *2025 U.S. Geothermal Market Report.* National Laboratory of the Rockies. https://docs.nlr.gov/docs/fy26osti/91898.pdf

13 U.S. Department of Energy. (2024). *Pathways to Commercial Liftoff: Next-Generation Geothermal Power.* (p. 2). https://cdn.catf.us/wp-content/uploads/2025/06/09154348/doe-liftoff-nextgen-geothermal.pdf

Superhot rock geothermal, at temperatures of 375°C and above, is the highest-temperature form of geothermal. It can be produced in any type of geothermal system (for an illustration of the types of geothermal systems, see Figure 2) and has the greatest potential of any geothermal approach, though innovation will be required to effectively produce power at superhot temperatures.[14] CATF's modeling finds that just 1% of the United States's superhot rock geothermal resource could produce 4.3 terawatts of clean firm power, which could generate over 35,711 terawatt hours of electricity: the equivalent of 21 billion barrels of oil, 8 times the United States' 2021 electricity consumption,[15] or enough energy to power the state of Colorado nearly 600 times over.[16]

Beyond its abundant energy potential, next-generation geothermal also produces energy without fuel, reducing exposure to fuel price volatility, and has a much smaller land footprint than other energy sources. It is renewable power that supports community health by reducing air pollution. Because it requires drilling and subsurface expertise, it can also provide quality domestic jobs for workers from the fossil fuel industry. And it is a baseload resource that can deliver reliable, clean firm electricity whenever it is needed, reducing infrastructure requirements, lowering total system costs, and expanding viable decarbonization pathways.[17]

The western United States is poised to lead global next-generation geothermal development

While next-generation geothermal could one day produce power across the U.S., it is currently most viable across the western half of the country, where heat is accessible at shallower depths (see Figure 3). Many early projects are already located in the region. FORGE, a DOE-funded testbed in southwest Utah, launched in 2017[18] and helped kick off a wave of next-generation geothermal projects throughout the West over the last decade – including the first project to put power on the grid,[19] the largest project in the world,[20] the first large-scale closed-loop demonstration project,[21] and the hottest EGS project in the world.[22] Multiple other projects are underway or being scoped across the region.[23]

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14 Most next-generation geothermal systems operate at temperatures of about 150-275°C (300-525°F), but superhot rock geothermal targets subsurface heat of around 375°C (707°F) and above. These temperatures create a step change in energy density, giving superhot rock geothermal the potential to produce the lowest-cost geothermal energy. *See* LucidCatalyst and Hotrock Research Organization. (2023). *A preliminary techno-economic model of superhot rock energy.* Clean Air Task Force. https://cdn.catf.us/wp-content/uploads/2022/12/26120004/shr-technoeconomic_2023report.pdf

15 Clean Air Task Force. (n.d.). Superhot Rock Geothermal in the United States. https://cdn.catf.us/wp-content/uploads/2025/06/22145235/US-SHR-Regional-Assessment.pdf

16 U.S. Energy Information Administration. (2025). *Colorado Electricity Profile 2024* [Data set]. Table 10. https://www.eia.gov/electricity/state/colorado/

17 Spokas, K. & Ricks, W. (2026). *Clean firm electricity technologies: What, why, how.* Clean Air Task Force. https://www.catf.us/resource/clean-firm-electricity-technologies-why-what-how/

18 Ough, T. (2025, April 10). *Why FORGE Works.* IFP. https://ifp.org/why-forge-works/

19 Terrell, M. (2023, November 28). *A first-of-its-kind geothermal project is now operational.* The Keyword. https://blog.google/company-news/outreach-and-initiatives/sustainability/google-fervo-geothermal-energy-partnership/

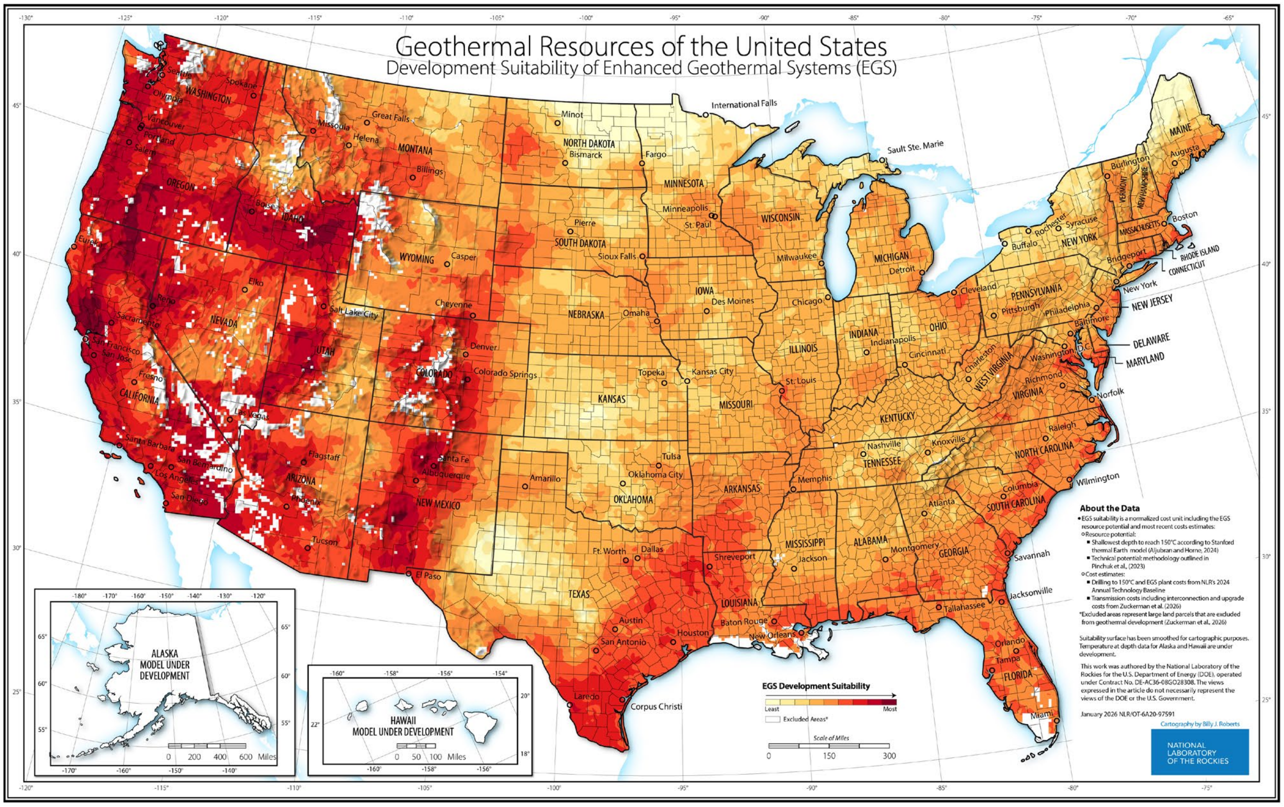
20 Jeffreys, F. (n.d.). *Fervo Energy's Cape Station: A landmark next generation geothermal development.* Seequent. https://www.seequent.com/fervo-energys-cape-station-a-landmark-next-generation-geothermal-development/

21 Eavor Technologies. (n.d.). *Eavor-Deep™*. https://eavor.com/eavor-deep/

22 Cariaga, C. (2025, October 29). *Mazama Energy develops 331 °C Enhanced Geothermal System at Newberry, Oregon.* ThinkGeoEnergy. https://www.thinkgeoenergy.com/mazama-energy-develops-331-c-enhanced-geothermal-system-at-newberry-oregon/

23 Geothermal developers Sage Geosystems and XGS Energy have both signed 150MW PPAs with Meta, Fervo has contracted with Google for a 115MW project in Nevada, and the Department of Defense (DOD) is partnering with six geothermal developers on an effort to bring geothermal power to DOD bases. *See* McCarthy, D. (2024, August 26). Sage Geosystems and Meta sign 150MW geothermal power agreement. Canary Media. https://www.canarymedia.com/articles/geothermal/sage-geosystems-and-meta-sign-150mw-geothermal-power-agreement; Office of the Governor Michelle Lujan Grisham. (2025, June 12). *Governor announces XGS Energy, Meta geothermal partnership – Nation-leading 150 MW geothermal project on its way to New Mexico* [Press release]. https://www.governor.state.nm.us/2025/06/12/governor-announces-xgs-energy-meta-geothermal-partnership-nation-leading-150-mw-geothermal-project-on-its-way-to-new-mexico/; Reuters. (2024, June 12). Google partners with Nevada utility for geothermal to power data centers. https://www.reuters.com/business/energy/google-partners-with-nevada-utility-geothermal-power-data-centers-2024-06-13/; *and* Defense Innovation Unit. (2025, August 11). Department of Defense expands geothermal initiative to support mission assurance. Department of Defense, Defense Innovation Unit. https://www.diu.mil/latest/department-of-defense-expands-geothermal-initiative-to-support-mission

Figure 3: Estimated suitability of geothermal in the U.S.[24]



About this report

Next-generation geothermal energy has vast resource potential, but it still needs targeted policy support to scale. This report identifies policy actions state governments can take to accelerate deployment. It focuses on utility-scale electricity generation, which is currently economically viable in the U.S. West, here defined as Alaska, Arizona, California,[25] Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming (see Figure 4). The report also draws on case studies and other examples from countries and states outside this region. As rapid innovation extends geothermal's viability to other regions,[26] these recommendations can apply to eastern states as well.

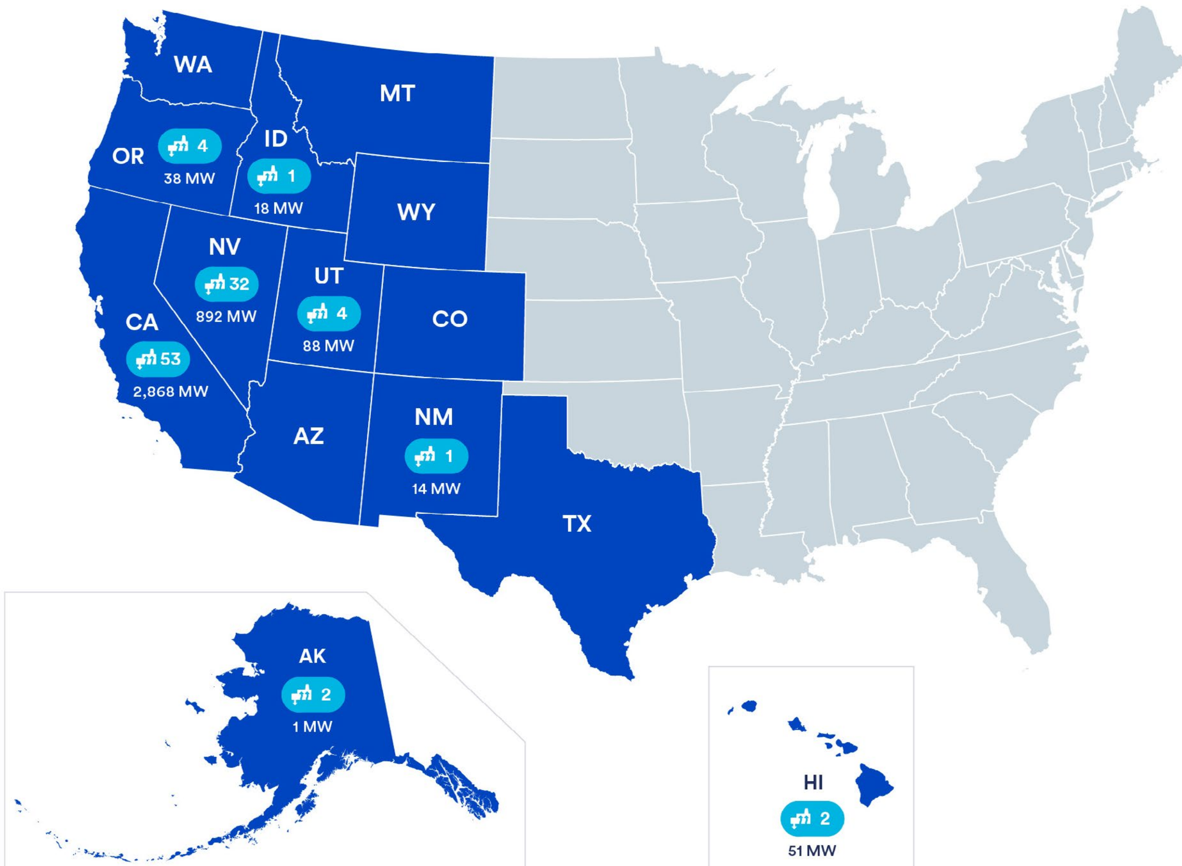
24 National Lab of the Rockies. (2026). *Geothermal Resources of the United States.* https://docs.nlr.gov/docs/gen/fy26/97591.jpg

25 For more information about barriers to geothermal development in California, *see* Rogers, T., Garth, A., & Arax, A. (2025). *Unlocking California's geothermal potential: A strategic opportunity for clean, firm power.* Clean Air Task Force. https://cdn.catf.us/wp-content/uploads/2025/06/23162128/california-geothermal-report.pdf

26 U.S. Department of Energy. (2024). *Pathways to Commercial Liftoff: Next-Generation Geothermal Power.* https://cdn.catf.us/wp-content/uploads/2025/06/09154348/doe-liftoff-nextgen-geothermal.pdf

Figure 4: The U.S. West, as defined in this report

Existing geothermal capacity in megawatts (MW) and number of geothermal power plants are noted.[27]



[27] Akindipe, D., Smith, F. M., Witter, E., Pauling, H., Oh, H., Podgorny, S., Rane, J., Harmon, J., Javed, S., Simpson, J., Shlosberg, D., Holt, E., Trainor-Guitton, W., Levine, A, Schmidt, B., & Pedersen, A. (2025). *2025 U.S. Geothermal Market Report.* National Laboratory of the Rockies. https://docs.nlr.gov/docs/fy26osti/91898.pdf

The report organizes policy actions under five deployment levers essential to unlocking geothermal at scale:

Characterize	Govern	Finance	Connect	Innovate
Map geothermal's subsurface resource potential	Establish a regulatory system that works for industry and communities	Incentivize exploration and demonstration	Develop supportive infrastructure	Sustain R&D

Ground-source heat pumps, thermal energy networks, district heating, and conventional geothermal energy are out of scope for this report, though some of the recommendations may also enable their development.[28]

To inform the recommendations in this report, CATF spoke with leading geothermal developers to understand the barriers to deployment that their projects face. We also surveyed the geothermal policy landscape in each western state, examining regulatory and permitting requirements for geothermal projects, definitions of "geothermal" in state law, financial incentives for geothermal energy projects, recent state bills related to geothermal, and more. Detailed tables capturing the findings of this landscape scan are located in Appendix C: Geothermal Regulatory Systems by State and Appendix D: Geothermal Regulatory Agencies by State. Further, we interviewed staff at state geological surveys in many western states to understand their capacities and needs related to subsurface mapping (see Deployment Lever 1: Characterize).

The clear conclusion from this research is that state-level action to support next-generation geothermal can significantly impact the scale and scope of its deployment.

[28] For additional policy recommendations, including those related to other forms of geothermal, refer to state policy reports from Project Innerspace. *See* Project Innerspace. (n.d.) *Resources*. https://projectinnerspace.org/resources/

SECTION 2

Barriers to Geothermal Deployment

Next-generation geothermal started in the American West[29] and is poised for global expansion, but its development has been limited – clustered in the places where shallow heat, well-characterized subsurface conditions, transmission access, and transparent regulatory frameworks already exist. Federal support also helped catalyze early projects. But state action is critical to achieving commercial-scale deployment across broader geographies. While continued R&D will help bring costs down and improve long-term performance, **technology is no longer the primary barrier to deployment – economics and project development risk are.**

The root cause of economic barriers to deployment is the intersection between geothermal development risks and the preferences of the private capital market, which state governments can alleviate with thoughtful and targeted policy action.

Next-generation geothermal faces a familiar financing gap commonly referred to as the “missing middle” (see Figure 5).[30] This refers to an intermediate stage of commercial development, after the pilot stage but before bankable replication. In this period, projects are perceived as too risky for late-stage infrastructure investors and too capital-intensive for most early-stage venture capital (VC) funds.

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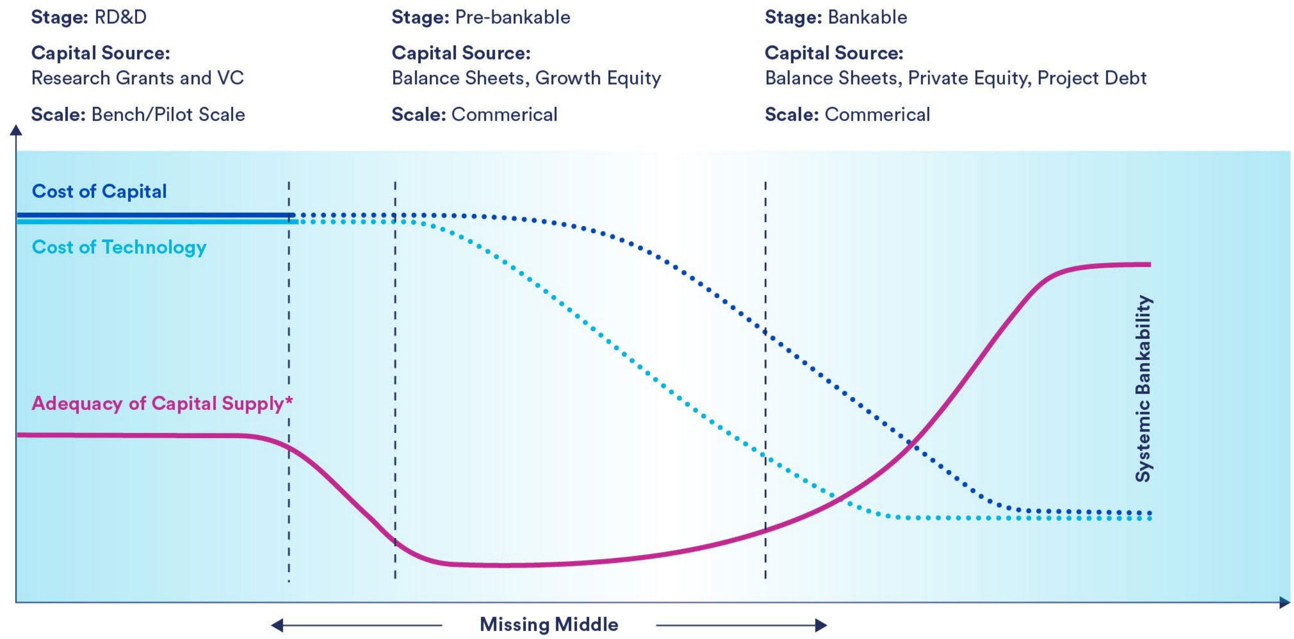
29 Lipton, J., & Seligman, A. (2025). *Powering the future: What 50 years of enhanced geothermal teaches us today.* Clean Air Task Force. https://www.catf.us/wp-content/uploads/2025/08/CATF-EGS-Trend-Analysis-Report.pdf

30 Spokas, K., Ulama, D., Greig, C., Waltzer, K, & Hobart, S. (2025). *Systemic bankability is the key to unlocking energy transition speed and scale.* Clean Air Task Force. https://www.catf.us/resource/systemic-bankability-is-the-key-to-unlocking-energy-transition-speed-and-scale/

Figure 5: Illustrative figure of cost of capital, cost of technology, and adequacy of capital from the early research, development and deployment (RD&D) stage to the pre-bankable and bankable stages[31]



In many emerging industries, the missing middle stems primarily from technical risk. For next-generation geothermal, this investment valley is attributable to a combination of technical as well as geological resource risks – both of which can be mitigated through state policy.

Early-stage project risks

Like any new technology, the first commercial-scale next-generation geothermal projects are expected to generate electricity at above-market prices in most regions, and they face elevated risks of cost overruns during early deployment. Over time, learning-by-doing brings costs down (see Figure 6). In the case of next-generation geothermal, learning-by-doing is enabling rapid cost declines, largely due to improvements in drilling speed and operational efficiencies that come from standardized practices and repeatable execution in the field (see Figure 7).[32] But it remains uncertain how first-of-a-kind (FOAK) commercial deployments will perform over their intended operational life, in part because the application of these technologies in geothermal settings at commercial scale is still relatively new.

Investors are eager to back geothermal projects once costs and uncertainty decrease further, but hesitate to put in the capital necessary for early projects.

[31] Spokas, K., Ulama, D., Greig, C., Waltzer, K, & Hobart, S. (2025). *Systemic bankability is the key to unlocking energy transition speed and scale.* Clean Air Task Force. https://www.catf.us/resource/systemic-bankability-is-the-key-to-unlocking-energy-transition-speed-and-scale/

[32] The FORGE testbed in the western U.S. has demonstrated a 500% improvement in drilling speeds since 2017, and recent modeling updates based on data from early commercial projects indicates that drilling costs could be up to 25% lower than previously expected. *See* Palmer, I. D. (2025, January 30). Third energy innovation signaling a golden age: Enhanced geothermal. Forbes. https://www.forbes.com/sites/ianpalmer/2025/01/30/third-energy-innovation-signaling-a-golden-age-enhanced-geothermal *and* Akindipe, D. & Witter, E. (2025). *2025 Geothermal Drilling Cost Curves Update.* National Lab of the Rockies. (p. 3). https://docs.nlr.gov/docs/fy25osti/92793.pdf

Figure 6: Illustration of a technology cost curve for next-generation geothermal energy

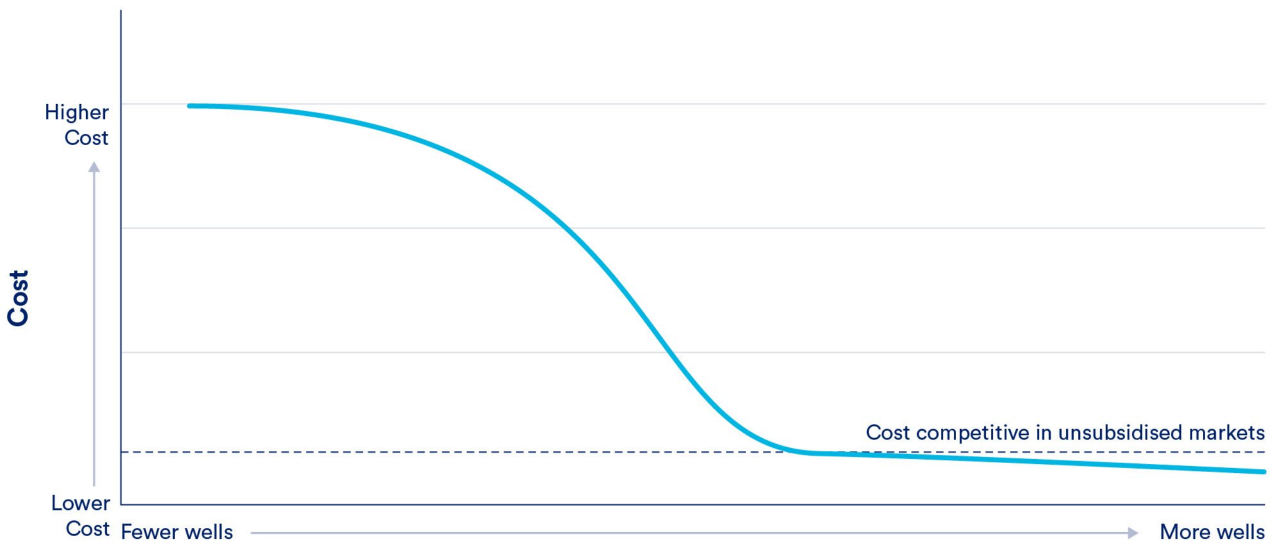
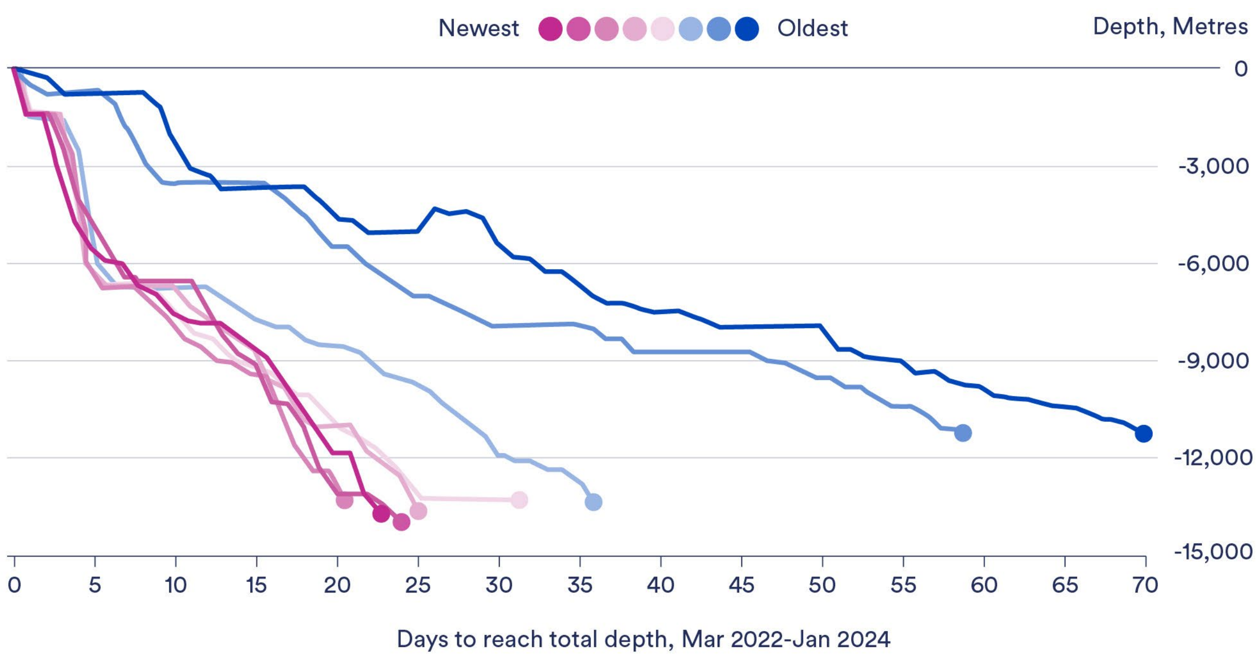


Figure 7: Drilling performance over time for a leading next-generation geothermal developer.[33]

Source: Fervo Energy



[33] The Economist. (2025, November 18). Geothermal's time has finally come. https://www.economist.com/interactive/science-and-technology/2025/11/18/geothermal-time-has-finally-come

The financing gap

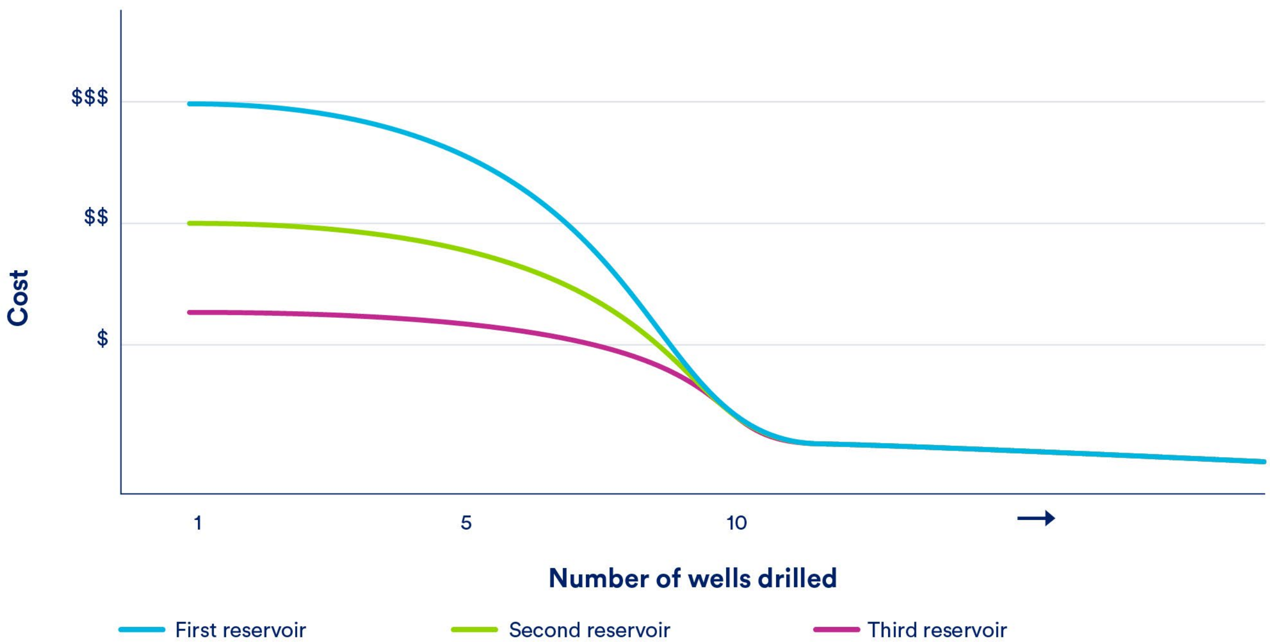
Constructing a commercial-scale next-generation geothermal project requires hundreds of millions of dollars of upfront capital for exploration drilling, resource confirmation, and plant construction.[34] This often exceeds what venture capital investors provide; geothermal development requires large, infrastructure-scale investments. Additionally, although project costs must be paid upfront, revenues are realized slowly over the life of long-term power purchase agreements (PPAs), typically 20 to 30 years. Startups cannot manage this timing mismatch using their own balance sheets the way mature industries can. The result is a persistent financing gap between the early-stage equity funding available to most startups and the large-scale project finance required for commercial deployment.

Subsurface uncertainty

The first commercial-scale next-generation geothermal projects succeeded because they drilled repeatedly in well-characterized regions, where learnings from early wells and projects allowed for optimization of subsequent wells and projects. By contrast, the first projects in new regions will be drilled and engineered conservatively, without the benefit that comes from a detailed understanding of the subsurface, creating the risk of unanticipated cost overruns. This uncertainty translates to increased costs of capital for projects in unexplored regions (see Figure 8).

Figure 8: Illustration of next-generation geothermal cost curves

Learnings from early projects drilled will dramatically reduce costs and risk for future projects in the same geologic region, but will only partially derisk wells in different regions.



[34] Next-generation geothermal projects in the West currently cost about $7 million per MW of installed capacity; this means that a 100 MW project would cost about $700 million. Continued learning-by-doing will bring costs down further; one leading developer is targeting $3 million per MW. *See* Fervo Energy Company. (2026, May 4). Form S-1. https://www.sec.gov/Archives/edgar/data/1853868/000162828026029515/fervoenergy-sx1a.htm

Outdated risk perceptions

Many investors remain wary of geothermal based on assumptions drawn from conventional geothermal systems, where drilling in the wrong place could mean a "dry hole" and failed project.[35] Recent improvements in modeling reduce this risk for all types of geothermal,[36] and next-generation geothermal has a fundamentally different risk profile: underperformance typically reduces output rather than eliminating the project's ability to generate electricity.[37] However, next-generation technologies have advanced so rapidly in the last decade that many investors have not fully internalized their different risk profiles and remain cautious of geothermal investments.

Non-technical barriers

Though the industry has overcome many technical barriers in recent years, it also faces non-technical barriers, such as lack of access to transmission and slow and uncertain permitting timelines. If a developer spends years waiting to receive a permit or access transmission and is rejected, the money invested into their project site can become stranded; this risk disincentivizes private investment in geothermal and increases the cost of capital. Even when projects successfully secure access to transmission and permits, invested capital must often sit for years waiting for the transmission or permitting approval before the project can begin generating a return. While other energy industries face similar barriers, the high upfront cost of capital for geothermal projects makes these barriers more costly.

Policy action can unlock private capital

Once the geothermal industry reaches full commercial scale, many of these problems will be solved: large-scale deployment will bring costs down through learning-by-doing, regional deployment will improve subsurface knowledge, and new entrants will bring innovation and competition. Private capital is ready to flow into next-generation geothermal once more of these barriers are overcome through targeted policy.

State governments can bring geothermal energy through the missing middle and kickstart large-scale deployment.

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[35] Robertson-Tait, A., Henneberger, R., & Sanyal, S. (2008). Managing geothermal resource risk – Experience from the United States. *Workshop on Geological Risk Insurance, World Bank Geothermal Energy Development Program (GEOFUND).* https://pangea.stanford.edu/ERE/pdf/IGAstandard/GeoFund/Germany2008/Robertson-Tait.pdf

[36] Kaufman, A. (2025, December 4). In a geothermal milestone, Zanskar claims major discovery in Nevada. *Canary Media.* https://www.canarymedia.com/articles/geothermal/zanskar-claims-geothermal-milestone-nevada

[37] Center for Public Enterprise. (Forthcoming). *Manageable but misunderstood.*

SECTION 3

Key Levers for Geothermal Deployment

Policy action to help next-generation geothermal scale is needed at all levels of government,[38] and state efforts are crucial. State regulatory agencies, geological surveys, and funding and procurement programs have critical roles to play to enable safe and speedy development.

State policy efforts on geothermal have increased in recent years, including rulemakings from various state agencies,[39] the inclusion of geothermal in state planning efforts,[40] and legislation, among others. From 2024-2025, dozens of geothermal-related bills were introduced across the West, including bills in nearly every western state, spanning a range of topics. By deepening their understanding of current barriers faced by next-generation geothermal developers and investors, states can advance key policy levers to enable broad-scale deployment.

Lever Zero: State Strategic Planning for Geothermal

As a starting point for all the recommendations laid out below, states can create a formal strategic plan for next-generation geothermal or include it as part of an existing energy policy strategic planning process (see Case Studies: Geothermal Strategic Plans, below). This would include landscaping the current state of play for geothermal in the state, setting short- and long-term goals for geothermal development, and laying out pathways to reach those goals. Geothermal strategic plans can utilize the five deployment levers listed below to assess where a state lacks the necessary conditions for deployment and what actions would be most impactful to unlock geothermal energy abundance. Strategic plans can also bring together relevant stakeholders (including state regulatory agencies; state economic development agencies; PUCs; utilities; Tribal, federal, and local governments; the geothermal industry; financing entities; local communities; and nonprofits and community organizations), helping them understand the role that next-generation geothermal could play in their state's energy system. By clearly defining priorities, timelines, and metrics for scale-up, a statewide strategic plan for geothermal can keep all stakeholders moving forward.

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38 For a discussion of federal government action needed to help next-generation geothermal deploy, *see* Garth, A. (Forthcoming). *Next-Generation Geothermal at Scale: A Federal Action Framework.* Clean Air Task Force. https://www.catf.us/resource/next-generation-geothermal-at-scale

39 For example, the New Mexico State Lands Office's rulemaking on geothermal leasing; *see* New Mexico State Land Office. (2026 May 1). NMAC 19.2.7. https://www.nmstatelands.org/wp-content/uploads/2026/03/Rule-Replacement-of-Part-19.2.7-NMAC-1.pdf

40 For example, the Washington state Department of Ecology's geothermal planning process; *see* Cariaga, C. (2025 November 6). *Washington state to lead collaborative process for early-stage geothermal studies.* ThinkGeoEnergy. https://www.thinkgeoenergy.com/washington-state-to-lead-collaborative-process-for-early-stage-geothermal-studies/

Case Studies: Geothermal Strategic Plans

Geothermal strategic plans can be initiated through either the executive or legislative branches, and there are examples of both Democratic and Republican initiatives.

In September 2025, Arizona Governor Katie Hobbs signed an executive order establishing the Arizona Energy Promise Taskforce. This task force launched a Geothermal Working Group that helped draft a report with recommendations to advance geothermal energy across Arizona. In the same month, Montana Governor Greg Gianforte launched a similar task force, the Energy Advisory Council.[41]

Legislatively, in 2024, the Washington State Legislature passed SB 6039, which directed the state to embark on a multi-agency process that included efforts that overlap with several policy levers outlined in this report.[42] In 2025, Hawaii passed HCR 58, which requested that the Hawaii State Energy Office convene a geothermal working group to examine the regulatory and policy landscape for geothermal energy in the state.[43]

1. Characterize: Map Geothermal's Subsurface Resource Potential

Why It Matters

High-quality subsurface mapping is one of the fastest and most cost-effective ways to reduce early exploration risk for next-generation geothermal. Mapping the subsurface is the first step in identifying geothermal project sites and successfully developing projects. Subsurface features[44] determine how deep a developer must drill, at what drilling speed, what wear and tear on equipment to expect, and how to place wells so they align with the natural features of the rock – all of which affect project cost, risk of cost overruns, and safety.

We have only scratched the surface of understanding the full geothermal potential across the West, and additional attention toward subsurface mapping is necessary for geothermal to reach full commercial scale.[45]

Where Things Stand

Collecting subsurface data by drilling new wells is relatively costly, but much of the data needed to derisk geothermal can be assembled in other cost-effective ways, including using surface surveying tools, analyzing existing wells (for instance, abandoned oil and gas wells), and digitizing subsurface data from other industries that could be relevant for next-generation geothermal.

Funding for subsurface data gathering and digitization is a low-cost, high-impact policy lever. **In particular, making historical well records usable for geothermal modeling would be orders of magnitude less expensive than gathering an equivalent amount of data by drilling new wells, and should be a high priority for any state government seeking to derisk geothermal development.**

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41 State of Montana Office of the Governor. (2025). Executive Order No. 6-2025. https://gov.mt.gov/Documents/GovernorsOffice/executiveorders/View?doc=EO_6-2025_EnergyTaskForce.pdf

42 SB 6039, 2024 Regular Session. (Washington 2024). https://app.leg.wa.gov/billsummary?Year=2023&BillNumber=6039

43 HCR58, 2025 Regular Session. (Hawaii 2025). https://legiscan.com/HI/text/HCR58/id/3192853

44 The most important subsurface information includes geothermal gradient (how rock temperature changes with depth), exactly what types of rock are found at different depths, and the structure and connectivity of the rock's natural fracture network and stress regime.

45 Mapping is also valuable for a wide range of industries and sectors, far beyond just geothermal. *See* Berg, R. C., & Faulds, J. E. (Eds.). (2025). *Economic analysis of the costs and benefits of geological mapping in the United States of America from 1994 to 2019.* American Geosciences Institute. https://doi.org/10.62322/wra5.gs9v *and* Bhagwat, & Ipe, V. C. (2000). *Economic benefits of detailed geological mapping to Kentucky.* Illinois State Geological Survey. https://library.isgs.illinois.edu/Pubs/pdfs/specialreports/sp-03.pdf

What States Can Do

Priority Actions for Policymakers:

- Digitize historical subsurface data that could be used to inform geothermal modeling (recommendation 1B)
- Collect subsurface data in regions with high geothermal potential (recommendation 1G)

Data Digitization

Digitizing historical well log and geophysical log data from other subsurface sectors – such as oil, gas, mining, carbon sequestration, conventional geothermal, and water wells – is an affordable way to advance geothermal deployment. Most western states have spent decades collecting data that could inform geothermal modeling,[46] but it is often stored in formats that cannot be used in digital analysis, severely limiting its accessibility. Similarly, most states have databases holding physical samples of well cores and cuttings, known as core repositories (see Figure 9). Analyzing these samples could significantly improve geothermal modeling.[47]

Figure 9: Well cores[48]

[46] For example, well logs generally track temperatures at different depths, which can inform knowledge of geothermal gradients, while geophysical logs can provide information about rock permeability and porosity, subsurface fracture networks, and water quality.

[47] Well cores and cuttings can provide information about rock type at depth, rock porosity and permeability, and subsurface fracture networks. Additional analysis of thin sections of well cores can provide additional information (e.g., which types of minerals make up the rock, which informs a more detailed understanding of rock strength).

[48] Mississippi Department of Natural Resources. (N.d.). Well logs, rock cuttings and cores. https://dnr.mo.gov/water/hows-water/state/groundwater/well-logs-rock-cuttings-cores

Turning historical well logs into useable digital files requires equipment as well as human capital.[49] Our interviews with ten state geological surveys across the West indicated that, while states vary widely on the amount of historical well log data that has been digitized, un-digitized data exists in many states that could be valuable for geothermal.[50] Preliminary cost estimates for digitizing the most geothermal-relevant state well logs ranged from a few hundred thousand dollars to about $1.5 million, depending on the state; digitizing all data would be more expensive (likely costing a few million dollars in most western states). These costs could likely be recouped by charging fees to access the data (see Case Study: Data Digitization). Similarly, there is a wide variation in how much work different states have done to catalogue their core repositories, collect data from cores, and digitize that data.

Case Study: Data Digitization

The North Dakota Oil & Gas Division has scanned and digitized almost all the state's historic geological data (including core data) gathered from oil and gas development.[51] The data is available via subscription, including both premium and basic subscription options; subscription fees are waived for academic projects. Funds from the subscriptions are used to maintain the database and cover the costs of adding new information as it arrives.

POLICY RECOMMENDATIONS:

1A. Data Needs Assessment

Analyze what gaps exist in geothermal-relevant data and how they can be filled. This would include inventorying what data exists in hard copy form, what data exists in digital form, and what data does not exist and would need to be collected. States should consider the data needed to support development of all types of geothermal systems, including both EGS and closed-loop, and geothermal systems in superhot conditions.

1B. Historical Data Digitization

Give explicit statutory authority, direction, and funding to state agencies that hold geothermal-relevant historical data to catalogue, scan, and digitize these records (see Case Studies: Subsurface Mapping, below). A few hundred thousand dollars (most of which is for staff time) would be sufficient in many states to digitize most or all geothermal-relevant data, and even partial digitization would still provide significant value. Federal programs like the National Geological and Geophysical Data Preservation Program provide funding for state agencies to digitize geological and geophysical data but require a 50% state cost-share.[52] State funding for digitization efforts can therefore unlock federal funding, increasing its impact.

- If multiple agencies in a state own geothermal-relevant records, these agencies can coordinate their digitization efforts. It may be most effective to designate one agency to lead digitization efforts, with other agencies supporting by sharing their data.
- States can take in feedback from industry and academic experts to help determine which areas are most promising for geothermal development and prioritize digitizing data from those areas.

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49 The first step is to catalogue what records exist. Next, paper records are scanned to produce digital files (e.g., PDFs); this requires specialized well log scanners. Finally, the files are digitized so that the data can be inputted into geothermal modeling software; this requires access licenses for digitization software as well as time and effort to interpret the scanned data during the digitization process. Some (but not all) of this work can be completed by interns with supervision from professional staff.

50 States with significant oil and gas development tend to have more historical records, but the greater demand for those records may have resulted in more digitization. In North Dakota, for example, essentially all records have been digitized and made available through a fee-based database (*see* Case Study: Data Digitization). No other state we spoke to had digitized as many of their records as North Dakota.

51 Oil and Gas Division. (n.d.) North Dakota Oil and Gas. North Dakota Oil and Gas Division. https://www.dmr.nd.gov/oilgas/

52 National Geological and Geophysical Data Preservation Program. (n.d.). NGGDPP Grants. U.S. Geological Survey, National Geological and Geophysical Data Preservation Program. https://www.usgs.gov/programs/national-geological-and-geophysical-data-preservation-program/nggdpp-grants

Case Studies: Subsurface Mapping

In 2024, Hawaii allocated $5 million to geothermal resource characterization, aiming to identify possible locations for geothermal projects.[53]

In March 2026, Arizona announced a $1 million investment into subsurface mapping for geothermal development. The Arizona Geological Survey will use this funding to integrate historical subsurface data and to analyze and collect new information, using tools such as airborne imaging and laser-based imaging, into a “clear roadmap of the Arizona locations best suited for further geothermal exploration.

1C. External Data Digitization
Solicit additional data that might be useful for geothermal (e.g., records from local municipalities) and scan and digitize that data as well.

1D. Core Repository Data
Inventory core repositories and collect and digitize data from those samples, leveraging programs like the National Geological and Geophysical Data Preservation Program to provide a 50% cost-share for much of this work.

1E. Accessible Core Repositories
Make state core repositories accessible to the public (including both academics and industry).

1F. Subscription Services
Establish subscription services to provide a stable funding source for data digitization efforts (see Case Study: Data Digitization, above).

Data Collection

Collecting additional and new subsurface data will help geothermal scale, especially in regions with limited historical data.

POLICY RECOMMENDATIONS:

1G. Collecting New Data
Robustly resource and staff state agencies, and direct them to collect more geothermal-relevant subsurface data (see Case Study: Subsurface Mapping, above). This would include drilling probes, which are often the only way to gather some critical subsurface information (e.g., rock properties and temperature at depth) as well as surface geophysics work (such as seismic surveys, magnetotelluric surveys, magnetic surveys, and gravimetric surveys).

- States can take in feedback from industry to help determine which areas are most promising for geothermal development and prioritize mapping and characterization in those areas.
- States can also support data collection and sharing by private or academic institutions, such as by funding mapping (see Case Study: Exploratory Drilling, below) or paying project developers to share their exploration data. The latter approach would provide funding for developers prior to project completion, when accessing private capital is most difficult, and would therefore address financing barriers as well.
- Resource mapping efforts should cover geothermal resources of all types and temperatures, including next-generation (both EGS and closed-loop) and superhot rock geothermal resources.

53 *Requesting the Hawaii State Energy Office to Convene a Geothermal Energy Working Group to Evaluate the Regulatory and Policy Landscape Surrounding Geothermal Energy in Hawaii,* Hawaii Senate Committee on Energy and Intergovernmental Affairs. (2025) (Testimony of Mark B. Glick). https://energy.hawaii.gov/wp-content/uploads/2025/04/SCR0136_BED-SEO_03-25-25_EIG_Comments.pdf

Case Study: Exploratory Drilling

In 2024, the state of Washington established a cost-share grant program to support geothermal exploratory drilling, with funding available to private, public, and tribal entities. When allocating grants, the state requires that preference be given to "high impact projects in favorable geologic settings that have been comparatively underexplored," and results of the drilling must be submitted to the Washington Geological Survey to be made available in a public database.[54]

1H. Abandoned Well Data
Gather subsurface data (such as temperature at depth) from the millions of abandoned oil and gas wells across the U.S.,[55] which represent an immense resource for affordable geothermal data collection.

1I. Subsurface Monitoring
Expand subsurface monitoring networks by deploying monitoring equipment in areas of high geothermal potential, potentially in partnership with local jurisdictions (see Case Study: Subsurface Monitoring).

Case Study: Subsurface Monitoring

The federal government of Switzerland funds the Swiss Seismological Service to provide free baseline monitoring and seismological expertise to subnational jurisdictions, rather than relying on developers to conduct this subsurface mapping themselves.[56] This system reduces costs for developers, incentivizing investment and development, while also improving safety by ensuring that appropriate monitoring is in place for projects. (For more detail on monitoring and safety, see Deployment Lever 2: Govern.)

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54 SB 6039, 2024 Regular Session. (Washington 2024). https://app.leg.wa.gov/billsummary?Year=2023&BillNumber=6039

55 SciLine. (2023 November 30). *Abandoned oil and gas wells.* https://www.sciline.org/environment-energy/abandoned-oil-gas-wells/

56 Ritz, V. A., Antunes, V., Bergamo, P., Kraft, T., Marti, M., Roth, P., Simon, V., Toledo, T., & Wiemer, S. (2026). Overview of the Swiss Seismological Service's Efforts to Monitor the July 2025 Test-Stimulation in Haute-Sorne, Switzerland. PROCEEDINGS, 51st Workshop on Geothermal Reservoir Engineering. https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2026/Ritz.pdf

Data Sharing

To maximize its impact, data must be easy to access, download, and interpret.

POLICY RECOMMENDATIONS:

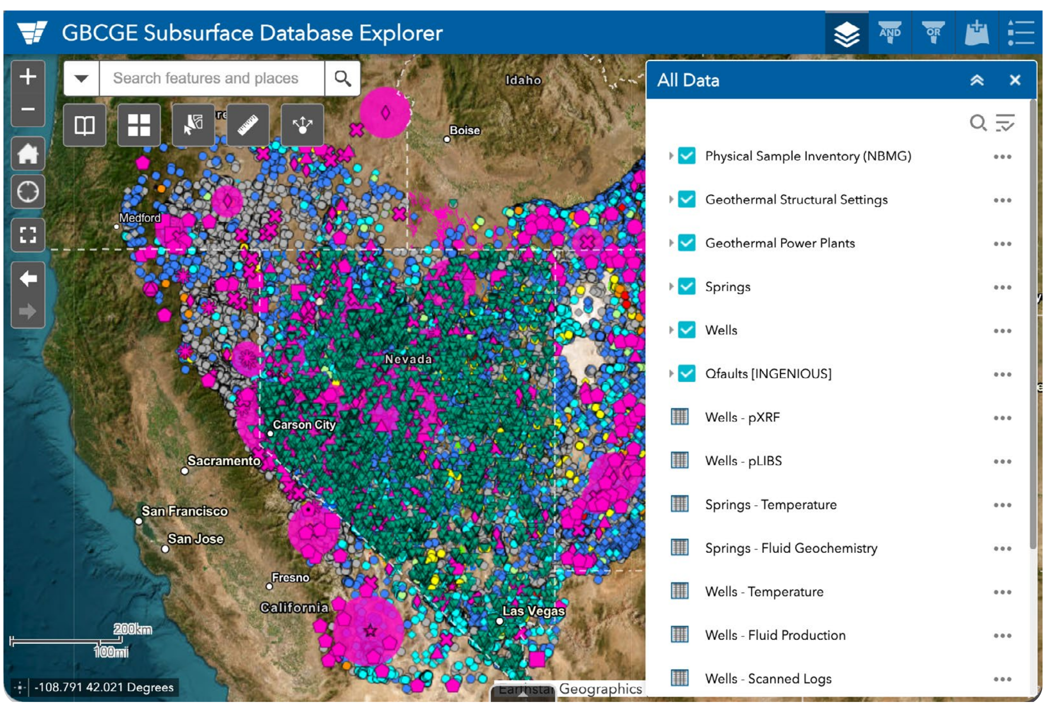
1J. Data Sharing Platforms
Develop public, easy-to-use data-sharing platforms to host data from well logs, geophysical logs, well cores and cuttings, and other current and historical sources (see Case Study: Geothermal Data Explorer).

- Data stored on these platforms should be uniform, allowing it to be analyzed across projects; viewable by map; and downloadable by common attributes, such as geologic basin.
- These platforms can collect subsurface data of numerous types and from numerous sources (e.g., oil, gas, mining, conventional geothermal, carbon sequestration, next-generation geothermal, water wells, etc.) but should include filters that allow users to view data from only specific types of projects.

Case Study: Geothermal Data Explorer

The Great Basin Center for Geothermal Energy (GBCGE), funded primarily by the U.S. Department of Energy and based in Nevada, hosts a Subsurface Database Explorer (see Figure 10).[57] This data explorer includes subsurface data for Nevada and for the larger Great Basin geologic region. It is free to the public and is searchable and filterable to maximize ease of use.

Figure 10: The Great Basin Center for Geothermal Energy (GBCGE)'s subsurface data explorer[58]



[57] Great Basin Center for Geothermal Energy. (2025 November 18). *GBCGE subsurface database explorer.* www.GBCGE.org/subsurface

[58] Great Basin Center for Geothermal Energy. (2025 November 18). *GBCGE subsurface database explorer.* www.GBCGE.org/subsurface

1K. Data Transparency
Require new well and geophysical log data submitted to state regulatory agencies to be open access, and new well cores to be added to state core repositories. Keeping this data confidential for an appropriate period (e.g., 5 years) before making it public balances public transparency against the risk of disincentivizing geothermal projects.

1L. Public Data
Require data from any geothermal project which receives state funding to be made public. Information about the performance of tools and techniques that are protected intellectual property should be kept confidential, but other data (including temperature gradient, rock type at depth, groundwater depth and chemistry, local fracture networks, and fault sizes and structures) can be kept confidential only temporarily (e.g., for 5 years).

1M. Modern Data Formats
Require data to be in modern, useable formats whenever possible. Different types of data are shared in different formats, but the gold standard for most geophysical data is Log ASCII Standard ("LAS") files, which are compatible with modern software and can be imported directly into geologic models.[59]

1N. Multilateral Data Sharing
Partner with other states, the federal government, and potentially other countries (e.g., provinces of Canada or states of Mexico) to share data in one public online database – ideally a database already in use, with demonstrated functionality. Doing so would require states to standardize the metadata used to organize their data, enabling consistent and clear cross-regional analyses and improved geothermal modeling.

The Value of Testbeds

Public-private testbeds are a particularly impactful way to advance geothermal deployment.[60] Testbeds – locations where new materials and equipment can be tested in real-world conditions – simultaneously advance R&D (see Deployment Lever 5: Innovate) and improve understanding of the subsurface (see Deployment Lever 1: Characterize), derisking deployment in the surrounding area. For example, the federally-funded FORGE testbed allows private companies to test their equipment and methods in real-world conditions, while also collecting and publishing data about the subsurface. FORGE has contributed to innovation from numerous private companies and research institutions,[61] while simultaneously enabling the development of the world's first commercial-scale next-generation geothermal project, Fervo Energy's Cape Station.

Similar testbeds have been launched for other energy technologies with state support. For example, the PacWave testbed, which tests grid-connected wave energy, is run by Oregon State University with funding from DOE and the state of Oregon.[62] South Carolina's Nexus for Advanced Resilient Energy is a series of testbeds focused on commercializing grid and energy storage innovations.[63] And in Texas, the Texas A&M University System has partnered with four nuclear companies on a project to build a cluster of small modular reactors.[64]

State governments could initiate similar programs for next-generation geothermal technologies – especially those where innovation is still needed, such as superhot rock geothermal – in collaboration with academia, industry, and/or the federal government.

59 North Carolina Geological Survey. (n.d.). Geophysical Well Log Portal. https://storymaps.arcgis.com/stories/940117df7fe644bfac94988b844f1294

60 Clean Air Task Force (2025). *Gaps, Challenges, and Pathways Forward for Superhot Rock Geothermal Synthesis Report.* https://www.catf.us/wp-content/uploads/2025/09/CATF_SHRTechRoapMapReport_Digital_09.18.25.pdf

61 Utah FORGE. (n.d.). *Research and development funding opportunities.* https://utahforge.com/solicitations/

62 PacWave. (n.d.). Frequently Asked Questions. https://pacwaveenergy.org/faq/

63 The SC Nexus for Advanced Resilient Energy (SC NEXUS). (n.d.). *South Carolina: the advanced energy industry's next power move.* South Carolina Department of Commerce. https://www.sccommerce.com/scnexus

64 Texas A&M University System. (2025, February 4). Texas A&M system goes nuclear. https://stories.tamu.edu/news/2025/02/04/texas-am-system-goes-nuclear/

2. Govern: Establish a Regulatory System that Works for Industry and Communities

Why It Matters

Regulatory systems for next-generation geothermal energy should aim to enable safe, environmentally responsible production of as much geothermal energy as is needed and economically viable. Clear, consistent and predictable regulatory systems are essential to speed up deployment and crowd in private investment while maintaining appropriate safety and environmental protections.

Where Things Stand

In most states, the regulatory system that governs geothermal energy has room for improvement. Multiple state agencies are usually involved in regulating geothermal energy, and communication among them and with external stakeholders is often unnecessarily limited. Differences among states add overhead burden for companies, which must adjust to new approaches and regulatory frameworks in new states. Legal frameworks for geothermal ownership and development may be unclear or inconsistent, particularly for next-generation approaches that did not exist when such frameworks were developed. And permitting and environmental review processes designed for older forms of geothermal may not reflect the actual risks and benefits of next-generation geothermal. Too often, the result is slow and uncertain permitting timelines that pose a significant barrier to the development of next-generation geothermal energy. Overcoming these barriers would dramatically improve the geothermal regulatory system and incentivize further deployment.

For detailed information about state regulatory systems across each western state, see Appendix C: Geothermal Regulatory Systems by State and Appendix D: Geothermal Regulatory Agencies by State.

What States Can Do

Priority Actions for Policymakers:

- Improve regulatory capacity for relevant oversight agencies (recommendation 2A)
- Establish clear principles of state property law with respect to ownership of geothermal resources (recommendation 2K)
- Improve permitting processes for geothermal resources by developing appropriate, tailored regulations for geothermal projects (recommendations 2R and 2S)

Improve Agency Capacity, Communication, and Coordination

Investing in state regulatory capacity and communication protocols supports an efficient and protective permitting system. Regulating geothermal resources often involves multiple legal frameworks related to minerals, water, and environmental protection,[65] and permitting nearly always involves multiple agencies, each with its own deadlines and processes (for a list of agencies involved in geothermal permitting in each western state, see Appendix D: Geothermal Regulatory Agencies by State). Although multiple agencies' overlapping jurisdiction for the various aspects of geothermal development can be appropriate, poor coordination among those agencies can lead to redundant requirements or other inefficiencies.[66] Some state agencies may also lack in-depth knowledge of next-generation geothermal, impeding efficient and appropriate permitting decisions.

During our interviews with geothermal developers, we asked: "If a government entity (e.g., a state) had $10 million to put towards incentivizing geothermal, how would you want them to spend it?" Improving the permitting process by increasing agency capacity was the most common answer.

65 Geothermal is sometimes described as either a mineral right, a water right, or as a *sui generis* resource associated with neither. However, the applicable requirements for a given project are in fact more complex, with differing treatment depending on the details of the project at issue (such as its location, depth, temperature, and type of water use).

66 For example, in some states, developers report having to submit the same forms to different state agencies through multiple different online portals, each one for a different agency.

POLICY RECOMMENDATIONS:

2A. Agency Capacity

Ensure that agencies responsible for geothermal permitting, leasing, and environmental review processes have sufficient resources and staff capacity to manage those processes efficiently and effectively. This requires staff with expertise in the geosciences (geology, geophysics, geochemistry, hydrology, soil sciences, etc.), drilling and well construction, subsurface engineering, surface facility engineering, and geothermal energy (including next-generation geothermal) who can properly evaluate projects and risks.

2B. Application Fees

Increase application fees charged to developers and use those funds to improve and streamline leasing, permitting, and environmental review processes (e.g., by hiring additional staff). Because delays and uncertainty in these processes are so expensive, this model is economically advantageous for developers.

2C. Lead Agency

Designate one lead agency for geothermal development. This agency would manage the permitting process for geothermal projects (for example, by taking in application forms and other information from developers), streamline permits and information-sharing, and work with other agencies to keep processes efficient.[67]

- The lead agency should be the agency with the most expertise and experience permitting subsurface projects. Typically, this will be the same agency as is responsible for minerals, natural resources, and/or oil and gas. However, in states where there is a history of geothermal development happening through a different agency (e.g., Utah's Division of Water Rights), that agency may have developed historical knowledge of geothermal that makes it best-suited to lead the process.

2D. Review Timelines

Improve permit review timelines.

- Over half of U.S. states have permitting timelines set by statute or regulation that govern permit issuance for solar and/or wind,[68] some of which may also apply to geothermal; some states also have timelines specifically guiding portions of the geothermal permitting process. States that have permitting timelines for solar and/or wind could set timelines for geothermal permit issuance while ensuring agency capacity is sufficient to meet those timelines.
- When multiple permits are required for a geothermal project, processing applications concurrently (rather than sequentially) can improve timelines.

2E. Permitting Guidebooks

Help developers move through the permitting process by providing comprehensive, publicly available guidance that lays out the full geothermal development process, including a list of all necessary leases, permits, and rights that must be obtained, which agencies are involved at each part of the process, the laws and regulations that govern the process, any relevant guidance documents, and links to all necessary forms and applications.[69]

2F. Tracking and Transparency

Create a publicly-available tracking system that works across all relevant agencies to centralize collection of relevant documents and automatically update the status of projects as agencies receive, process, and finalize decisions on applications. Transparency about application status gives developers, agencies, and the public greater insight into the status of particular projects, any backlog the agency may be facing, and the typical timeline for permits.

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67 For example, projects in California can use a single Application for Certification process through the state's California Energy Commission. *See* California Energy Commission. (n.d.). *Opt-in certification program.* https://www.energy.ca.gov/programs-and-topics/topics/power-plants/opt-certification-program

68 Enterline, S. & Valainis, A. (2024). *Laws in order: An inventory of state renewable energy siting policies.* Regulatory Assistance Project, Lawrence Berkeley National Laboratory, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, Clean Air Task Force, Consensus Building Institute. (p. 10). https://eta-publications.lbl.gov/sites/default/files/rap-enterline-valainis-laws-order-inventory-state-renewable-energy-siting-policies-2024-june.pdf

69 For example, Utah has a guidance website that includes a flow chart listing the permit process for geothermal power production; *see* Utah Division of Water Rights. (n.d.). *Power production.* https://waterrights.utah.gov/geothermal/power-production.asp. New Mexico offers an interactive "clean energy concierge" website which provides information about permitting processes for multiple types of projects, a list of financial incentives for each type of project, and contact information for key state agencies that regulate and support clean energy projects; see New Mexico Energy Conservation and Management. (n.d.). *Your clean energy concierge – build in New Mexico*. https://clean.energy.nm.gov/clean-energy-concierge/. Siting and permitting guides of this type exist for wind and/or solar in most U.S. states, including 78% of western states. *See* Enterline, S. & Valainis, A. (2024). *Laws in order: An inventory of state renewable energy siting policies.* Regulatory Assistance Project, Lawrence Berkeley National Laboratory, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy,

Case Studies: Agency Coordination

The Nevada Division of Environmental Protection (NDEP) is the lead agency for the state's Underground Injection Control (UIC) program, while the Nevada Division of Minerals (NDOM) permits geothermal drilling. These agencies entered into a cooperative agreement in 2008[70] that delineates their respective jurisdictions over geothermal injection wells and streamlines processes. Under the agreement, approval of an NDOM drilling permit also satisfies the UIC program construction permit requirements for NDEP, and standard operating procedures under 30 days may be approved by NDOM rather than requiring separate NDEP UIC permitting.

The California Department of Conservation (DOC), Division of Oil, Gas, and Geothermal Resources, has an agreement with the U.S. Bureau of Land Management (BLM) that governs the shared regulation of oilfield operations on BLM land in California. The agreement lists specific goals for the agencies to jointly work towards, including coordination on inspections and electronically streamlining operator submissions in areas where BLM and DOC authorities overlap.[71]

2G. Interagency Agreements
Develop formal interagency agreements to govern and streamline coordination between state agencies and relevant federal agencies (e.g., BLM field offices) regarding geothermal projects on federal lands in a state (see Case Studies: Agency Coordination, above).

2H. Model Ordinances
Develop model ordinances that local jurisdictions can adopt for zoning and siting of geothermal projects. Most states have developed model ordinances for wind and/or solar projects,[72] and similar model ordinances for geothermal projects could give localities a ready template to address local impacts and risks associated with such projects.

2I. Inter-Agency Liaison
Assign each geothermal project a liaison, or establish a one-stop shop coordination office, to serve as a point of contact with other agencies and help developers move through the leasing and permitting processes.

2J. Inter-State Coordination
Work with other states to adopt coordinated definitions and regulatory systems for geothermal energy. Leasing processes, permitting and environmental review processes, and treatment of ownership rights in split estates should be consistent across jurisdictions.

Establish or Clarify Geothermal Property Rights

Geothermal developers require clear legal rights to access and use subsurface resources before proceeding with projects, but ownership regimes for geothermal resources in many states are unclear.

Property rights issues associated with next-generation geothermal can be broadly divided into those that may arise (a) between parties with interests in the same parcel of land (i.e., split estates); or (b) from geothermal development's impacts on neighboring properties.

Clean Air Task Force, Consensus Building Institute. https://eta-publications.lbl.gov/sites/default/files/rap-enterline-valainis-laws-order-inventory-state-renewable-energy-siting-policies-2024-june.pdf

70 The Commission on Mineral Resources, Division of Minerals and The Department of Conservation and Natural Resources, Division of Environmental Protection. (2008). Interlocal Contract Cooperative Agreement between Public Agencies. https://ndep.nv.gov/uploads/documents/2008_ndep_ndom_coop_agreement.pdf

71 California State Office U.S. Bureau of Land Management and California Department of Conservation Division of Oil, Gas, and Geothermal Resources. (n.d.). *Memorandum of Understanding.* https://www.conservation.ca.gov/calgem/for_operators/Documents/MOU-MOA/MOU_BLM_Jurisdiction_2012.pdf

72 Enterline, S. & Valainis, A. (2024). *Laws in order: An inventory of state renewable energy siting policies.* Regulatory Assistance Project, Lawrence Berkeley National Laboratory, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, Clean Air Task Force, Consensus Building Institute. https://eta-publications.lbl.gov/sites/default/files/rap-enterline-valainis-laws-order-inventory-state-renewable-energy-siting-policies-2024-june.pdf

Under leases on wholly federal lands, where most next-generation geothermal development has occurred to date, the situation is relatively clear: the rights are conveyed by the lease.[73] In general, however, multiple subsurface ownership rights can be separated from both the surface estate and from each other. For instance, a state or federal government may sell or transfer its land to private parties with a reservation of certain subsurface rights, but it may be unclear as to whether that reservation includes geothermal resources.[74] On private lands, it may similarly be unclear whether a conveyance or reservation of mineral rights includes the rights to geothermal resources. Although disputes over such issues may be resolved by courts, state lawmakers can establish clarifying default rules for the allocation of geothermal rights in split estates. For example, federal law and several states' laws clarify the treatment of geothermal resources in their governmental land disposal statutes.[75] And on private land, Nevada, Oregon, Texas, and Washington each establish by statute a presumption that geothermal resource rights belong to the owner of the surface estate absent specific reservation or conveyance of those geothermal rights to a different owner.[76] In other instances, the issue is not resolved, even if the delineation between mineral and geothermal resource rights has been defined for purposes of leasing.[77]

Across property boundaries, state property law generally governs the resolution of property rights disputes between neighboring interest holders. Geothermal operations on one parcel may affect neighbors through the migration of injected fluids, propagation of induced fractures, induced seismicity, or drawdown of geothermal heat. However, the legal frameworks governing these impacts are largely undeveloped as applied to next-generation geothermal. These issues will become increasingly significant as geothermal energy develops further, and uncertainty around potential liabilities could deter investment.

POLICY RECOMMENDATIONS:

2K. Surface Ownership Presumption
Establish by law a presumption that geothermal resources are owned by the owner of the surface estate and are not severed with a conveyance or reservation of the mineral estate (see Case Study: Ownership Clarification, below). This would follow the majority rule in Western states and would improve developers' ability to obtain clear rights to geothermal resources.

2L. Cross-Boundary Legal Frameworks
Establish legal frameworks for managing geothermal impacts across property boundaries. This would involve establishing both the property law framework for geothermal resource ownership rights and liabilities[78] and the regulatory framework for managing such rights.[79]

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73 *See* Geothermal Steam Act of 1970, 30 U.S.C. §§ 1001–1028.

74 For example, private parties have unsuccessfully disputed the federal government's retained rights to geothermal resources on lands divested pursuant to the Stock-Raising Homestead Act of 1916. *See* United States v. Union Oil, 549 F.2d 1271 (9th Cir. 1977), Rosette v. U.S., 277 F.3d 1222 (10th Cir. 2002).

75 Federal law clarifies that federal mineral reservations made after 1970 include geothermal resources; *see* 30 U.S.C. § 1024. Colorado more clearly provides that state land sales must include a reservation to a broad range of subsurface resources including geothermal resources; *see* Colo. Rev. Stat. § 36-1-125. Oregon law provides that the state may not reserve mineral or geothermal resource rights in certain "low-potential" lands; *see* Or. Rev. Stat. 273.787.

76 N.R.S. § 534A.050 (Nevada); O.R.S. § 522.035 (Oregon); Tex. Nat. Res. Code § 141.004 (Texas); R.C.W. § 78.60.040 (Washington state).

77 A state's treatment of geothermal resources as mineral resources (or not) within the state's leasing or permitting regimes does not necessarily relate to the allocation of property rights to such resources. *See*, e.g., Ida-Therm v. Bedrock Geothermal, 293 P.3d 630 n.1 (Idaho 2012) (conveyance deed interpreted without regard to geothermal resource definitions in other parts of the Idaho code).

78 This might involve specifying how trespass, nuisance, and the rule of capture apply to geothermal energy. *See* Eckstein, G. (2026). Owning Geothermal Energy. *Michigan Journal of Environmental & Administrative Law,* 15(2), 293-332. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=6914618. It might also cover whether, for example, agency-authorized activities are immunized from subsurface trespass liabilities. *Cf. Railroad Commission of Texas v. Manziel,* 361 S.W.2d 560 (Tex. 1962) (agency-authorized cross-boundary waterflooding not a trespass).

79 Such a regulatory framework might involve rules for protection of correlative rights and procedures for unitization. *Correlative rights* refers to a landowner's right to develop a just and equitable share of a common-pool resource, and obligation to not impair that right for others, such as oil from a shared subsurface reservoir or heat from a shared geothermal system. *Unitization* refers to the consolidation of separately-owned interests in a common reservoir into a single operating unit. Both are commonly used for oil and gas reservoirs. Several Western states have addressed these issues with respect to geothermal resources. *See*, e.g., Alaska Stat. § 41.06.005(a) (commission jurisdiction to protect correlative rights), 41.06.030 (unitization); Ariz. Rev. Stat. §§ 27-664, 27-665 (cooperative development and unitization); N.M. Stat. Ann. §§ 71-9-5.A, 71-9-6(6) (correlative rights); Tex. Nat. Res. Code §§ 141.011, 141.012(b)(4) (correlative rights); Utah Code §§ 73-22-7, -9 (unitization and correlative rights). *See* generally Eckstein, G. (2025). *Who Owns the Heat? Property Rights in Geothermal Energy.* U. Ill. L. Rev. 491.

Case Study: Ownership Clarification

In 2023, Texas passed SB 785, which established a default presumption that geothermal resources are owned by the owner of the surface estate; prior to this bill, it was unclear to many observers whether geothermal resources were owned by the owner of the surface estate or the owner of the mineral (subsurface) estate.[80]

Improve Leasing Processes for State-Owned Lands

Consistent and frequent lease sales are necessary for developers to be able to access land and to plan projects knowing that land will be available for lease.

State requirements for obtaining, maintaining, and renewing geothermal leases vary across states (see Appendix C: Geothermal Regulatory Systems by State). In some western states, developers that identify geothermal potential on a parcel of land can lease that land by negotiating with the state; in others, developers must nominate land for competitive leasing in a public auction.[81] Competitive leasing processes are an important way to evaluate demand for geothermal, and to ensure that states receive a fair market value for the use of state land. However, poorly designed competitive leasing regimes can create perverse incentives that may disincentivize exploration. If a developer invests resources into identifying geothermal potential in a new area, competitive leasing may force them to publicly announce their discovery by nominating the parcel for lease and risk being outbid by a company that did not make the same pre-lease investment in identifying geothermal potential. This free rider problem discourages investment in geothermal exploration, reducing the overall development of geothermal energy.

Leasing and land use frameworks for geothermal should incentivize exploration of new areas that might be suitable for geothermal development. Equally important is to account for the full range of areas that might host geothermal resources (including areas that were not previously viable for development through conventional hydrothermal systems), protect ecologically and culturally sensitive areas, maximize public benefit from geothermal projects on state-owned lands, and ensure that land is used promptly for projects.

POLICY RECOMMENDATIONS:

2M. Frequent, Consistent Lease Sales
Hold frequent and consistent lease sales when there is interest in geothermal in the state, including annual lease sales for states that use a competitive leasing process.

2N. Encouraging Exploration
Adopt mechanisms to reward geothermal exploration and reduce free-rider disincentives in competitive leasing, such as allowing for leasing through non-competitive mechanisms (i.e., negotiation with the relevant state agency) when a developer has invested significant resources into understanding the geothermal potential of a new area.

2O. Incentivizing Development
Set lease terms and conditions to incentivize prompt and efficient development of geothermal resources, such as by requiring ongoing development activity[82] as a condition of maintaining a lease.

2P. Enabling Exploration
Allow non-invasive exploration activities (such as air surveys and ground surveys with minimal disturbance) on unleased lands, as the federal government does.[83]

80 Tex. S.B. 785 (June 18, 2023) (enacting Tex. Nat. Res. Code § 141.004).

81 For more details on leasing requirements across the West, *see* Appendix C: Geothermal Regulatory Systems by State.

82 The details of such activity would vary depending on the phase of development. For more details on the phases of geothermal development, *see* Appendix B: Geothermal Project Phases.

83 *See* 89 Fed. Reg. 84380 (Oct. 22, 2024) (resource confirmation) and 90 Fed. Reg. 5981 (Jan. 17, 2025) (exploration)

Establish Clear Geothermal Permitting Processes

"Geothermal energy" is a broad term encompassing a wide range of energy systems[84] that vary widely in terms of the depth and temperature accessed,[85] the purpose of the system, the technology used,[86] and the risks that must be mitigated. In recognition of these differences, some states have developed separate permitting systems for different types of geothermal development, often differentiating by temperature and in at least one case by depth.[87] Differentiating by these factors is counterproductive; for example, temperature thresholds may create an artificial distinction between projects just on one side or the other of that threshold. **Instead, agencies should develop regulations that are calibrated to address the risks of each project.**

Most state geothermal regulatory frameworks were developed at a time when conventional hydrothermal systems were the only form of geothermal generation. However, there are important differences between conventional and next-generation systems that may necessitate updates to these frameworks and/or how they are applied. For example, conventional geothermal systems use heated water that is already present in the subsurface of the project site, known as *in situ* water, which may connect to nearby groundwater.[88] By contrast, next-generation geothermal systems use water from offsite (similar to agricultural or industrial users, though geothermal projects often use brackish water or municipal wastewater). These differences have implications for both property rights[89] and groundwater protection.[90]

Additionally, a geothermal development project may implicate multiple legal regimes around injection, water use, and mineral byproducts, and the regulatory framework must be clear about what permits are required for what activities. Consistent regulatory systems among states will make it easier for geothermal companies to track, understand, and comply with requirements.

84 This includes ground source heat pumps, district heating and thermal energy networks, utility-scale conventional geothermal, and utility-scale next-generation geothermal.

85 For example, ground source heat pumps generally operate at depths of 1-120 meters and temperatures of 4-21°C; *see* U.S. Department of Energy. (n.d.). *Geothermal heat pumps.* https://www.energy.gov/hgeo/geothermal/geothermal-heat-pumps. By contrast, next-generation geothermal projects have reached depths of 5.5 meters and temperatures of 290°C, and continued innovation is pushing into deeper depths and hotter temperatures; *see* Cariaga, C. (2023, January 31). Eavor completes Eavor-Deep geothermal demonstration project. ThinkGeoEnergy. https://www.thinkgeoenergy.com/eavor-completes-eavor-deep-geothermal-demonstration-project *and* Fervo Energy. (2026, February 9). *Fervo Energy drills hottest well to date at new giga-scale geothermal project site* [Press release]. https://fervoenergy.com/fervo-energy-drills-hottest-well-to-date-at-new-giga-scale-geothermal-project-site

86 There are technological differences even among next-generation geothermal systems – for instance, closed-loop systems aim to eliminate contact between subsurface rocks and the fluid used to transfer heat, while enhanced geothermal systems involve direct contact between the rock and the fluid.

87 *See* Appendix C: Geothermal Regulatory Systems by State.

88 Almost all geothermal systems use water as the transfer mechanism to collect heat from the subsurface. It is possible to use a different fluid rather than water to collect heat, but no such system has yet been developed at commercial scale. Some amount of water is consumed as part of all next-generation geothermal systems – for example, lost through evaporation while being processed in the power plant. The amount of water consumed in a geothermal project varies based on the design of the surface equipment and the choice between a closed-loop or enhanced geothermal system; *see* Seligman, A. (2026). *Water use and next-generation geothermal* [Fact sheet]. Clean Air Task Force. https://www.catf.us/resource/water-use-next-generation-geothermal/

89 *Compare*, e.g., Wyo. Stat. § 41-3-901(a) ("underground water" subject to the state's prior appropriation regime includes "hot water and geothermal steam" without limitation); *with* Idaho Code §§ 42-4002(c), 42-4003(4), 42-4005(e) (groundwater at or above 212 F is defined to be a geothermal resource but requires water appropriation permits in specified circumstances); *and* Colo. Rev. Stat. § 37-90.5-104(1)–(2) (geothermal resources associated with tributary groundwater are subject to prior appropriation, while those associated with nontributary groundwater or hot dry rock are incident to the surface estate).

90 Next-generation geothermal poses different risks during drilling operations and reservoir creation than conventional geothermal does, and generally has lower groundwater contamination risks than conventional geothermal. Conventional geothermal water has a higher likelihood of carrying chemicals due to the surrounding rock type and the increased length of time that the hot water has been in contact with that rock.

POLICY RECOMMENDATIONS:

2Q. Clear, Standardized Permitting Requirements
Ensure permitting regimes clearly establish the way different aspects of geothermal development are covered – including *in situ* water, the geothermal heat itself (apart from the medium in which it is contained), and the potential byproducts of geothermal operations, such as co-produced helium or dissolved minerals – and standardize state definitions of geothermal resources subject to the state's permitting regime. States should follow the most common rule to include all use of heat, without a temperature threshold. (For an overview of state definitions of geothermal resources subject to the state's permitting regime, see Appendix C: Geothermal Regulatory Systems by State.)

2R. Comprehensive Regulations
Develop appropriate regulations for geothermal, which may differ between conventional geothermal, next-generation geothermal, and next-generation geothermal at superhot temperatures. Such regulations should cover drilling; well design, casing, and construction; surface and groundwater protection; induced seismicity; and decommissioning. Regulators should also continually track new approaches, techniques, and materials and update regulations as needed to ensure that regulatory systems continue to match real-world conditions and new industry innovations.

- For example, states can require protocols to mitigate the risk of induced seismicity for geothermal projects, building on leading models such as those developed by the U.S. Department of Energy (see Case Study: Induced Seismicity Mitigation)[91] and the Swiss Seismological Service.[92]

Case Study: Induced Seismicity Mitigation

In 2012, DOE published a "Protocol for Addressing Induced Seismicity Associated with Enhanced Geothermal Systems."[93] The protocol was explicitly developed in response to public concerns about seismic activity associated with geothermal energy, and it brought together leading experts to develop a data-informed mitigation approach. The protocol's seven steps include preliminary screening, pre-project and real-time seismic monitoring, modeling and quantification of seismic hazards, and the development and implementation of a risk-based mitigation approach to guide operator actions during development. Adhering to the protocol is required as a condition of DOE funding for geothermal projects. Since its publication, no next-generation geothermal project in the U.S. has created felt induced seismicity.[94]

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91 Majer, E., Nelson, J., Robertson-Tait, A., Savy, J., & Wong, I. (2012). *Protocol for addressing induced seismicity associated with enhanced geothermal systems.* Geothermal Technologies Program, U.S. Department of Energy. https://www1.eere.energy.gov/geothermal/pdfs/geothermal_seismicity_protocol_012012.pdf

92 Kraft, T., Roth, P., Ritz, V., Antunes, V., Toledo, T., & Wiemer, S. (2025). Good-practice guide for managing induced seismicity in deep geothermal energy projects in Switzerland. Swiss Seismological Service (SED) at ETH Zurich. https://doi.org/10.3929/ethz-b-000714220

93 Majer, E., Nelson, J., Robertson-Tait, A., Savy, J., & Wong, I. (2012). *Protocol for addressing induced seismicity associated with enhanced geothermal systems.* U.S. Department of Energy, Energy Efficiency & Renewable Energy, Geothermal Technologies Program. https://www1.eere.energy.gov/geothermal/pdfs/geothermal_seismicity_protocol_012012.pdf

94 Seligman, A. (2026). *Induced seismicity and next-generation geothermal* [Fact sheet]. Clean Air Task Force. https://www.catf.us/resource/induced-seismicity-next-generation-geothermal/

2S. Tailored Regulations by Type

Tailor regulations to each type of geothermal development. Applying the highest level of scrutiny required for one activity to a lower-risk activity can raise costs and slow project timelines unnecessarily. Key considerations for next-generation geothermal projects include:

- Is the project hydrologically connected to drinking water aquifers (see Case Studies: Water and Deep Geothermal)?[95]
- Is the project drilling below the level of the deepest nearby drinking water aquifer?
- Will the bottom of the well be open, so that water comes into direct contact with the rock (as happens in EGS projects), or will it be fully cased so that water never touches the rock (as happens in closed-loop projects)?
- Does the project use *in situ* water, or only offsite water?[96] Projects using offsite water should go through normal processes to secure access to that water, just like any other user of offsite water, but may not need to fulfill the same permitting requirements as geothermal systems that use and consume in situ water (see Case Studies: Water and Deep Geothermal).
- Does the project use potable water? If the project is using non-potable water, what is the geochemistry of that water?
- What is the geochemistry of the subsurface geothermal system?
- What materials and fluids will be injected into the well and/or used to construct the well?
    - Does the project use hydraulic fracturing (see Case Study: Induced Seismicity Mitigation, above)?[97] If so, what types of fracking fluids will be used?
- What are the decommissioning steps needed for the type of well in question?

Case Studies: Water and Deep Geothermal

Arizona law specifies that “Geothermal resources and their development shall be exempt from the water laws of this state unless either: 1. Such resources are commingled with surface waters or groundwaters of this state. 2. Such development causes impairment of or damage to the groundwater supply. … In the development of geothermal resources, any well drilled to obtain and use groundwater, as defined in section 45-101, shall be subject to the water laws of this state.”[98]

Colorado law differentiates between geothermal projects that use tributary groundwater (water that is hydrologically connected to a surface stream) and projects that use nontributary groundwater; for example, the state defines a “deep geothermal operation” in part as a geothermal operation that uses nontributary groundwater, with “shallow geothermal operation” including operations that use tributary groundwater.[99] In 2025, the state passed HB26-1165, which established that a permit from Colorado State Engineer is not required for withdrawing nontributary groundwater for deep geothermal operations for specified purposes.[100]

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95 This is extremely rare.

96 It is also important to distinguish consumptive and nonconsumptive water use. Nonconsumptive use diverts water from its original location for another use (e.g., graywater diverted to circulate through a geothermal system) without it being consumed, whereas consumed water is permanently withdrawn from its source (e.g., water at a geothermal power plant that evaporates away). The amount of water consumed in geothermal power plants varies greatly by system. *See* Clean Air Task Force. (2026, April 3.). *Water Use and Next-Generation Geothermal.* https://www.catf.us/resource/water-use-next-generation-geothermal/

97 Some next-generation geothermal systems use hydraulic fracturing (also known as “fracking”), while others do not. Fracking for geothermal energy is different from – and significantly less risky than – fracking for oil and gas, but still carries some risk. Safety protocols developed by leading independent scientists have been used for years to help ensure that geothermal projects that use fracking can be developed and operated safely. *See* McLaughlin, K., Jaeger, J., Womble, J., Bird, L., Hausker, K. (2024). (p.16-17). *Next-generation geothermal: Considerations and opportunities for responsible development.* World Resources Institute. https://doi.org/10.46830/wriib.24.00015

98 Arizona Revised Statutes (ARS) § 27-667

99 Colorado Revised Statutes (CRS) § 37-90.5-103 (2024)

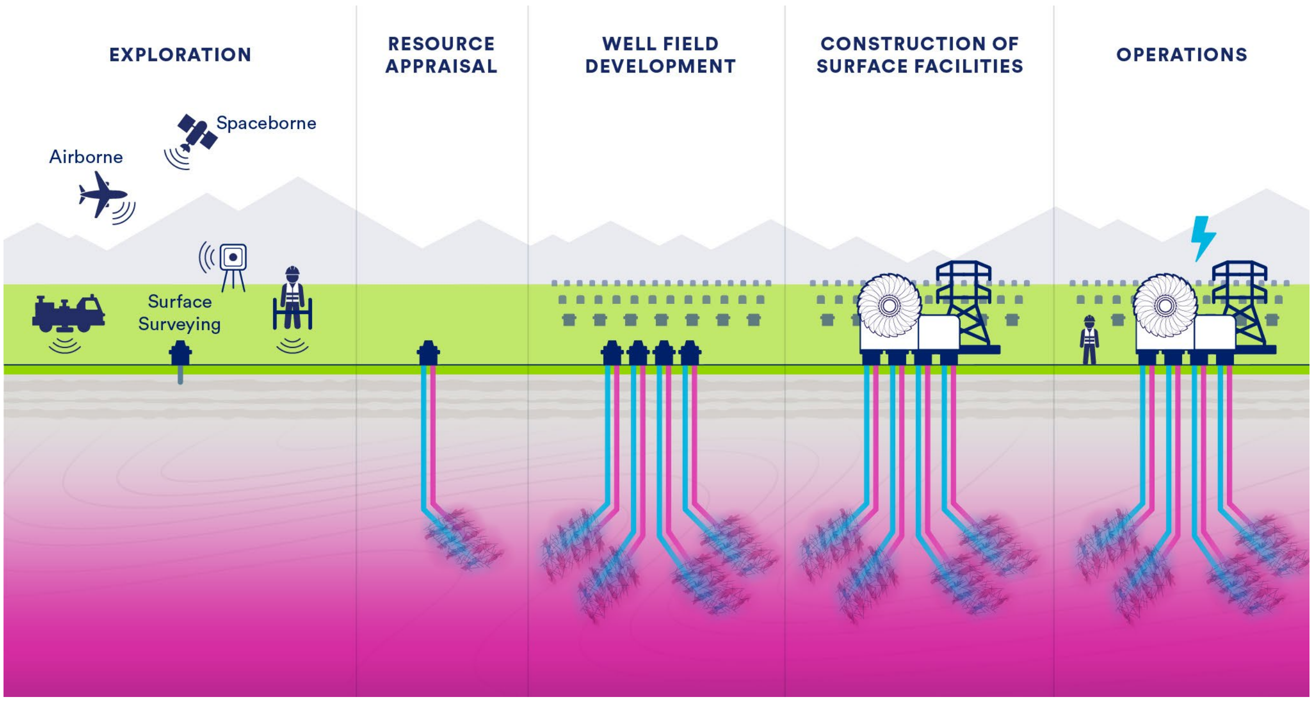
100 HB25-1165, 2025 Regular Session. (Colorado 2025). https://leg.colorado.gov/bills/hb25-1165

2T. Tailored Regulations by Phase

Tailor regulations to the phase of geothermal development activity being regulated: exploration, resource appraisal, well field development, construction of surface facilities, operations, and decommissioning (see Figure 11 and Appendix B: Geothermal Project Phases). States can choose to offer one inclusive permit that applies to both exploration and production drilling,[101] or use a phased approach in which different parts of the process require different permits. Regardless of approach, permitting requirements should be tailored to address all necessary safety considerations while maximizing efficiency (see Case Study: Temporary Permits, below).

- Tailored regulations should also include requirements for security deposits or bonds that take into consideration the limited balance sheets of some geothermal startups while also reserving sufficient funds to manage abandoned wells and future decommissioning obligations.

Figure 11: Geothermal energy project development phases



[101] Levine, A., Smith, F. M., & Buchanan, H. (2023). *Topics and Considerations for Developing State Geothermal Regulations.* (p. 33). National Renewable Energy Laboratory. https://docs.nlr.gov/docs/fy23osti/86985.pdf

Case Study: Temporary Permits

The Nevada Division of Minerals (NDOM) can authorize a seven-day temporary injection permit as part of the exploration process.[102] This temporary permit gives enough time for developers to capture the data needed to apply for a UIC permit, and follows a more streamlined process than the permits for wells that will be used for longer periods of time.

2U. UIC Primacy
Consider seeking primacy under the federal Underground Injection Control (UIC) program to unify primary regulatory authority within state agencies. Geothermal wells are typically Class V wells under the UIC program. The lead state agency for geothermal could administer or coordinate the administration of the relevant UIC permits.

2V. Clarity in Permitting
When multiple permits are required for a geothermal project, or when some permits are only required for some geothermal activities, be clear about what permits are required for what activities.

Improve Environmental Review Requirements

Some states (including the western states of California, Hawaii, Montana, and Washington) have environmental review requirements that require permitting agencies to evaluate, and sometimes mitigate, the environmental impacts of their actions.[103] These requirements can be an important way to meet state goals for responsible development, but – depending on the details of the state law – might also be duplicative with other state processes or with the federal process under the National Environmental Policy Act (NEPA). Careful consideration of state-level environmental review requirements may allow states to improve these processes while maintaining the strong environmental protections they are designed to foster.

POLICY RECOMMENDATIONS:

2W. Tailored Categorical Exclusions
Consider establishing categorical exclusions from state-level environmental review requirements for low-impact geothermal exploration and resource confirmation activities, similar to those established under federal law.[104]

2X. Federal-State Streamlining
Streamline coordination between state-level environmental review processes and federal NEPA reviews. To the extent the requirements of the statutes are similar or duplicative, states can accept the same forms and information as are used for federal NEPA processes.

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102 Levine, A., Smith, F. M., & Buchanan, H. (2023). *Topics and Considerations for Developing State Geothermal Regulations.* (p. 34). National Renewable Energy Laboratory. https://docs.nlr.gov/docs/fy23osti/86985.pdf

103 Rollins, B. & Roberson, J. (n.d.). *States' "mini-NEPA" laws.* The National Agricultural Law Center. https://nationalaglawcenter.org/state-compilations/state-mini-nepa-laws/

104 In January 2025, the federal Bureau of Land Management (BLM) finalized a categorical exclusion from NEPA for geothermal resource confirmation activities that had been successfully implemented without environmental impact; *see* National Environmental Policy Act Implementing Procedures for the Bureau of Land Management (516 DM 11), 90 FR 5981 (codified January 17, 2025). https://www.federalregister.gov/documents/2025/01/17/2025-01084/national-environmental-policy-act-implementing-procedures-for-the-bureau-of-land-management-516-dm. Geothermal developers report that this categorical exclusion has improved timelines for environmental review. In April 2026, BLM finalized an additional categorical exclusion for resource exploration; *see* National Environmental Policy Act Implementing Procedures for the Bureau of Land Management, 91 FR 22848 (codified April 28, 2026). https://www.federalregister.gov/documents/2026/04/28/2026-08235/national-environmental-policy-act-implementing-procedures-for-the-bureau-of-land-management

3. Finance: Incentivize Exploration and Demonstration

Why It Matters

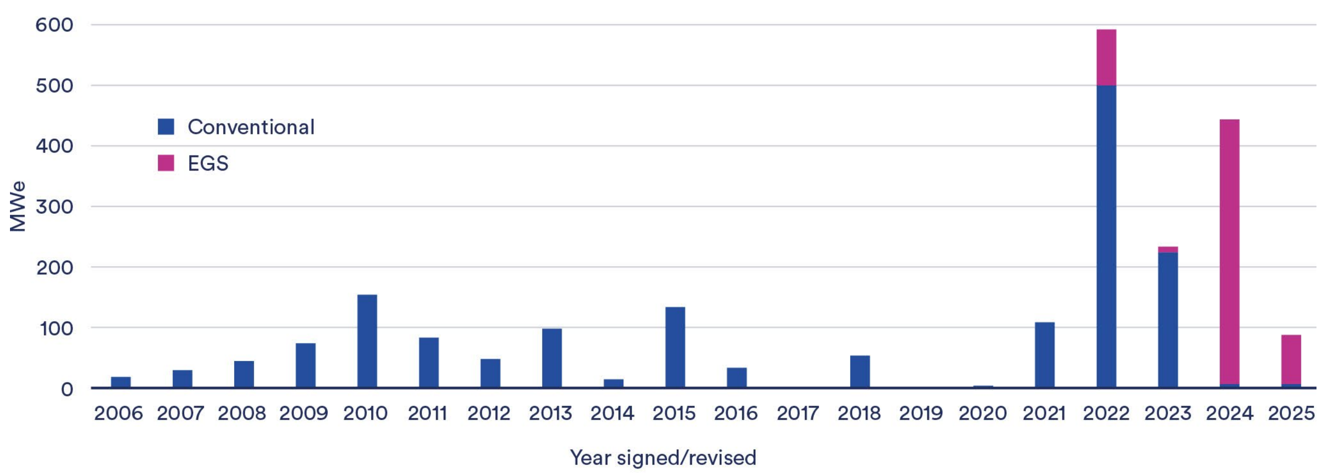
Government support is necessary to help any early-stage technology scale up, including next-generation geothermal.

The recent growth of next-generation geothermal has been driven primarily by three sources: federal funding,[105] California's 2021 procurement requirement for 1 GW of clean firm power,[106] and data center demand.

These factors combined to drive a surge in PPAs (see Figure 12)[107] that supported early commercial demonstrations of next-generation geothermal since the late 2010s. However, more needs to be done to fully bring the industry through the missing middle. Continued government support for early projects in new areas is necessary to ensure that those projects are built. Additional demonstrations will derisk geothermal technology and new geologic regions, increase the number of private investors willing to fund geothermal projects, and initiate a virtuous cycle of learning-by-doing, decreasing costs, and increasing deployment.

Figure 12: Announced geothermal PPAs by type and year signed/revised

There has been significant growth in geothermal PPAs in the U.S. since 2021, driven primarily by three sources: federal funding, California's 2021 procurement requirement for clean firm power, and data center demand. Note: data through Q1 of 2025.[108]



[105] For example, DOE funded early next-generation demonstrations in southwest Utah (Utah FORGE) and at the Newberry Volcano in central Oregon; *see* Cariaga, C. (2024 October 3). *Utah FORGE secures 4-year extension, more funding for enhanced geothermal research.* ThinkGeoEnergy. https://www.thinkgeoenergy.com/utah-forge-secures-4-year-extension-more-funding-for-enhanced-geothermal-research/ *and* Geothermal Technologies Office. (2013, April 9). *EERE success story – Oregon: DOE advances game-changing EGS geothermal technology at the Newberry Volcano.* U.S. Department of Energy. https://www.energy.gov/hgeo/geothermal/articles/eere-success-story-oregon-doe-advances-game-changing-egs-geothermal. These proved that next-generation geothermal is viable and derisked the nearby subsurface, crowding in private investment. DOE also funded the Geothermal Limitless Approach to Drilling Efficiencies (GLADE) test project in Colorado; see Brasch, S. (2026 March 5). *An oil company quietly dug a surprisingly deep geothermal well.* Canary Media. https://www.canarymedia.com/articles/geothermal/oil-company-dug-four-mile-deep-well

[106] California Public Utilities Commission. (n.d.). *Fact Sheet: Decision Requiring Clean Energy Procurement for Mid-Term Reliability*. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-termprocurement-plan-irp-ltpp/d2106035-mtr-decision-factsheet--07-01-2021.pdf

[107] 70% of the geothermal PPAs signed in 2022-2023 were with buyers in California. (Zhou, Y., personal communication, February 4, 2026).

[108] Lipton, J., & Seligman, A. (2025). *Powering the future: What 50 years of enhanced geothermal teaches us today.* (p. 17). Clean Air Task Force. https://www.catf.us/wp-content/uploads/2025/08/CATF-EGS-Trend-Analysis-Report.pdf

Where Things Stand

Multiple western states have recognized the importance of geothermal energy and developed financing tools meant to support its development, including grant programs; loan financing programs; and tax credit, abatement, or exemption programs. But not all of these programs are calibrated toward the most important financing barriers for next-generation geothermal. Larger and better-tailored programs are needed to incentivize significant amounts of new deployment.[109]

The fundamental issue facing states that want to support geothermal development is that geothermal projects are expensive and state budgets are limited.[110] Direct financing for full-scale projects would cost more money than most states have available. However, targeted financing mechanisms and incentives can make a real difference for geothermal deployment while also remaining in fiscal scope.

What States Can Do

Priority Actions for Policymakers:

- Establish procurement targets or standards for geothermal energy (recommendation 3A)
- Support early geothermal projects in new regions through milestone-based convertible loans (recommendation 3B)

The most effective use of state funding for geothermal deployment is on programs that crowd in private capital by supporting early projects in new regions.

POLICY RECOMMENDATIONS:

3A. Procurement Standards

Establish procurement targets or standards for geothermal or clean firm resources (see Case Study: Procurement, below). For states with a renewable portfolio standard (RPS) or clean electricity standard (CES), one option is to include a carve-out for geothermal in the state RPS or CES, as some states have done for solar or wind.[111] To protect ratepayers, any such procurement standard could include cost containment mechanisms, such as pauses or reductions in the procurement target if geothermal power costs rise above a certain level.[112] States can also prioritize clean firm sources like geothermal for state power procurement, and/or offer advance market commitments for next-generation geothermal power.[113]

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109 Many of the tax credits are capped, limiting the amount that can be given to any one project, and the grant programs also tend to be small, in the tens of millions of dollars across the entire program, meaning that individual grants will be even smaller and unlikely to make an impact on developer incentives. For example, earlier CATF research found that grants from California's geothermal grant program are "relatively small and are not sufficient to enable new next-generation geothermal projects"; other energy-related grant programs may offer larger award amounts, but "funding allocations depend on shifting state priorities each investment cycle, and geothermal projects are typically considered within broad, competitive funding categories." *See* Rogers, T., Garth, A., & Arax, A. (2025). *Unlocking California's geothermal potential: A strategic opportunity for clean, firm power.* Clean Air Task Force. https://cdn.catf.us/wp-content/uploads/2025/06/23162128/california-geothermal-report.pdf

110 Federal support for geothermal energy is another key factor affecting impact the pace of deployment; *see* Garth, A. (Forthcoming). *Next-Generation Geothermal at Scale: A Federal Action Framework.* Clean Air Task Force. https://www.catf.us/resource/next-generation-geothermal-at-scale. But despite their smaller budgets, states can play a targeted role in helping early commercial-scale geothermal projects move forward.

111 Tarr, J., Cobb, P. L., & Goho, S. (2024). *State clean energy standards.* Clean Air Task Force. https://www.catf.us/resource/state-clean-electricity-standards/

112 States could also develop a hybrid procurement model in which utility or state procurement provides guaranteed backstop demand for a certain amount of clean firm power, but third parties can pay a premium to access of some portion of the selected project's energy, capacity, and environmental attributes.

113 Spokas, K. & Ricks, W. (2026). *Clean firm electricity technologies: What, why, how. Clean Air Task Force.* https://www.catf.us/resource/clean-firm-electricity-technologies-why-what-how/

Case Study: Procurement

California has developed numerous procurement standards for geothermal and clean firm energy, including procurement requirements and procurement authorities. The first such standard was a 2021 decision from the California Public Utilities Commission (CPUC) requiring load-serving entities to procure at least 1 GW of clean firm energy; this effort was motivated by concerns about grid reliability.[114] In 2024 and to implement AB 1373, the CPUC set up a centralized procurement entity, requesting that the Department of Water Resources (DWR) procure up to 1 GW of geothermal by 2035.[115] And in February 2026, the CPUC issued a decision for its Integrated Resource Planning (IRP) proceeding, requiring the procurement of at least 1.5 GW of clean firm resources by 2032.[116]

3B. Milestone-Based Convertible Loans

Create a milestone-based convertible loan program for the first geothermal projects in new regions. Loans would be distributed in sequential tranches as project milestones are met,[117] limiting the funds loaned to unsuccessful projects. Loaned funds would be repaid once a project reached commercial deliverability and began to generate revenue. The cumulative loans could be partially or fully converted to grants if phases of the projects were unsuccessful. States could set interest rates for the program at or below market rates, reducing costs of capital. Learning curves for geothermal repeat in new regions, making the first project in any new region riskier than subsequent projects. To address this issue, the program could be tiered, with the most generous support going to early projects in new areas and subsequent projects receiving less and eventually no support. A program of this type would derisk geothermal development in new regions – exactly what private financiers are least comfortable funding – ultimately crowding in private capital.

3C. Targeted Funding

Target funds to policies that will be a meaningful tipping point for geothermal deployment.

- In our interviews, we asked developers about the most effective use of limited pots of funding (e.g., $10 million). Developers reported that $10 million is generally not enough to derisk a full project, so a funding or tax credit program of that size will not meaningfully incentivize additional geothermal deployment. If a state only has that amount of money available to spend on geothermal, it should focus on improving permitting processes and agency capacity (see Deployment Lever 2: Govern) and funding subsurface data gathering and digitization (see Deployment Lever 1: Characterize). Across our interviews with geothermal developers, improving state agency permitting capacity was the most common recommendation for the most effective way that a state could spend $10 million to incentivize geothermal development.
- A program of about $10 million could also be used to fund early-stage feasibility studies, pre-scoping, and/or engineering and design work for geothermal projects, focused on the first projects in new regions. Supporting more detailed planning from developers in the early stages of developing projects would reduce the risk and cost of those projects and of successive future projects (see Case Studies: Predevelopment Support, below). Any such program should be open to applications from the private sector.

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114 California Public Utilities Commission. (n.d.). *Fact Sheet: Decision Requiring Clean Energy Procurement for Mid-Term Reliability.* https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/d2106035-mtr-decision-factsheet--07-01-2021.pdf

115 California Public Utilities Commission. (2024, August 26). *CPUC Advances Clean Energy with Centralized Procurement Strategy* [Press release]. https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-advances-clean-energy-with-centralized-procurement-strategy

116 California Public Utilities Commission. (2026, March 2). *CPUC Advances Clean and Affordable Electricity with New Procurement Decision.* https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-advances-clean-and-affordable-electricity-with-new-procurement-decision

117 For a list of project phases that could be used as milestones, *see* Appendix B: Geothermal Project Phases.

Case Studies: Predevelopment Support

In April 2026, Colorado awarded $494,000 to Fervo Energy, a leading next-generation geothermal developer, to “evaluate the potential for future geothermal electricity development” in two regions of the state.[118]

In February of the same year, New York announced a program to support predevelopment activities for offshore wind and nuclear projects. These activities can include "site characterization studies, onshore & nearshore surveys ... project design and layout, cost modeling, [and] other activities that clarify development costs and timelines."[119]

3D. Revenue Support

Provide long-term revenue certainty or other financial support for an initial tranche of geothermal generation in a new geologic region. The appropriate instrument for providing such support depends on market structure. For example, early-stage projects may be supported with output-based subsidies or price guarantees (see Case Study: Feed-In Tariffs), so long as these are designed to respect constraints imposed by federal law.[120] Revenue support of this kind helps developers finance projects in new geologic regions.

Case Study: Feed-In Tariffs

Forms of feed-in tariffs have been implemented across the U.S., including in Oregon, Maine, California, and Gainesville, Florida.[121] They were primarily used to incentivize solar development during an earlier period of its deployment (in the 2000s and 2010s), and could play a similar catalytic role for advancing geothermal energy today.

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118 Colorado Energy Office. (n.d.). *Polis administration awards $12.4 million to further develop geothermal energy in Colorado* [Press release]. https://energyoffice.colorado.gov/press-releases/polis-administration-awards-12.4-million-to-further-develop-geothermal-energy-in

119 New York State Energy Research and Development Authority. (2026, February 10). *Consideration of an Offshore Wind Predevelopment Support Program Request for Information (RFI) OSWRFI26-1.* (p. 4). https://portal.nyserda.ny.gov/servlet/servlet.FileDownload?file=00Pcr00000kfPzREAU

120 State policies affecting wholesale electricity sales must fall within constraints imposed by the Federal Power Act and Public Utility Regulatory Policies Act. See, e.g., Hughes v. Talen Energy Marketing, 136 S.Ct. 1288 (2016); Winding Creek Solar v. Peterman, 932 F.3d 861 (9th Cir. 2019); *see generally* Hempling, S., Elefant, C., Cory, K., & Porter, K. (2010). *Renewable Energy Prices in State-Level Feed-in Tariffs: Federal Law Constraints and Possible Solutions.* National Renewable Energy Laboratory. https://docs.nlr.gov/docs/fy10osti/47408.pdf

121 Oregon Public Utility Commission. (2025). *Solar photovoltaic volumetric incentive program: 2025 program update.* https://www.oregon.gov/puc/forms/Forms%20and%20Reports/2025-Solar-VIR-Program-Report.pdf; Maine Public Utilities Commission. (2010). *Community-based Renewable Energy Pilot Program.* https://web.archive.org/web/20120521155209/http://www.state.me.us/mpuc/electricity/community_pilot.shtml; California Public Utilities Commission. (2008, February 14). *CPUC approves feed-in tariffs to support development of onsite renewable generation* [Press release]. https://docs.cpuc.ca.gov/word_pdf/NEWS_RELEASE/78824.pdf; Crider, J. (n.d.). *Implementing the Gainesville feed-in tariff.* Gainesville Regional Utilities. https://web.archive.org/web/20120426000640/http://www.clean-coalition.org/storage/references/Letter%20from%20CLEAN%20Gainesville%20administrator%20John%20Crider%205%20Jul%202011.pdf

3E. Energy Development Funds
Ensure that geothermal is eligible for funding under large state energy development funds (e.g., California's Electric Program Investment Charge [EPIC] program, Alaska's Renewable Energy Fund, the New Mexico Community Benefit Fund, or the Texas Energy Fund). Depending on the program, it may be appropriate to prioritize energy sources that provide additional grid value (e.g., clean firm resources and those with limited price volatility).

3F. Timelines for Funding Programs
Ensure that timelines for state funding programs are efficient and that reporting requirements are reasonable.

3G. Pooled Regional Funds
Partner with other states to create pooled regional funds to support geothermal development. One structure for such a program would be a non-state entity chartered by states (similar to a green bank) with the capacity to accept funds from governments, industry, and philanthropy.[122] The larger funding pool would allow for returns to scale that would create shared benefits for all participating states. An entity of this type could support a range of policies for geothermal development, such as regional transmission (see Deployment Lever 4: Connect), geological mapping across a region (known as Play Fairway Analysis; see Deployment Lever 1: Characterize),[123] or the milestone-based convertible loan program discussed above.

3H. Clean Transition Tariff
Direct state PUCs to create a framework for large offtakers in their region to procure energy (including geothermal energy) without affecting ratepayers. Sometimes called a "clean transition tariff," this is a form of sleeve agreement in which higher-than-market costs are paid directly by the offtaker rather than by ratepayers (see Case Study: Clean Transition Tariff).

Case Study: Clean Transition Tariff

In 2025, the Nevada Public Utilities Commission approved the U.S.'s first clean transition tariff. It has already been used to support the development of two geothermal projects, including one next-generation geothermal project.[124]

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[122] Lala, C. (2025). *An Enhanced Geothermal Consortium for the Mountain West.* Center for Public Enterprise. https://publicenterprise.org/wp-content/uploads/An-Enhanced-Geothermal-Consortium-for-the-Mountain-West.pdf

[123] Geothermal Data Repository. (n.d.). Play Fairway Analysis. https://gdr.openei.org/pfa

[124] Jenkins, L. M. (2025, May 15). *The 'clean transition tariff' won approval in Nevada. What's next for Fervo?* Latitude Media. https://www.latitudemedia.com/news/the-clean-transition-tariff-won-approval-in-nevada-whats-next-for-fervo/; Ormat. (2026, February 17). *Ormat Technologies Announces the Signing of Geothermal Portfolio PPA of Up to 150 MW to Support Google's Data Center Operations Through NV Energy* [Press release]. https://investor.ormat.com/news-events/news/news-details/2026/Ormat-Technologies-Announces-the-Signing-of-Geothermal-Portfolio-PPA-of-Up-to-150-MW-to-Support-Googles-Data-Center-Operations-Through-NV-Energy/default.aspx

4. Connect: Develop Supportive Infrastructure

Deploying next-generation geothermal requires more than just a heat resource and the technology to access it. Supportive infrastructure is also necessary, including access to transmission (most important) as well as a ready workforce to staff projects, supply chains for equipment, and social license from local communities.

Transmission

Why It Matters

Innovations in deep drilling could make next-generation geothermal viable across the country and allow it to be sited near existing interconnection. However, while it is still scaling up in areas with the easiest-to-access geothermal resources, access to transmission is crucial. In our interviews, we asked leading developers to list the top one or two barriers to geothermal deployment that they face. Every developer we interviewed listed transmission and interconnection as a top barrier, and most stated that it was the single biggest barrier they face. One developer described the transmission and interconnection situation as "a mess" and stated that it is a significant bottleneck for their work; other developers expressed similar sentiments.

Where Things Stand

Transmission is a regional issue that will require regional solutions: transporting geothermal-produced electricity requires moving power between and across grids.[125]

Most Western utilities, with a few exceptions,[126] are not part of an independent grid operator like a Regional Transmission Organization (RTO) or Independent System Operator (ISO). While the Western Electricity Coordinating Council (WECC) coordinates the non-RTO and non-ISO Western grid at a baseline level, it has not historically engaged in the level of detailed long-term planning or coordination that an RTO or ISO would provide.

In fact, a 2025 Transmission Planning and Development Report Card rated the Northwest and Southwest as a D+ and C- respectively for transmission planning and development.[127] Recently-instituted Federal Energy Regulatory Commission (FERC) requirements for long-term transmission planning may improve the state of transmission in the West,[128] and efforts are underway to set up an RTO for western states, which would increase coordination. But for now, state action on transmission has an especially large impact in the West compared to other regions of the country.

What States Can Do

Priority Actions for Policymakers:

- Integrate geothermal potential and resource availability into planning processes to ensure that transmission is built to areas with high near-term geothermal potential (recommendation 4A)
- Address transmission capacity constraints by building more transmission (recommendation 4D) and improving the capacity of existing transmission (recommendation 4K)

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125 For example, selling power from a project in Utah to a buyer in California could require moving energy across three grid operators: from PacifiCorp, through NV Energy, and then to CAISO.

126 The two main exceptions are the California ISO (CAISO), which covers most of California and a small portion of Nevada, and the Electric Reliability Council of Texas (ERCOT), which covers most of Texas.

127 Zimmerman, Z., Brooks, A. E., Gramlich, R., Shreve, N., & Jamal, D. (2026). *2025 transmission planning and development report card.* Grid Strategies. https://gridstrategiesllc.com/project/transmission-report-card/

128 Federal Energy Regulatory Commission. (2024). *Order 1920.* https://www.ferc.gov/media/e1-rm21-17-000

Transmission access for geothermal projects requires the construction of transmission lines to regions with high geothermal potential.

POLICY RECOMMENDATIONS:

4A. Long-Term Transmission Planning
Identify areas with high near-term geothermal potential and insufficient transmission by conducting long-term planning and engagement with stakeholders (leveraging existing identification of such locations by interested stakeholders) and include geothermal resources in transmission planning processes.

4B. Transmission Timelines
Ensure that resource and transmission planning timelines match geothermal development timelines. For example, California's Integrated Resource Planning (IRP) process, which helps determine transmission buildout in the state, focuses on technologies that can be deployed within ten years – timing that can misalign with long-lead-time resources like geothermal, which can take five to ten years to bring online.

4C. Clean Firm Valuation
Quantify the value of clean firm generation, including geothermal, in grid and interconnection studies. This will require thinking beyond the levelized cost of electricity (LCOE) metric to engage in system-level analyses that take into consideration the many factors that are excluded from LCOE (such as system needs, technology generation profile, generation characteristics such as dispatchability and inertia, non-electricity infrastructure tradeoffs such as land use and public health effects, and the volatility of input costs).[129] Many of geothermal's grid benefits – such as its dispatchability, low operating costs, reliability, and negligible emissions – are not properly accounted for in the levelized cost of energy (LCOE) framework.[130]

In addition to the geothermal-specific recommendations listed above, there are many policies that would facilitate the construction of transmission lines generally or address transmission capacity constraints, enabling geothermal deployment.

POLICY RECOMMENDATIONS:

4D. Transmission Buildout
Support the construction of new transmission lines (as well as upgrades to existing lines) by efficiently permitting transmission projects, streamlining planning activities, and improving coordination both within and between states for transmission development. Many recommendations in Deployment Lever 2: Govern could be applied to transmission projects as well.

4E. Rights of Way
Identify existing rights of way where transmission lines can be colocated (e.g., along highways) and streamline approval processes for those routes.

4F. Preparing Communities for Transmission
Provide financing and education for communities to help prepare them for hosting transmission infrastructure.[131]

4G. Eminent Domain
Clarify eminent domain authorities between developers and the state, and centralize eminent domain authorities for key transmission projects that are vital to delivering electricity.

4H. Public Transmission Financing
Accelerate public financing for transmission (for example, by issuing public bonds, identifying opportunities for public-private partnerships, and/or allowing the use of public debt to replace private debt in transmission projects.[132]

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129 Moraski, J., Qvist, M., & Spokas, K. (2025). *Beyond LCOE: A Systems-Oriented Perspective for Evaluating Electricity Decarbonization Pathways.* Clean Air Task Force. https://www.catf.us/resource/beyond-lcoe/

130 Western Governors' Association. (2023). *The heat beneath our feet.* https://westgov.org/images/files/2023_HBOF_Initiative_Report_for_web.pdf

131 Kurland, A., Pavia, N., Manitius, N, & Landau, K. (2025). *Beyond the wires: Lessons from transmission lines built with community benefits.* Environmental Defense Fund and Clean Air Task Force. https://cdn.catf.us/wp-content/uploads/2025/11/07155050/final-EDF-CATF_WrapAround-Report.pdf

132 Clean Air Task Force and Net-Zero California. (2024). *Wired for savings: Evaluating the impact of alternative transmission financing and development models on California ratepayers.* https://cdn.catf.us/wp-content/uploads/2024/10/31145139/wired-for-savings.pdf; Dickerson, J., Landau, K., Pavia, N., & Poplavska, A. (2026). *A smarter way to pay: Public financing for affordable transmission development in New England.* Acadia Center and Clean Air Task Force. https://cdn.catf.us/wp-content/uploads/2026/05/18194140/smarter-way-to-pay.pdf

4I. Interconnection Processes
Support RTOs and utilities in improving their interconnection queue processes to increase the transparency and efficiency of these processes and reduce uncertainty about interconnection timelines.[133]

4J. Reduced Congestion
Implement demand response and efficiency programs that can free up capacity on existing lines and reduce congestion.

4K. Increased Capacity
Support increased use of grid-enhancing technologies, high-performance conductors, and other advanced transmission technologies. These tools increase the capacity of the existing grid and address near-term transmission capacity limits.[134]

4L. Improved Analytics
Integrate analytical tools to improve grid efficiency and balance a state's generation mix, which will include variable and firm generation as well as storage resources.

4M. Colocation Guidelines
Create clear guidelines for colocation of energy generation and consumption (i.e., "behind-the-meter" generation) to ensure that generation of this type does not negatively impact ratepayers.

Workforce

Why It Matters

Geothermal energy development requires workers in a range of professions, including geoscientists, subsurface engineers, drillers, surface engineers, construction workers, power plant operators, and more.[135]

Where Things Stand

In the short term, geothermal workforce needs can be met by workers from the U.S. oil and gas sector who also work on geothermal projects. DOE estimates that "[t]he total number of jobs needed for a mature geothermal industry is less than the size of the existing workforce in occupations with adjacent transferrable skills"[136] (see Figure 13), and one leading next-generation geothermal developer has stated that it takes only two days to retrain an oil and gas worker to work on an enhanced geothermal system rig.[137]

However, the U.S. is facing an "imminent geologist shortage," with more than a quarter of the current geoscience workforce on track to retire in the next 5 years and a projected labor gap of 130,000 full-time geoscientists by 2030.[138] This labor gap will become especially acute as next-generation geothermal begins to deploy at scale and workforce needs rise. State action to build a pipeline of trained workers for geothermal projects will ensure that geothermal energy can continue to scale while preparing young people for new careers in a growing industry.

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133 For more detailed recommendations on interconnection queue reforms, *see* Pfeifenberger, J., Lam, L. Graham, K., Northrup, N., & Hledik, R. (2025). *Optimizing grid infrastructure and proactive planning to support load growth and public policy goals* (p. 38-41). Brattle Group and Clean Air Task Force. https://www.catf.us/wp-content/uploads/2025/07/grid-utilization-planning.pdf

134 Pfeifenberger, J., Lam, L., Graham, K., Northrup, N., & Hledik, R. (2025). *Optimizing grid infrastructure and proactive planning to support load growth and public policy goals.* The Brattle Group. https://www.catf.us/wp-content/uploads/2025/07/grid-utilization-planning.pdf

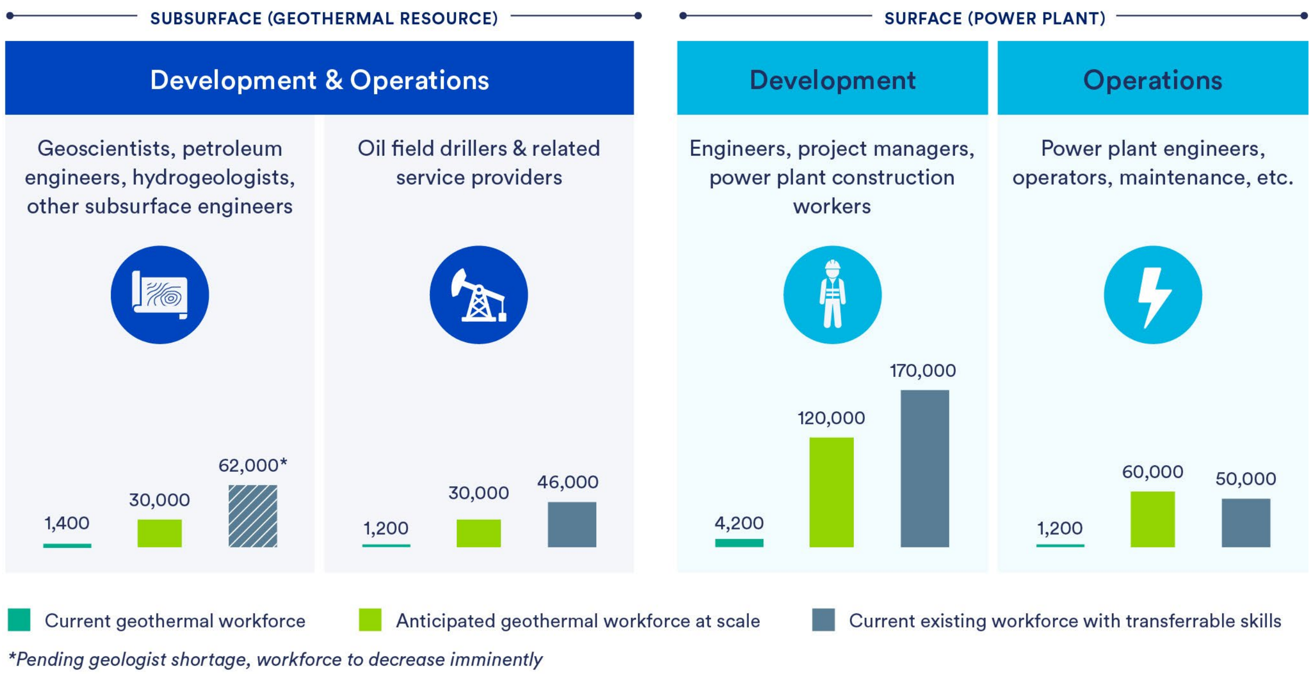
135 U.S. Department of Energy. (2024). *Pathways to Commercial Liftoff: Next-Generation Geothermal Power.* (p. 17-18). https://cdn.catf.us/wp-content/uploads/2025/06/09154348/doe-liftoff-nextgen-geothermal.pdf

136 U.S. Department of Energy. (2024). *Pathways to Commercial Liftoff: Next-Generation Geothermal Power.* (p 17). https://cdn.catf.us/wp-content/uploads/2025/06/09154348/doe-liftoff-nextgen-geothermal.pdf

137 House Natural Resources Committee Democrats. (2025, December 16). *Energy and Mineral Resources Legislative Hearing* | December 16, 2025 [Video]. YouTube. https://democrats-naturalresources.house.gov/news/videos/watch/energy-and-mineral-resources-legislative-hearing_december-16-2025

138 Allsup, Maeve. (2023, December 20). *The imminent geologist shortage.* Latitude Media. https://www.latitudemedia.com/news/the-imminent-geologist-shortage/

Figure 13: Estimated workforce needs for deployment of next-generation geothermal compared with existing workforce.[139]



What States Can Do

POLICY RECOMMENDATIONS:

4N. Training Programs
Collaborate with state universities and technical colleges, geothermal companies and industry associations, and unions to set up training and certification programs in geology and other geothermal-relevant jobs.[140]

4O. Workforce Transition Support
Help oil and gas workers expand and transition to geothermal energy by ensuring that technical/academic qualifications from oil and gas can be applied to geothermal projects as appropriate, supporting retraining programs, and reframing academic areas focused on oil and gas to focus on subsurface energy more broadly (see Case Study: Geothermal Workforce Development, below). This can help reduce boom-and-bust employment cycles in energy regions while preserving critical subsurface expertise needed for geothermal deployment.

139 U.S. Department of Energy. (2024). Pathways to Commercial Liftoff: Next-Generation Geothermal Power. (p 18). https://cdn.catf.us/wp-content/uploads/2025/06/09154348/doe-liftoff-nextgen-geothermal.pdf

140 These might include the geosciences (geology, geophysics, geochemistry, hydrology, soil sciences, etc.), drilling and well construction, subsurface engineering, and surface facility operations.

Case Study: Geothermal Workforce Development

The New Mexico Department of Workforce Solutions administers a program within the state's Community Benefit Fund, created in 2025, which works to "establish or expand worker training for industries that assist in any of [the fund's] goals," such as reducing greenhouse gases and advancing economic development needed to address climate change.

Supply Chains

Why It Matters

Supply chain bottlenecks create significant challenges for any industry, and geothermal is no exception.

Where Things Stand

Some geothermal project components are generally available (for example, the same rigs used to drill oil and gas wells are also used to drill geothermal wells), though it is unclear if they will be available in sufficient quantities as geothermal scales up. But other types of equipment, such as turbines, are less available in the U.S. and rely on a small number of manufacturers.[141] Even the components that are available rely on global supply chains, with limited U.S. production and the risk of disruption.[142] Next-generation geothermal is currently a small industry with relatively little supply chain demand, but it is poised to scale and grow rapidly. Without careful planning and investment now, there is significant risk that the industry might scale faster than existing supply chains can keep up.

What States Can Do

Expanding and growing domestic supply chains for geothermal equipment is a multi-faceted process that will require federal coordination, but states can play an important role.

POLICY RECOMMENDATIONS:

4P. Geothermal Equipment Manufacturing
Support the production of equipment and materials to reduce geothermal supply chain bottlenecks, such as by siting production facilities in-state and expanding geothermal incentives to include equipment manufacturing.[143]

4Q. Economic Development Strategies
Integrate geothermal equipment manufacturing into state economic development strategies.[144]

4R. Sales Tax Exemptions
Make it easier for companies to bring in geothermal equipment by reducing sales taxes on such equipment.[145]

141 Clean Air Task Force. (2025, September 25). Geothermal supply chain. https://www.catf.us/2025/09/geothermal-supply-chain/; Feshbach, B., Garland, E., & Meisel, J. (2026). *The geothermal supply chain is America's to gain – or lose.* Rocky Mountain Institute. https://rmi.org/the-geothermal-supply-chain-is-americas-to-gain-or-lose/

142 Clean Air Task Force. (2025, September 25). *Geothermal supply chain.* https://www.catf.us/2025/09/geothermal-supply-chain/; Feshbach, B., Garland, E., & Meisel, J. (2026). *The geothermal supply chain is America's to gain – or lose.* Rocky Mountain Institute. https://rmi.org/the-geothermal-supply-chain-is-americas-to-gain-or-lose/

143 Feshbach, B., Garland, E., & Meisel, J. (2026). *The geothermal supply chain is America's to gain – or lose.* Rocky Mountain Institute. https://rmi.org/the-geothermal-supply-chain-is-americas-to-gain-or-lose/

144 Feshbach, B., Garland, E., & Meisel, J. (2026). *The geothermal supply chain is America's to gain — or lose.* Rocky Mountain Institute. https://rmi.org/the-geothermal-supply-chain-is-americas-to-gain-or-lose/

145 For example, Washington has a sales tax exemption for machinery, equipment, and labor for installation for some forms of renewable energy systems, including geothermal energy; *see* E2SSB 5116, 2019 Regular Session. (Washington 2019). https://dor.wa.gov/forms-publications/publications-subject/tax-topics/clean-energy-renewable-energy-equipment

Social License

Why It Matters

Local buy-in is important to move projects forward.[146] Community support is therefore essential to the pace and scale of next-generation geothermal deployment.

Where Things Stand

Early next-generation geothermal projects, like those in Milford County, Utah, have conducted extensive community engagement efforts that have resulted in strong support for geothermal development among local communities.[147] But as geothermal projects expand to more locations, community engagement will need to expand as well. CATF's research indicates that many members of the general public are unfamiliar with geothermal, especially with next-generation geothermal. When provided basic information about it, members of the public typically appreciate the potential benefits that geothermal development can create, while also holding some concerns about the safety of geothermal projects.[148]

What States Can Do

POLICY RECOMMENDATIONS:

4S. Addressing Community Concerns
Address concerns that local communities may have about next-generation geothermal. One of the biggest community concerns about geothermal development is whether projects can be developed safely.[149] Creating a regulatory system that is appropriately protective of communities and the natural environment (see Deployment Lever 2: Govern) is therefore one of the most important actions that governments can take to build social license for geothermal deployment.

4T. Community Engagement
Provide assistance and resources to help developers engage with communities. Early, meaningful, and sustained engagement with local communities is crucial to build support for geothermal projects. Many project developers will do this work on their own, but states can improve outcomes by supporting community engagement.

4U. Community Education
Educate the public about geothermal: how it works, its risks and benefits, and how it can be safely deployed. Most people are still unfamiliar with geothermal energy, especially next-generation geothermal. As a result, they may misunderstand the risks and benefits of geothermal deployment.[150]

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146 Garth, A. (2026). *"There's no substitute for trust": Communication and community engagement best practices for next-generation geothermal development.* Clean Air Task Force. https://www.catf.us/resource/theres-no-substitute-for-trust-communication-and-community-engagement-best-practices-for-next-generation-geothermal-development/. See also Clean Air Task Force. (n.d.). The power of digging deep: Frontier Observatory for Research in Geothermal Energy (FORGE) [Fact sheet]. https://cdn.catf.us/wp-content/uploads/2025/08/29102607/Power-of-Engagement-Utah-FORGE.pdf

147 Clean Air Task Force. (2025, November 26). Beneath the Surface: The Community Behind Next-Generation Geothermal [Video]. YouTube. https://www.youtube.com/watch?v=3KyuM5LrPWc

148 Geothermal Rising. (2026, February 6). *Full Steam Ahead Webcast: Public Perceptions of Geothermal Energy* [Video]. YouTube. https://www.youtube.com/watch?v=exPejrOQJVc

149 Geothermal Rising. (2026, February 6). *Full Steam Ahead Webcast: Public Perceptions of Geothermal Energy* [Video]. YouTube. https://www.youtube.com/watch?v=exPejrOQJVc

150 Geothermal Rising. (2026, February 6). *Full Steam Ahead Webcast: Public Perceptions of Geothermal Energy* [Video]. YouTube. https://www.youtube.com/watch?v=exPejrOQJVc

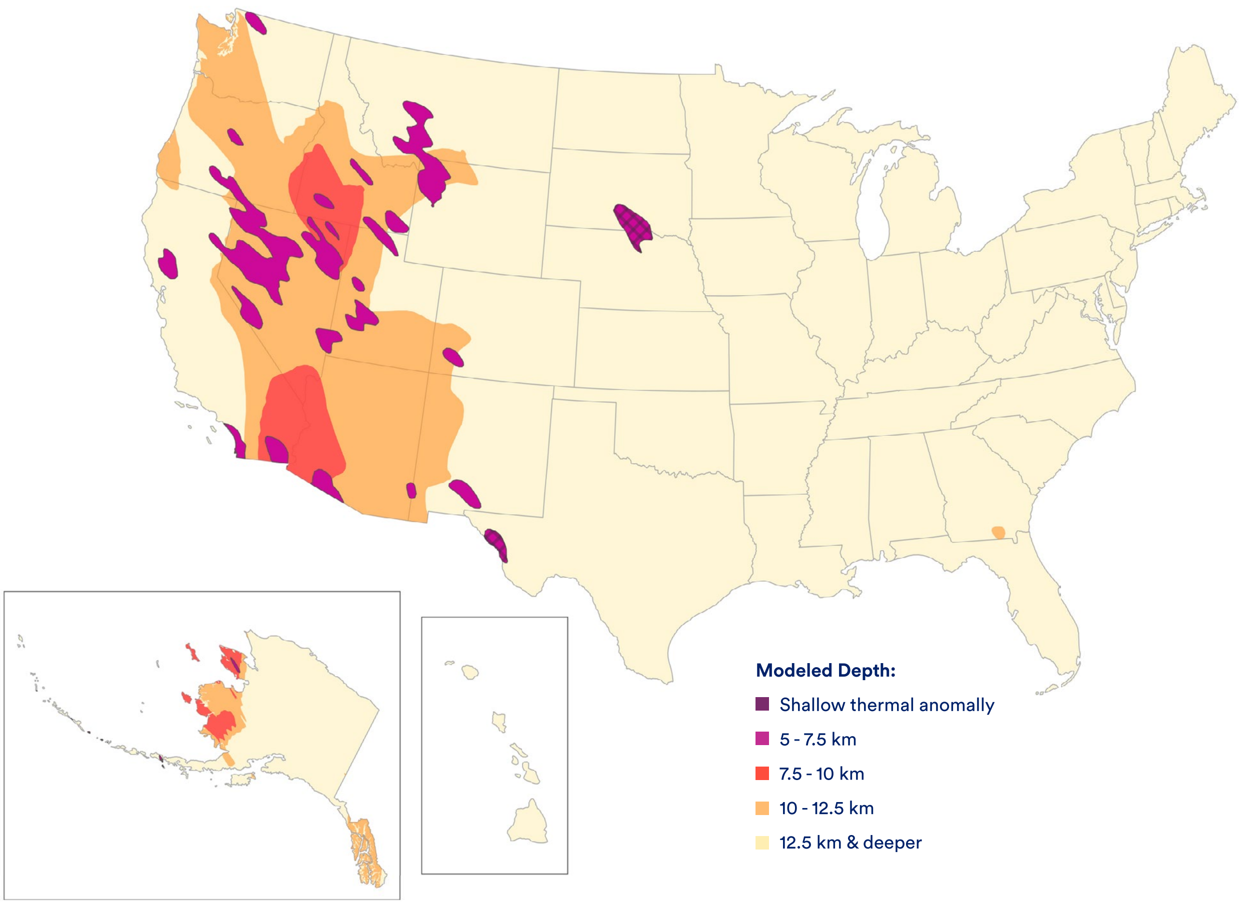
5. Innovate: Sustain R&D

Why It Matters

Temperatures suitable for geothermal power production are available at relatively shallow depths in the West compared to other regions of the country (see Figure 14), which means that next-generation geothermal is ready to scale across much of the western U.S. using current technologies and approaches. However, additional innovation (especially in deep drilling and high-temperature superhot geothermal systems) can make next-generation geothermal energy significantly more affordable and available and will allow western states to export their geothermal expertise around the world.

Figure 14: Estimate of US potential for superhot rock geothermal (temperatures of approximately 450°C) at varying depths.[151]

While deeper depths are not currently economically viable, progress in drilling innovation holds the potential to unlock resources in more areas.



151 Clean Air Task Force. (n.d.). *The Heat Beneath our Feet: Mapping the potential of superhot rock geothermal.* https://www.catf.us/superhot-rock/heat-mapping/

Where Things Stand

Western states can lead the world in geothermal innovation because of their easier access to geothermal heat, which makes testing more affordable. Laboratories, academic institutions, and companies based across the region also have extensive subsurface expertise and can contribute meaningfully to geothermal R&D.

States with fiscal constraints may choose to focus on deploying the geothermal technologies that can scale right now, but even states with limited budgets can contribute to R&D and innovation.

What States Can Do

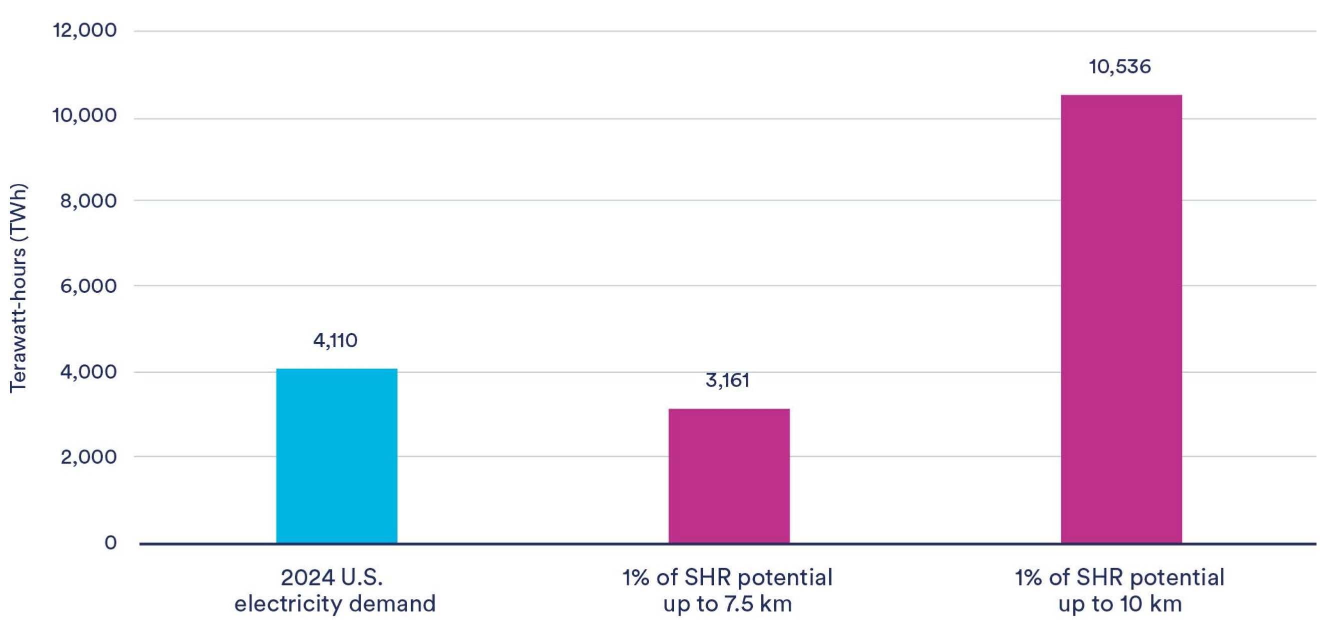
Priority Actions for Policymakers:

- Resource and encourage state universities to contribute to geothermal R&D (recommendation 5A)

There are a few areas where geothermal R&D will have the greatest impact. Advancements in reservoir engineering at superhot temperatures (above around 375°C or 707°F) – including equipment, well design and placement, and novel material applications – will unlock vast amounts of geothermal energy. Innovations in deep drilling will expand geothermal potential even further (see Figure 15). And continued advancements in site characterization, flow optimization, drilling speed, well construction, power conversion, and equipment standardization will further lower costs for all geothermal technologies available today.[152]

Figure 15: Just 1% of the U.S. superhot rock resource at shallower depths (7.5 km) could produce almost as much electricity as the entire country used in 2024

Advancements in deep drilling would expand the superhot rock geothermal resource potential even further.



152 For an in-depth analysis of key R&D needs for superhot rock geothermal, *see* https://www.catf.us/superhot-rock/bridging-gaps/

POLICY RECOMMENDATIONS:

5A. University Research

Resource and encourage state universities to contribute to geothermal R&D.

5B. Innovation in Geothermal Programs

Set eligibility criteria for geothermal funding programs (see Deployment Lever 2: Finance) so that new technologies and approaches can apply and compete. Carve-outs for some portion of the funding in those programs can be targeted to projects that are advancing innovation and helping drive down costs.

5C. Eligibility for Innovation Programs

Ensure that any state programs supporting technological innovation and R&D are open to geothermal technologies.

5D. Multilateral Coordination

Coordinate with other states and with the federal government or international governments on geothermal R&D programs and joint testbeds to maximize the effectiveness of such programs.

5E. Innovation Diffusion

Stay up-to-date on geothermal innovation happening elsewhere and ensure that it quickly diffuses through state university laboratories, funding programs, and regulatory agencies by supporting partnerships with national labs and international testbeds and participating in multi-state working groups. This helps shorten learning cycles and accelerate next-generation geothermal deployment.

5F. Sharing Learnings Publicly

Ensure that innovations and learnings developed in state universities or testing facilities are shared publicly.

5G. Geothermal Testbeds

Fund field test sites and full-scale testing facilities for geothermal technologies and materials. Testbeds like these are crucial for advancing geothermal R&D, yet the cost of drilling and site development remains prohibitively capital-intensive for many companies. Testbeds should be open to researchers of all kinds – including public labs, universities, nonprofit consortia, private research groups, and for-profit companies – to test new approaches, products, and materials. They should focus on cutting-edge innovation, such as superhot rock geothermal and deep drilling, which will decrease costs and ultimately increase the scale of geothermal deployment.

- States that cannot fund a testbed alone could collaborate with each other and with private industry to support the creation of regional testbeds.

SECTION 4

Conclusion

Next-generation geothermal is an exciting new source of clean firm power that is ready to scale, but it needs support from state policymakers to achieve its full potential. This report lays out key policy recommendations under five deployment levers, highlighting better subsurface characterization, appropriate regulatory structures, targeted funding mechanisms, access to supportive infrastructure such as transmission, and programs to sustain further innovation. Implementing the recommendations under each lever will improve the conditions for next-generation geothermal to scale and grow in any state with a geothermal resource.

Fully implementing any of these policy recommendations will require *information-sharing and coordination* as well as *targeted funding for implementation*.

Large-scale geothermal deployment requires information-sharing and coordination among many entities, from regulatory agencies to technical experts to state universities and beyond, both within individual states and across states and countries. Improved coordination and communication among these stakeholders will be necessary for full implementation of the deployment levers described above.

Action on the levers described above will also require some amount of targeted, short-term funding. State agencies responsible for geothermal energy – including state geological surveys, agencies responsible for permitting and environmental reviews, and agencies responsible for tax and funding programs – need sufficient resources to carry out their work effectively. Many of these projects can be discrete and set up in ways to become self-funding after their initial establishment, limiting fiscal burdens on state budgets. Next-generation geothermal can also bring new economic benefits to states through royalties, tax revenues, investment in local communities, and in-state jobs. But targeted short-term investments are needed to unlock this potential.

Next-generation geothermal holds immense potential to become a major player in western state energy systems, advancing goals related to reliability, affordability, and decarbonization. **If states act in the coming years to help it reach commercial scale, next-generation geothermal can be an engine of growth for communities across the West for decades to come.**

APPENDIX A

Policy Recommendations

1. Characterize: Map Geothermal's Subsurface Resource Potential

Data Digitization

1A. Data Needs Assessment

1B. Historical Data Digitization

1C. External Data Digitization

1D. Core Repository Data

1E. Accessible Core Repositories

1F. Subscription Services

Data Collection

1G. Collecting New Data

1H. Abandoned Well Data

1I. Subsurface Monitoring

Data Sharing

1J. Data Sharing Platforms

1K. Data Transparency

1L. Public Data

1M. Modern Data Formats

1N. Multilateral Data Sharing

2. Govern: Establish a Regulatory System that Works for Industry and Communities

Improve Agency Capacity, Communication, and Coordination

2A. Agency Capacity

2B. Application Fees

2C. Lead Agency

2D. Review Timelines

2E. Permitting Guidebooks

2F. Tracking and Transparency

2G. Interagency Agreements

2H. Model Ordinances

2I. Inter-Agency Liaison

2J. Inter-State Coordination

Establish or Clarify Geothermal Property Rights

2K. Surface Ownership Presumption

2L. Cross-Boundary Legal Frameworks

Improve Leasing Processes for State-Owned Lands

2M. Frequent, Consistent Lease Sales

2N. Encouraging Exploration

2O. Incentivizing Development

2P. Enabling Exploration

Establish Clear Geothermal Permitting Processes

2Q. Clear, Standardized Permitting Requirements

2R. Comprehensive Regulations

2S. Tailored Regulations by Type

2T. Tailored Regulations by Phase

2U. UIC Primacy

2V. Clarity in Permitting

Improve Environmental Review Requirements

2W. Tailored Categorical Exclusions

2X. Federal-State Streamlining

3. Finance: Incentivize Exploration and Demonstration

3A. Procurement Standards

3B. Milestone-Based Convertible Loans

3C. Targeted Funding

3D. Revenue Support

3E. Energy Development Funds

3F. Timelines for Funding Programs

3G. Pooled Regional Funds

3H. Clean Transition Tariff

4. Connect: Develop Supportive Infrastructure

Transmission

4A. Long-Term Transmission Planning

4B. Transmission Timelines

4C. Clean Firm Valuation

4D. Transmission Buildout

4E. Rights of Way

4F. Preparing Communities for Transmission

4G. Eminent Domain

4H. Public Transmission Financing

4I. Interconnection Processes

4J. Reduced Congestion

4K. Increased Capacity

4L. Improved Analytics

4M. Colocation Guidelines

Workforce

4N. Training Programs

4O. Workforce Transition Support

Supply Chains

4P. Geothermal Equipment Manufacturing

4Q. Economic Development Strategies

4R. Sales Tax Exemptions

Social License

4S. Addressing Community Concerns

4T. Community Engagement

4U. Community Education

5. Innovate: Sustain R&D

5A. University Research

5B. Innovation in Geothermal Programs

5C. Eligibility for Innovation Programs

5D. Multilateral Coordination

5E. Innovation Diffusion

5F. Sharing Learnings Publicly

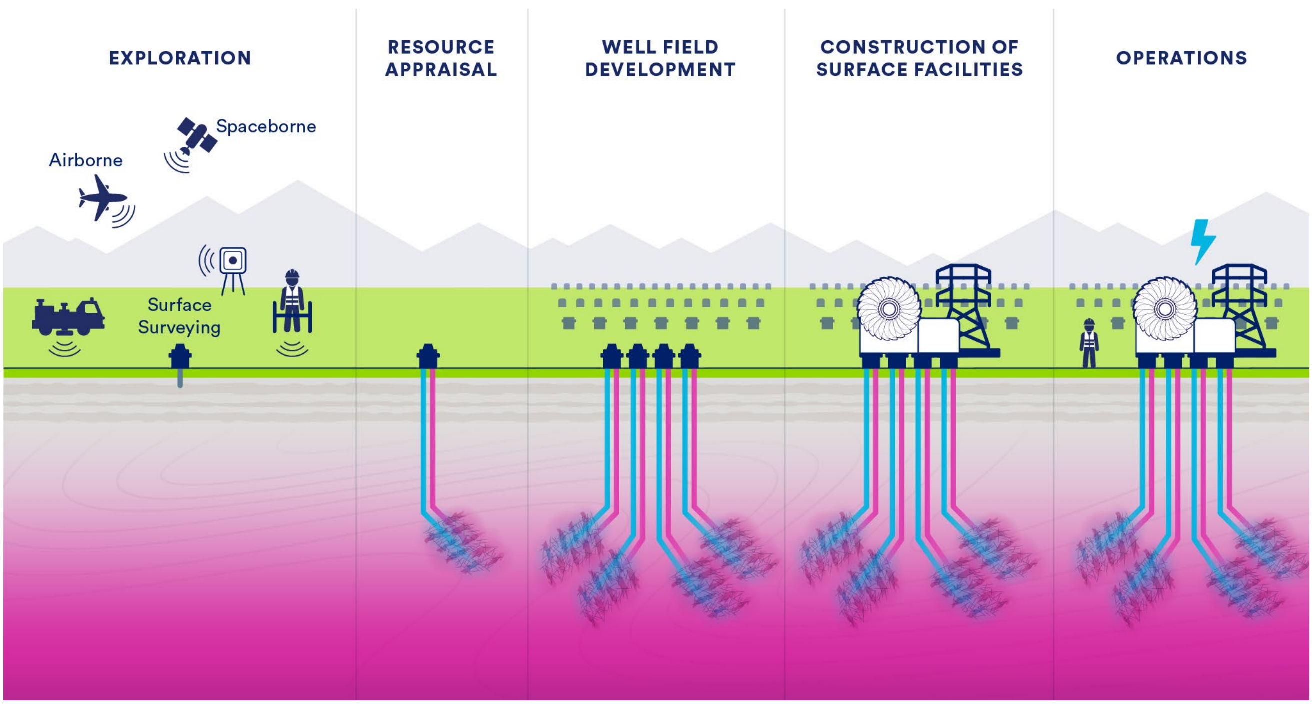
5G. Geothermal Testbeds

APPENDIX B

Geothermal Project Phases

Geothermal energy development unfolds in phases, including *exploration, resource appraisal, well field development, construction of surface facilities,* and *operations* (see Figure 16).

Figure 16: Geothermal energy project development phases



In the *exploration* phase, developers use subsurface mapping to identify promising location(s) for geothermal development. Subsurface mapping draws on existing subsurface data, surveys of multiple types,[153] and drilling small-diameter test wells. The cost of exploration varies widely depending on what activities are included in it and could range from around $2 million for limited surveying to as much as $50 million for more extensive surveying and drilling small-diameter wells.[154]

During *resource appraisal* (sometimes referred to as "resource confirmation"), developers drill full-size wells. The goal is to confirm the temperature at depth and ensure that water[155] can continuously and reliably circulate through the system, from subsurface to surface and back again. Enhanced geothermal systems (EGS) use at least two wells, an injection well and a production well. Water is pumped down the injection well, which is generally lined with cement and cased in steel (or an equivalent impermeable material) from the surface down to the target depth to keep the well stable and prevent water from escaping. At the bottom of the well, the casing ends, allowing water to exit the well and travel through a network of small cracks and pathways (known as "fractures") in the rock until it reaches the production well and flows back up to the surface. Closed-loop geothermal systems generally have some type of casing or barrier lining the entire well so that the water does not directly touch the rock. Some closed-loop systems use only one well, in which water flows both down and up, while others use two or more wells that are connected in the subsurface to form a loop. Hybrid projects blend elements from both EGS and closed-loop systems. Resource confirmation activities require permits, though the details of the permitting process will vary by jurisdiction. Costs vary by project; wells at recent next-generation geothermal projects have cost between $5 million and $13 million,[156] and costs could rise as high as $20 million depending on the length of the well and the geologic settings.[157]

The *well field development* phase replicates the resource confirmation stage at scale, often with lower costs per well. The exact number of wells drilled in a full-scale geothermal project varies, but can be as many as hundreds of wells. The permits required for well field development replicate the permits required for resource confirmation. Costs for well field development often decrease over time as project developers learn more about the subsurface and are able to improve their approach, bringing costs down a "learning curve," as well design is no longer bespoke (see "Barriers to Geothermal Deployment" section for a longer discussion of learning curves).

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153 Aerial surveys are conducted from airplanes or drones, while other surveys are conducted on the ground using special trucks and/or equipment carried by hand.

154 R. Pearce (personal communication, May 15, 2026).

155 Some next-generation geothermal systems use another type of fluid, such as CO_2, in place of water. Geothermal projects that do use water often use brackish water that is not suitable for agriculture or human consumption. For ease of readability, this section will use "water" throughout.

156 U.S. Department of Energy. (2024). *Pathways to Commercial Liftoff: Next-Generation Geothermal Power.* (p. 3). https://cdn.catf.us/wp-content/uploads/2025/06/09154348/doe-liftoff-nextgen-geothermal.pdf

157 The average drilling cost of wells at an early next-generation geothermal project (Project Red), applied to a 6 km well, would be approximately $20 million. *See* Akindipe, D. & Witter, E. (2025). *2025 Geothermal Drilling Cost Curves Update.* National Lab of the Rockies. (p. 3). https://docs.nlr.gov/docs/fy25osti/92793.pdf

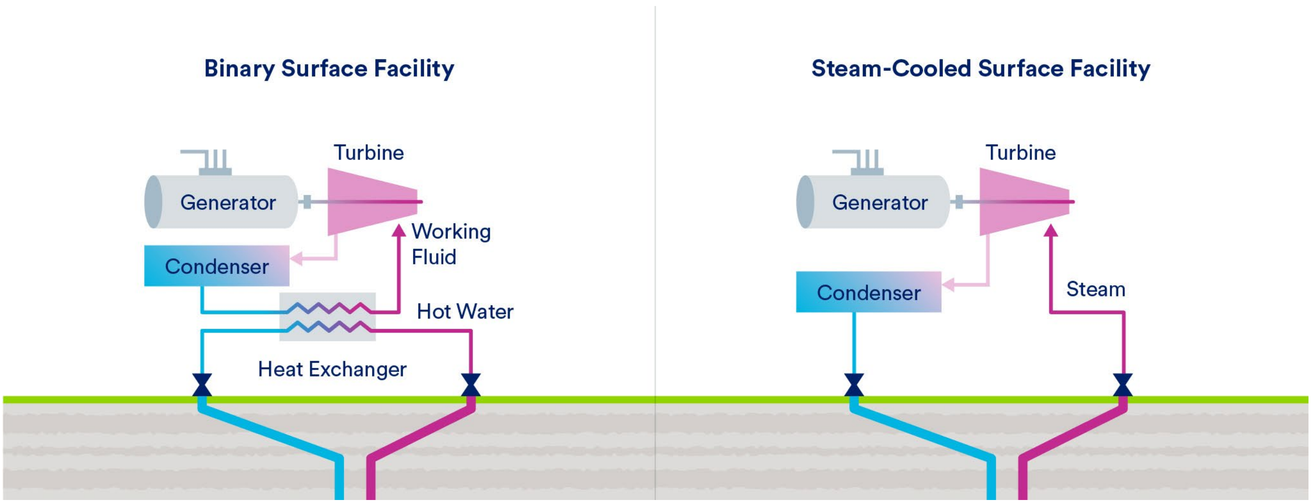
The *surface facility* construction phase requires building surface facilities to process heated water.[158] For electricity generation, there are two primary options for surface facilities: binary and steam generation (see Figure 17).[159] Both surface facilities require equipment such as turbines, generators, transformers, cooling equipment, and plant control systems (e.g., a control room) to turn heated fluid into electricity and enable the continuous operation and monitoring of the project. Surface facility construction requires additional permits beyond those required for prior phases of development.

The first phase of the first commercial-scale next-generation geothermal project in the West cost about $7 million per MW of installed capacity.[160] Continued learning-by-doing is bringing costs down; the second phase of that project is expected to cost $5.5 million per MW, and the project developer is targeting $3 million per MW for later phases and projects.[161]

Once construction is completed and transmission and buyer(s) secured, the project enters the *operations* phase, generating electricity and revenue over years or decades.

Figure 17: Geothermal surface facilities

Air-cooled binary cycle equipment minimizes water consumption but is more costly to build and operate, whereas wet-cooled steam generation systems typically consume more water but have higher thermal efficiency and thus lower costs.[162]



[158] Thus far, next-generation geothermal projects in the U.S. have generated electricity, but next-generation geothermal can also be used to produce heat for industrial processes and/or district heating. For example, one next-generation geothermal project in Germany produces 8.2 MW of electricity and 64 MW of district heating; this model could be used in the U.S. as well. Different end uses require different surface facilities to process the heat. *See* Gallucci, M. (2025, October 28). *Eavor is about to bring its first-of-a-kind geothermal project online.* Canary Media. https://www.canarymedia.com/articles/geothermal/eavor-is-about-to-bring-its-first-of-a-kind-geothermal-project-online

[159] Seligman, A. (April 2026). *Water use and next-generation geothermal* [Fact sheet]. Clean Air Task Force. https://www.catf.us/wp-content/uploads/2026/04/water-use-fact-sheet.pdf

[160] Fervo Energy Company. (17 April 2026). *Form S-1.* https://www.sec.gov/Archives/edgar/data/1853868/000162828026025821/fervoenergy-sx1.htm

[161] Fervo Energy Company. (17 April 2026). *Form S-1.* https://www.sec.gov/Archives/edgar/data/1853868/000162828026025821/fervoenergy-sx1.htm

[162] Seligman, A. (2026). Water use and next-generation geothermal [Fact sheet]. Clean Air Task Force. https://www.catf.us/resource/water-use-next-generation-geothermal/

APPENDIX C

Geothermal Regulatory Systems by State

The following table describes select features of the geothermal statutory frameworks in the western states assessed in this report. We include it as a brief reference, providing a high-level overview of certain key elements of these schemes, but note that it omits details of the statutory structure and implementing regulations that can also be critical for implementation.

Table 1: Geothermal Regulatory Systems by State

State	Geothermal Ownership[163]	Heat Resource Permitted[164]	Environmental Review Statute[165]	Leasing Structure[166]	Length of Lease Term
Alaska	State retains rights to all geothermal resources[167]	Heat > 120°C[168]	No	Competitive in set areas; non-competitive elsewhere.[169] Preferential lease rights for surface owners[170]	Initial 10 years; 5-year extensions; continues during commercial production[171]

163 State law regarding presumptive determinations of ownership of geothermal resources where "mineral" rights or similar have been severed from the surface estate.

164 Applicable scope of the statutory definition of geothermal resources for the permitting of geothermal resources in the state, and applicable thresholds.

165 Environmental review statute obligating agencies to review and document the environmental consequences of state agency actions.

166 Whether the process for acquiring the right to explore and develop geothermal resources on state lands is competitive or noncompetitive; scope of applicable resources.

167 A.S. § 38.05.125.

168 A.S. § 41.06.060(5).

169 A.S. § 38.05.181.

170 A.S. § 38.05.181.

171 A.S. § 38.05.181.

State	Geothermal Ownership[163]	Heat Resource Permitted[164]	Environmental Review Statute[165]	Leasing Structure[166]	Length of Lease Term
Arizona	Undecided	All heat[172]	No	Competitive[173]	Initial 10 years; continues during commercial production[174]
California	Likely runs with the mineral estate[175]	All heat[176]	CEQA[177]	Competitive[178]	Initial 10 years; continues during commercial production[179]
Colorado	Surface estate, except if associated with tributary groundwater[180]	All heat; separated at 2,500+ ft. depth[181]	No	Negotiation or competitive bidding[182]	Discretionary
Hawaii	Undecided	All heat[183]	HEPA[184]	Competitive on state lands; can be competitive or non-competitive on reserved lands[185]	Initial 10 years; maximum 65 years[186]

172 Ariz. Rev. Stat. § 27-651.

173 Ariz. Rev. Stat. § 27-670.

174 Ariz. Rev. Stat. § 27-671.

175 The California Supreme Court has not addressed the issue, but early appellate decisions have found a general conveyance of mineral resources includes geothermal resources. *See* Geothermal Kinetics v. Union Oil, 75 Cal. App. 3d 56 (Cal Ct. App. 1977). However, the principle is untested as applied to heat alone, apart from hydrothermal resources.

176 Cal. Pub. Res. Code § 6903.

177 California Environmental Quality Act, Cal. Pub. Res. Code §§ 21000–21189.3.

178 2 CCR § 2249.

179 Cal. Pub. Res. Code § 6918.

180 Colo. Rev. Stat. § 37-90.5-104.

181 C.R.S. § 37-90.5-103(9).

182 C.R.S. § 36-1-113.

183 H.R.S. § 182-1.

184 Hawaii Environmental Policy Act, H.R.S. Ch. 343.

185 Hawaii Code R. §§ 13-183-22, 13-183-23.

186 Hawaii Code R. § 13-183-29.

State	Geothermal Ownership[163]	Heat Resource Permitted[164]	Environmental Review Statute[165]	Leasing Structure[166]	Length of Lease Term
Idaho	Likely runs with surface estate[187]	All heat/energy, and groundwater ≥ 100° C[188]	No	Discretionary[189]	Up to 49 years[190]
Montana	Surface estate[191]	All heat[192]	MEPA[193]	Competitive[194]	Initial 10 years; 10-year extensions[195]
Nevada	Surface estate[196]	All heat[197]	No	Noncompetitive[198]	Discretionary
New Mexico	Undecided	Heat > = 121 °C[199]	No	Competitive leasing[200]	Initial 5 years; 5-year and 1-year conditional extensions; continues during commercial production[201]
Oregon	Surface estate[202]	All heat; separated at 121+ °C or 2,000+ ft[203]	No	Generally competitive[204]	Unlimited[205]
Texas	Surface estate[206]	All heat[207]	No	Competitive[208]	Discretionary[209]

187 *See* Ida-Therm v. Bedrock Geothermal, 293 P.3d 630 (2012) (conveyance of mineral rights construed not to include geothermal resources).

188 Idaho Code 47-4002.

189 Idaho Code 47-1605.

190 Idaho Code 47-1601.

191 Mont. Code Ann. § 77-4-104.

192 Mont. Code Ann. § 77-4-102.

193 Mont. Code Ann. tit. 75 ch. 1.

194 Mont. Admin. R. 36.25.404. If no bids are offered on a parcel for which an application for sale was made, the applicant may negotiate for the lease.

195 Mont. Code Ann. §§ 77-4-122, 77-4-123.

196 N.R.S. § 534A.050.

197 N.R.S. § 534A.010.

198 N.R.S. § 322.030.

199 N.M.S.A. § 71-9-3.D (250 °F).

200 N.M.S.A. § 19-13-26.

201 N.M.S.A. § 71-9-3.

202 Or. Rev. Stat. § 522.035.

203 Or. Rev. Stat. §§ 14-43-522.005 (geothermal resource definition); 522.025 (250 degree Fahrenheit differentiation); 522.019(2) (agency to adopt rules "governing the disposal by reinjection or other means of geothermal fluids derived from geothermal resources from wells of 250 or more degrees Fahrenheit bottom hole temperature or wells 2,000 or more feet deep").

204 Or. Admin. R. 141-125-0100. Holders of a license to conduct a geothermal demonstration have the first right to apply for a lease.

205 Or. Rev. Stat. § 273.551.

206 Tex. Nat. Res. Code. § 141.004.

207 Tex. Nat. Res. Code § 141.003.

208 Tex. Nat. Res. Code § 51.001

209 Tex. Nat. Res. Code § 141.073(b).

State	Geothermal Ownership[163]	Heat Resource Permitted[164]	Environmental Review Statute[165]	Leasing Structure[166]	Length of Lease Term
Utah	Undecided[210]	Heat > 120 °C[211]	No	Default competitive[212]	Up to 10-year initial term; continued during commercial production or diligent operations[213]
Washington	Surface estate[214]	All heat	SEPA[215]	Competitive[216]	Up to 55 years[217]
Wyoming	Undecided[218]	N/A	No	N/A (or discretionary)[219]	N/A (or up to 10 years)[220]

210 Utah Code § 73-22-4 provides that "[o]wnership of a geothermal resource derives from an interest in land and not from an appropriative right to geothermal fluids," but this is likely not dispositive as to whether said ownership interest would transfer with a conveyance of mineral rights.

211 Utah Code § 73-22-3(5).

212 *See* Utah Code §§ 53C-2-407 (trust lands); 65A-6-5(c) (other state-owned lands); see also Utah. Admin. Code R652-20-3400 (mineral lease framework applied to geothermal).

213 *See* Utah Code §§ 53C-2-405 (trust lands); 65A-6-4(4), (11) (other state-owned lands).

214 R.C.W. § 78.60.040.

215 R.C.W. ch. 43.21C.

216 Wash. Admin. Code 332-22-040.

217 Wash. Admin. Code 332-22-190.

218 Current law specifies only the regime for hydrothermal resources. See Wyo. Stat. § 41-3-930(a), (b).

219 Wyoming lacks express geothermal leasing provisions. The Wyoming courts have not addressed whether Wyoming mineral leasing provisions regarding "other minerals" apply to geothermal resources.

220 *Id.*

APPENDIX D

Geothermal Regulatory Agencies by State

The following tables provide geothermal-related authorizations identified by the authors during preparation of this report. Any given project requires individualized analysis to determine which of these apply, and what additional federal, state, tribal, or local requirements may also apply.

Alaska

Regulation	Agency	Applicability
Geothermal Exploration License[221]	Alaska Department of Natural Resources (DNR) – Division of Oil & Gas	All geothermal wells, including closed-loop systems. Regulates exploration, drilling, development, and operation.
Plan of Operations & Geothermal Drilling Authorization[222]	DNR & Alaska Oil & Gas Conservation Commission (AOGCC)	AOGCC applies well-construction rules; DNR approves a Plan of Operations for each drilling operation on a state lease.
Water Use Permit[223]	DNR – Water Resources Section	If the geothermal project consumes freshwater, withdrawals require a water right or temporary authorization.

221 Alaska Stat. § 38.05.181.

222 11 Alaska Admin. Code § 84.700.

223 Alaska Stat. § 46.15.

Arizona

Regulation	Agency	Applicability
Geothermal Well Drilling Permit[224]	Arizona Oil & Gas Conservation Commission (AZOGCC)	Required for any drilling or deepening of a well for geothermal resources in Arizona.
Injection Well Permit[225]	AZOGCC	Required for Class V geothermal injection wells.
Underground Injection Control Class V Permit[226]	Arizona Department of Environmental Quality (ADEQ)	Required for geothermal injection wells.
Geothermal Resource & Water Law Exemption[227]	Arizona Dept. of Water Resources (ADWR)	Arizona law explicitly exempts geothermal resources development from state water laws unless the geothermal resource is commingled with or impairing surface/groundwater. If commingled with, then a water well permit may be necessary from ADWR.
Certificate of Environmental Compatibility[228]	Arizona Corporation Commission (ACC) – Power Plant & Line Siting Committee	Large geothermal power plants may trigger Arizona's site certification. A CEC from the ACC is required for construction of any new thermal electric generating unit ≥ 100 MW capacity.
Native Plant Protection[229]	Arizona Dept. of Agriculture	Arizona has a Native Plant Law protecting species like saguaros, ocotillo, etc. If a geothermal project will destroy or remove protected native plants, the developer must obtain a permit from the Arizona Dept. of Agriculture and notify the department prior to clearing land.
Duty to Report Cultural Discoveries[230]	Arizona State Museum	If the development discovers "any archaeological, paleontological or historical site or object".

224 Ariz. Admin. Code § R12-7-104.

225 Ariz. Admin. Code § R12-7-175 et seq.

226 Ariz. Admin. Code §§ R18-9-I650 (ADEQ Class V); 90 Fed. Reg. 44327 (Sept. 15, 2025) (primacy approval).

227 Ariz. Rev. Stat. § 27-667 (geothermal exemption to water laws); Ariz. Rev. Stat. § 45-598(A) (permits for impairing groundwater).

228 Ariz. Rev. Stat. § 40-360.03.

229 Ariz. Admin. Code § R3-3-1104.

230 Ariz. Rev. Stat. § 41-844.

California

Regulation	Agency	Applicability
California Environmental Quality Act (CEQA)[231]	The Lead Agency responsible for preparing the CEQA document is the "agency with the greatest responsibility for supervising or approving the project as a whole." (CEQA Guidelines Section 15051)	CEQA requires environmental review of discretionary projects within the State of California. Environmental review is completed with an Environmental Impact Report or Mitigated Negative Declaration unless the project qualifies for a statutory or categorical exemption.
Warren Alquist Act, California Code of Regulations, Title 20, Division 2	California Energy Commission (CEC)	Licensing process applies to thermal power plants rated 50 MW or greater.
California Public Resources Code, Division 3, Sections 3700–3776	California Geologic Energy Management Division (CalGEM)	Permits required for well drilling, workovers and injection; regulates operation, maintenance, and permanent closure of geothermal production and injection wells.
California Fish and Game Code, Section 1603	California Department of Fish and Wildlife (CDFW)	A Lake or Streambed Alteration Agreement is required for activities that impact the flow, bed, channel, or bank of a river, stream, or lake or riparian dependent vegetation (e.g., access road or transmission line crossing of a stream or drainage). The process requires submittal of a notification to CDFW.[232]
California Fish and Game Code, Section 2081(b); California Code of Regulations, Title 14, Section 783.2-783.8	CDFW	An incidental take permit is required prior to activities that would result in "take" of a California Endangered Species Act-listed species. Mitigation may be purchased from a CDFW approved conservation or mitigation bank, if available or permittee proposed habitat management land.
Porter Cologne Water Quality Control Act, Water Code Division 7	California Regional Water Quality Control Board[233]	Permits are required prior to any discharge of material to waters of the state. The permit process for discharge of fill materials is defined in State Wetland Definition and Procedures for Discharge of Dredge or Fill Material to Waters of the State (State Water Board Resolution No. 2021-0012).[234]
National Pollutant Discharge Elimination System (NPDES)	State Water Resources Control Board	Construction Stormwater General Permit (Order 2022-0057-DWQ) regulates ground disturbing activities 1 acre or larger and Industrial General Permit (Order 2014- 0057-DWQ) which regulates stormwater discharges associated with industrial activities.

231 Cal. Pub. Res. Code §§ 21000–21189; Cal. Code. Reg. §§ 15000-15387.

232 Information on CDFW permit application is available via EPIMS portal https://epims.wildlife.ca.gov/index.do

233 Permitting is implemented by the applicable regional water quality control board for the project area; *see* State Water Resources Control Board. (n.d.). *State and regional water boards.* https://www.waterboards.ca.gov/waterboards_map.html

234 State Water Resources Control Board. (n.d.). *Wetland riparian area protection policy*. https://www.waterboards.ca.gov/water_issues/programs/cwa401/wrapp.html

Colorado

Regulation	Agency	Applicability
Deep Geothermal Rules[235]	Energy and Carbon Management Commission (ECMC)	Geothermal wells >2,500 ft deep or wells using "Allocated Geothermal Resources". Applies to siting, drilling, injecting, operations, financing, safety, and environmental protection.
Shallow Geothermal Rules[236]	Division of Water Resources (DWR)	All geothermal wells not covered by the Deep Geothermal Rules.
Geothermal Well Permit[237]	DWR	All geothermal wells (exploration, production, injection).
Geothermal Use Permit (non-tributary)[238]	DWR	Withdraw/use non-tributary geothermal water without water court decree.
Water Right Adjudication (tributary)[239]	Colorado Water Court	Consumptive use of tributary groundwater.
Wildlife Incidental Take Permit[240]	Colorado Parks and Wildlife	If the geothermal development takes or impacts state-listed species or their habitat.
Unmarked Human Graves Act[241]	County Coroner and State Archeologist	If the development discovers human remains.

235 Colo. Code Regs. § §§ 404-1:1301 to 1320.

236 Colo. Rev. Stat. § 37-90.5-106.

237 Colo. Rev. Stat. § 37-90.5-107.

238 Colorado House Bill 25-1165 (2025).

239 Colo. Rev. Stat. § 37-92.

240 Colo. Rev. Stat. § 33-2-101.

241 Colo. Rev. Stat. § 24-80-1301.

Hawaii

Regulation	Agency	Applicability
Geothermal Mining Lease[242]	Hawai'i Dept. of Land & Natural Resources (DLNR) – Land Division / Board of Land & Natural Resources	Geothermal resources are considered a state-reserved mineral resource and thus require permits. Permitting process varies based on whether the land is "reserved", state-owned, or held privately.
Geothermal Exploration Permit[243]	DLNR – Engineering Division	Geothermal wells that involve underground injection.
Hawai'i Environmental Review Process EIS / EA[244]	Hawai'i Office of Planning and Sustainable Development	If the geothermal project is on state lands or uses state funds, then an EIS / EA is likely necessary under HEPA.
Underground Injection Control Class V Permit[245]	Hawai'i Department of Health – Safe Drinking Water Branch	Required for reinjection and enhanced geothermal development. Process varies based on proximity to shoreline.
Habitat Conservation Plan / Incidental Take License[246]	DLNR – Department of Fish and Wildlife	Required if project may incidentally "take" state listed species.
Cultural & Burial Site Compliance[247]	DLNR – State Historic Preservation Division & Island Burial Council	Consultation on iwi kupuna may be necessary depending on location of the project.

Idaho

Regulation	Agency	Applicability
Geothermal Resource Well Permit[248]	Idaho Department of Water Resources (IDWR) – Geothermal Resources Program	A Geothermal Resource Well Permit must be obtained prior to drilling any exploration, production, or injection well for high-temperature geothermal resources.
Underground Injection Control Class V Permit[249]	IDWR – UIC Program	Geothermal injection wells must meet IDWR's construction standards for casing, zone isolation, and monitoring to prevent groundwater contamination. The UIC permit for a geothermal project can be integrated with the Geothermal Resource well permit.

242 Haw. Rev. Stat. § 12-182.

243 Haw. Rev. Stat. § 12-182-6.

244 Haw. Admin. R. § 11-200.1.

245 Haw. Admin. R. § 11-23-09.

246 Haw. Rev. Stat. § 195D-4.

247 Haw. Rev. Stat. § 6E-2.

248 Idaho Code § 42-4003.

249 Idaho Admin. Code § 37.03.03.

Montana

Regulation	Agency	Applicability
Geothermal Well Drilling Permit[250]	Montana Department of Natural Resources & Conservation (DNRC) – Board of Oil & Gas Conservation (BOGC)	Applies well-construction and safety standards to geothermal bores.
State Land Geothermal Lease / Exploration License[251]	DNRC – Trust Lands Division	Leasing of geothermal resources on state lands.
Water Right Permit[252]	DNRC – Water Resources Division	Consumptive use of water requires permit under; reinjection with no net depletion may avoid permit.
MEPA Environmental Assessment / State EIS[253]	DNRC	Required for any discretionary state permit, lease, or approval.
Sage-Grouse Habitat Project Review[254]	Montana Sage Grouse Habitat Conservation Program	Projects in designated habitat reviewed.
Cultural & Historic Preservation Review[255]	Montana State Historic Preservation Office	Any project receiving federal permits or federal funding.

250 Mont. Admin. R. 36.22.601.

251 Mont. Code Ann. § 77-4-101.

252 Mont. Code Ann. § 85-2-311.

253 Mont. Code Ann. § 75-1-201.

254 Montana Executive Order 12-2015.

255 Mont. Code Ann. § 22-3-429.

Nevada

Regulation	Agency	Applicability
Geothermal Well Drilling Permit[256]	Nevada Division of Minerals (NDOM)	Required for all exploration, production, injection, and observation wells statewide (incl. on federal leases). Project Area Permits cover multiple wells.
Class V Underground Injection Control Permit[257]	Nevada Division of Environmental Protection (NDEP)	Required for reinjection or any geothermal fluid injection. Generally will cover injection wells and surface basin discharges, eliminating the need for a separate ground water discharge permit.
Wildlife Special Purpose Permit[258]	Nevada Department of Wildlife (NDOW)	Handling or disturbing state-protected wildlife.
Wildlife Energy Development Filing[259]	NDOW	Any energy development project above 10 MW in capacity.
Water Appropriation Permit[260]	Nevada State Engineer	Needed only if project consumes groundwater (net depletion). Non-consumptive reinjection is exempt.
Cultural Resource Protection[261]	Office of Historic Preservation	Needed only if drilling disturbs an Indian burial site.

256 Nev. Rev. Stat. § 534A; Nev. Admin. Code § 534A.

257 Nev. Admin. Code §§ 445A.849, 891.

258 Nev. Admin. Code § 503.093.

259 Nev. Rev. Stat. § 701.610.

260 Nev. Rev. Stat. §§ 533, 534A.040.

261 Nev. Rev. Stat. § 383.170.

New Mexico

Regulation	Agency	Applicability
High-Temperature Geothermal Resources Development Permit[262]	New Mexico Energy, Minerals & Natural Resources Dept. – Energy Conservation & Management Division (ECAM)	Required for all high temperature geothermal projects (>121°C) including drilling of exploration, production, injection, and observation wells statewide (on public or private land).
Class V Underground Injection Control Permit[263]	New Mexico Environment Department (Ground Water Quality Bureau)	Underground injection of geothermal fluids (reinjection of produced brine, or fluid injection for EGS/closed-loop systems) requires approval under the state's UIC program.
Groundwater Appropriation Permit[264]	New Mexico Office of the State Engineer (OSE)	Consumptive use of water for geothermal projects triggers water rights permitting. No OSE permit is required for geothermal fluid >121°C that is fully reinjected with no new depletion.
State Historic / Cultural Protection[265]	New Mexico Historic Preservation Division	If drilling uncovers human remains or artifacts, work must pause and the State Historic Preservation Officer (SHPO) must be consulted.

262 N.M.A.C. § 19-11-2.

263 40 C.F.R. Part 147 Subpart GG.

264 N.M.A.C. § 71-9-4.

265 N.M.A.C. § 18-6-11.2.

Oregon

Regulation	Agency	Applicability
Geothermal Well Drilling Permit[266]	Oregon Dept. of Geology & Mineral Industries (DOGAMI) – Mineral Land Reg. & Reclamation (MLRR) Program	All geothermal wells, including closed-loop systems. Regulates exploration, drilling, development, and operation.
Underground Injection Control Class V Permit[267]	Oregon Dept. of Environmental Quality (DEQ) – Water Quality Division	Injection of geothermal fluids into the subsurface (e.g. reinjection of spent geothermal brine) requires a UIC permit or authorization. Closed-loop systems may be exempt.
Water Use Permits & Rights[268]	Oregon Water Resources Department (OWRD)	Oregon distinguishes geothermal fluid as a mineral resource (not subject to water rights) if bottom-hole temp > 121°C. However, if a project uses or diverts groundwater for other purposes then a water use permit is needed.
Energy Facility Site Certificate[269]	Oregon Dept. of Energy – Energy Facility Siting Council (EFSC)	A Site Certificate is required for any geothermal electric facility with ≥ 50 MW average output.
Cultural Resources[270]	State Historic Preservation Office (SHPO)	Oregon SHPO review is required for projects requiring a state permit. For discoveries of human remains, work must stop and SHPO and law enforcement notified.

266 Or. Rev. Stat. § 14-43-522.055.

267 Or. Admin. R. § 340-044-012.

268 Or. Rev. Stat. § 15-45-537.090.

269 Or. Rev. Stat. § 13-36A-469.300.

270 Or. Rev. Stat. §§ 6-20-215.446 (SHPO permit); 3-10-97.745 (remains requirements).

Texas

Regulation	Agency	Applicability
Texas Natural Resources Code[271]	Railroad Commission of Texas (RRC)	All geothermal wells, including closed-loop systems. Regulates exploration, drilling, development, and operation.
Underground Injection Control Class V Permit[272]	RRC	Geothermal wells that involve underground injection.
Groundwater Conservation District Rules[273]	Local Groundwater Conservation District	Groundwater extraction, well spacing requirements, production limits. Locally regulated, varies depending on area.
Texas Water Code[274]	Texas Commission on Environmental Quality (TCEQ)	Diversion of state surface water for project use. Stormwater permits for industrial activity.
Unknown Cemeteries[275]	Texas Historical Commission	If the development discovers human remains.

Utah

Regulation	Agency	Applicability
Geothermal Well Permit[276]	Utah State Engineer, Division of Water Rights (DWR)	All geothermal wells. The permitting process is laxer for wells under 120°C.[277]
Well Driller's License[278]	Utah State Engineer	All drilled wells. This is a license tied to the individual driller as a person, not the project.
Water Rights Application[279]	DWR	Appropriation and beneficial use of water, including geothermal fluids for traditional production, direct use/open-loop systems, and source water for closed-loop systems.
Underground Injection Control (UIC) Class V Permit[280]	Utah Division of Water Quality (DWQ)	All geothermal projects that involve injection wells.
Historic Preservation Review[281]	State Historic Preservation Officer	All permitted wells.

271 Tex. Nat. Res. Code §§ 141.002–.013; 16 Tex. Admin. Code § 3.5

272 16 Tex. Admin. Code §§ 3.37, 3.38, 3.39, 3.40.

273 16 Tex. Admin. Code §§ 3.37, 3.38, 3.39, 3.40.

274 Texas Water Code Title 2, Subtitle B, Chapter 11

275 13 Tex. Admin. Code § 22.4

276 Utah Code § 73-22; Utah Admin. Code R655-1-1 to -10.

277 Utah Admin. Code R655-4.

278 Utah Admin. Code R655-4-3.

279 Utah Code § 73-21-1 to -10.

280 Utah Admin. Code R317-7-3.

281 Utah Code § 9-8-404.

Washington

Regulation	Agency	Applicability
Site Certification[282]	Energy Facility Site Evaluation Council (EFSEC)	All power production facilities ≥ 25 MW.
Geothermal Drilling Permit[283]	Washington Dept. of Natural Resources (DNR) – Geology & Earth Resources Division	Required to drill, redrill, or deepen any geothermal exploration/production well.
State Environmental Policy Act (SEPA)[284]	DNR	All state and local permits/approvals are subject to SEPA review.
Underground Injection Control Class V Permit[285]	Washington Dept. of Ecology – Water Quality Program	Reinjection of produced fluids or EGS circulation wells; must meet groundwater-protection standards and be registered/permitted before injection.
Water-Right Permit[286]	Washington Dept. of Ecology – Water Resources	Consumptive withdrawal of surface or ground water (e.g., cooling, make-up water); non-consumptive closed-loop/reinjection projects may avoid a permit.
Cultural Review[287]	Washington Dept. of Archaeology & Historic Preservation	Any disturbance of archaeological sites, Indian graves, or historic properties on public or private land requires a permit.

282 Wash. Rev. Code § 80.50.

283 Wash. Rev. Code § 78.60.070(1).

284 Wash. Rev. Code § 43.21C.

285 Wash. Admin. Code § 173-218.

286 Wash. Rev. Code § 90.03.250.

287 Wash. Rev. Code § 27.53.060

Wyoming

Regulation	Agency	Applicability
Industrial Siting Permit[288]	Wyoming Department of Environmental Quality – Industrial Siting Council	Required for large "industrial facilities," which include geothermal-powered electric plants above the cost/size threshold in the Industrial Development Information & Siting Act. The exact threshold changes, but as of 2024 it was ~$280 million.
Well-Drilling License[289]	State Engineer's Office	Contractor licensing scheme for drilling of a "water well"; may apply to EGS injection wells.
Sage-Grouse Review[290]	Wyoming Game & Fish Dept.	Projects in designated Core Areas must meet disturbance limits and timing restrictions.
Cultural & Historic Preservation Review[291]	State Board of Land Commissioners	Required before excavation of certain historic resources on state or federal lands.

288 Wyo. Stat. § 35-12-106.

289 Wyo. Stat. § 33-42-101 to 117.

290 Wyoming Executive Order 2019-3.

291 Wyoming Antiquities Act of 1935, Wyo. Stat. Ann. §§ 36-1-114 to 116.