Part II

Geothermal Resources and Applications in New Mexico

Chapter 2

The Geothermal Opportunity in New Mexico

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New Mexico can position itself at the forfront of the global geothermal transition, ensuring a cleaner more secure energy future for generations to come.

As the first pages of this report make clear: New Mexico is abundant with the geothermal resources and technological expertise necessary to make the state a leader in the industry. All that geothermal potential, largely from the Rio Grande rift and the Jemez Lineament, blesses the Land of Enchantment with as much as 163.32 gigawatts of geothermal electricity potential, not to mention a vast amount of heat for heating and cooling and other direct-use applications.[1] In fact, there is sufficient heat at depth throughout nearly the *entire* state for geothermal energy use of one kind or another. (See Chapter 3, "Where is Geothermal in New Mexico?")

Also, although geothermal development has historically faced higher upfront costs than natural gas, recent advancements are narrowing the gap. Costs are already competitive with other always-on power generation sources. As the oil and gas industry continues to make improvements in drilling and other technology, costs will continue to come down.

Recognizing this potential—including a skilled oil and gas workforce—New Mexico created a $15 million Geothermal Projects Development Fund, as well as a production tax credit of 1.5 cents[2] and consumer incentives up to $9,000 for ground source heat pumps (GSHPs).[3] These incentives aim to reduce upfront costs and make geothermal projects more financially viable. This is a great start, but more can be done.

This report offers policy proposals (see Chapter 7) to accelerate geothermal in New Mexico; it dives into where to find the best heat for the best applications; it explores how to work closely with the state's strong oil and gas industry; and it examines the different people, organizations, and environmental considerations to

IN SHORT: THE BENEFITS OF GEOTHERMAL FOR NEW MEXICO

- **Untapped potential:** New Mexico ranks sixth in the country in estimated geothermal resources, according to one Department of Energy analysis, yet the resource remains largely underdeveloped.[4]
- **Workforce compatibility:** Geothermal development requires skills similar to those needed for oil and gas (e.g., drilling, reservoir management).
- **Existing infrastructure:** The state's oil and gas infrastructure, such as drilling rigs and service companies, could be adapted for geothermal development.
- **Economic diversification:** Expanding geothermal reduces the impact of oil and gas volatility by providing stable revenue streams for oil and gas companies that add geothermal to their business models.
- **Rural economic development**: Geothermal projects can bring investment, jobs, and infrastructure to rural communities that have geothermal potential but are located far from urban areas.
- **Baseload sustainable energy:** Unlike wind and solar, geothermal provides consistent, 24/7 power, improving grid reliability and energy security.
- **Low-carbon energy:** Whether it's deployed for electricity generation, or heating and cooling in the form of ground source heat pumps or direct-use systems, geothermal energy supports the state's climate goals and complies with New Mexico's regulations by delivering clean, sustainable energy with minimal greenhouse gas emissions.
- **Small footprint**: A typical geothermal energy power plant occupies just 3.7% of the land that a coal-fired power plant needs. Next-generation geothermal technologies require even less space. Additionally, geothermal facilities require far less infrastructure than most other energy sources, including less transmission build-out.
- **Energy independence and potential for energy export:** Developing local geothermal resources strengthens New Mexico's energy sovereignty, boosts its ability to remain a leader in energy production and exportation, and ultimately contributes to increased state revenues.

take into account. But, an important thing to establish is New Mexico's electricity landscape. That's because the ultimate goal is to use geothermal energy to deliver clean, always-on, secure energy at the source, and so much of that happens through the grid.

NEW MEXICO'S ELECTRICITY LANDSCAPE

Electricity Generation

New Mexico is a net energy exporter of raw energy commodities such as crude oil, natural gas, and coal, as well as electricity. Over the past decade, the state has harnessed advancements in technology to expand wind and solar resources.[5] As a result, the sourcing for electricity generation in New Mexico has shifted considerably. Wind now accounts for 41% of the state's total installed capacity[6] (**Figure 2.1**). Coal-fired electricity generation has declined significantly as the state has shuttered plants, including the San Juan Generating Station in 2022.[7,8] (Notably, battery capacity saw a substantial increase in 2023.[9]) And while New Mexico is one of only seven states with utility-scale geothermal electricity generation[10], geothermal provides a tiny fraction of the state's installed capacity, with one power plant, the Lightning Dock Geothermal facility.

As shown in **Figures 2.1** and **2.2**, since 2019, electric capacity and generation have increased by 22% and 12%, respectively. At the same time, the number of New Mexican electricity customers has grown by only 3% (see **Figure 2.4**). Some—but not all—of the increased generation has been exported, indicating an in-state increase in per-capita electricity consumption.

INSTALLED ELECTRICITY CAPACITY IN NEW MEXICO

Year	2019	2021	2023	2019–23 Change
Wind	2,036	4,266	4,409	117%
Natural gas	3,275	3,128	3,263	0%
Coal	2,640	2,387	1,540	-42%
Solar	672	739	1,132	69%
Hydroelectric	83	83	83	0%
Petroleum	48	187	46	-4%
Battery	2	2	239	11,850%
Geothermal	9	9	9	0%
Other biomass	5	5	3	-40%
Other	1	1	1	0%
Total electric industry	**8,771**	**10,807**	**10,725**	**22%**

Figure 2.1: New Mexico's primary installed electricity capacity (in megawatt-hours), 2019–23. Source: U.S. Energy Information Administration, 2024. https://www.eia.gov/state/analysis.php?sid=NM

ELECTRICITY GENERATION BY PRIMARY SOURCE

Year	2019	2021	2023	2019–23 Change
Coal	14,691,665	12,536,319	7,371,813	-50%
Natural gas	11,803,192	10,093,190	14,230,765	21%
Wind	6,892,087	10,580,735	14,914,473	116%
Solar	1,365,900	1,749,810	2,613,007	91%
Hydroelectric	158,180	122,862	107,792	-32%
Other biomass	22,582	25,683	13,081	-42%
Petroleum	183,601	33,178	1,411	-99%
Geothermal	58,102	50,934	35,858	-38%
Total electric industry	35,174,509	35,192,365	39,269,073	12%

Figure 2.2: New Mexico's electricity generation (in megawatt-hours) by primary energy source, 2019–23. Source: U.S. Energy Information Administration, 2024.

USE OF ELECTRICITY BY SECTOR

Year	2019	2020	2021	2022	2023	2019–23 Change
Residential	6,871,561	7,282,079	7,088,358	7,282,636	7,336,277	7%
Commercial	9,028,861	8,406,884	8,655,826	9,084,022	9,349,407	4%
Industrial	8,979,712	9,088,192	9,649,559	10,789,520	11,661,806	30%
Total electric industry sales	24,880,134	24,777,155	25,393,743	27,156,178	28,347,490	14%
Direct use	152,082	162,685	211,769	155,868	203,730	34%
Estimated losses	1,349,098	1,379,945	1,194,686	1,468,917	1,255,430	-7%
Unaccounted for	62,114	-37,222	162,183	-49,070	143,822	132%
Net interstate exports	8,731,082	7,793,020	8,229,984	12,157,142	9,318,601	7%
Total disposition	35,174,510	34,075,583	35,192,365	40,889,035	39,269,073	12%
Net trade index (ratio)	1.3	1.3	1.3	1.4	1.3	

Figure 2.3: Use of electricity by sector and end use (in megawatt-hours) 2019–2023. Source: U.S. Energy Information Administration, 2024.

Electricity Consumption

Figure 2.3 shows where and how the electricity generated in New Mexico is consumed. Electricity that isn't sold to the residential, commercial, or industrial sectors is either used directly by the producer without being sold to a customer, lost via transmission or parasitic load, unaccounted for, or exported to other states. Between 2019 and 2023, New Mexico's total electricity sales (in megawatt-hours) increased by 14%.

Figure 2.3 also shows that the industrial sector has been the largest user of electricity in the state, surpassing the commercial sector (which includes offices, retail, and other businesses). Industry is also the fastest-growing consumer of electricity, with a 30% increase between 2019 and 2023. Electricity exports have become a larger share of the state's electricity use, rising 7% between 2019 and 2023.

Figures 2.1 through **2.5** show the evolving electricity landscape in New Mexico. Oil and gas currently dominate New Mexico's industrial energy landscape, but the state has implemented initiatives such as the Renewable Energy Production Tax Credit,[11] the Geothermal Projects Development Fund,[12] and the Energy Transition Act[13] to promote renewable energy and encourage industries to explore power sources such as solar, wind, and geothermal. Today, there is a clear trend toward renewable energy sources, including significant investments in battery storage, which have also grown in recent years.[14]

As the share of intermittent power sources increases in the energy mix, more storage will be necessary to maintain grid stability. Not only is geothermal a non-intermittent renewable power source, but developers are also demonstrating that geothermal wells can provide energy *storage* capacity.[15] These storage benefits may enhance the attractiveness of geothermal energy investments in areas where solar and wind capacity are already high.

In addition to understanding the electricity generation landscape in New Mexico, it's also important to understand the power potential of geothermal; the capacity and reliability of the electrical grid; and the cost considerations of geothermal development, along with the benefits.

NUMBER OF ELECTRICITY CUSTOMERS BY SECTOR IN NEW MEXICO

Year	2019	2020	2021	2022	2023	2019–23 Change
Residential	895,086	905,885	914,495	921,109	928,216	4%
Commercial	144,960	145,459	146,312	147,142	147,632	2%
Industrial	9,456	9,436	9,271	9,278	9,339	-1%
Total	1,049,502	1,060,780	1,070,078	1,077,529	1,085,187	3%

Figure 2.4: Number of electricity customers by sector, 2019-23. Source: U.S. Energy Information Administration, 2024.

AVERAGE ELECTRICITY PRICE BY SECTOR IN NEW MEXICO

Year	2019	2020	2021	2022	2023	2019–23 Change
Residential	12.51	12.94	13.52	13.84	13.85	11%
Commercial	9.79	10.28	10.80	11.07	10.68	9%
Industrial	5.48	5.58	6.16	6.56	5.75	5%

Figure 2.5: Average electricity price (cents/kilowatt-hour) per sector, 2019-23. Source: U.S. Energy Information Administration, 2024.

GEOTHERMAL ELECTRICITY POTENTIAL IN NEW MEXICO

As noted, New Mexico ranks among the best states for geothermal potential.[16] Although some projections—like the National Renewable Energy Laboratory's (NREL) *Enhanced Geothermal Shot Analysis*—estimate New Mexico's potential to be only between 3 gigawatts and 5 gigawatts of generation capacity by 2050, this is a conservative estimate.[17]

At an average electricity generation capacity of between 3 megawatts and 10 megawatts per geothermal well, reaching New Mexico's full geothermal potential will require thousands of new wells. Given the state's 53,600 active oil and gas wells and 44,370 plugged or abandoned wells, and the demonstrated drilling capacity of the oil and gas sector (about 1,000 new wells per year), the state clearly has the resources and expertise to reach its full potential. And geothermal technology that uses existing oil and gas wells for energy production and storage can provide an another path to increased renewable energy generation.

With the advancements to drilling, turbine, and other technologies made in the oil and gas industry, it is feasible that we will see a 90% reduction in the cost of deploying an engineered geothermal system (EGS) by 2035.[18]

Grid Reliability Considerations and Geothermal Benefits

New Mexico's electric grid is a dynamic system undergoing significant changes to incorporate more renewable energy sources. Currently, the state's electric

GEOTHERMAL ENERGY STORAGE

As addressed in Chapter 1: The modern electricity grid is a delicate system that requires constant monitoring to balance electricity production against electricity demands. With more electrons flowing onto the grid from intermittent energy sources such as wind and solar—which are only available when the sun shines or the wind blows—concerns about having power when it is needed have brought the need for energy storage to the forefront. Today, hydroelectric storage provides most global energy storage capacity, and recent years have seen a significant expansion in the deployment of batteries for energy storage.

A new approach, underground thermal energy storage—also known as geothermal energy storage (GES)—may offer an additional option. GES systems capture and store waste heat or excess electricity by pumping fluids into natural and artificial subsurface storage spaces, from aquifers to boreholes to mines. GES can be primarily mechanical—with hydraulic fracturing techniques storing pressurized fluid in subsurface reservoirs—or mechanical and thermal—with both pressure and heat combined to return more energy than was required to pump the fluid underground.

Due to the passage of New Mexico's HB 361, which allows old wells to be converted to geothermal energy resources, and the significant production of wind and solar in the state, geothermal storage is an exciting opportunity in the Land of Enchantment.

grid transmits a blend of traditional and renewable energy sources. The state also has a renewable portfolio standard goal of 40% renewables by 2025; 80% by 2040; and 100% of electricity supplied by zero-carbon resources by 2045.[19]

Looking ahead, as New Mexico strives to meet those targets, growing the percentage of intermittent renewables will require adjustments to grid operations, while population growth and electrification trends will increase overall demand.

Important aspects of the current grid, and future needs, include the following:

- **Energy sources and generation:** New Mexico's electricity generation is diverse. A significant portion of energy on the grid comes from renewable sources.[20] Fossil fuels, particularly natural gas and coal, continue to play a significant role, with natural gas being a major component due to the state's extensive natural gas reserves.

- **Grid infrastructure and modernization:** The electric grid in New Mexico is undergoing significant modernization efforts to enhance its resilience and integrate renewable energy sources.[21] These efforts include investments in advanced metering infrastructure and smart-grid technologies that improve efficiency and enable better demand response capabilities (i.e., the managed reduction of electricity demand during peak times).

- **Transmission and distribution:** New Mexico's transmission infrastructure is extensive, with major utilities managing the grid. As noted earlier, the state is also a net exporter of electricity, helping meet the region's electricity demands.[22,23]

- **Stakeholder engagement and planning:** New Mexico has adopted an inclusive approach to energy planning, requiring that utilities provide opportunities for various stakeholders to comment on their plans for new generation. These initiatives ensure that the perspectives of different stakeholders—including utilities, consumers, and policymakers—are considered in resource planning.[24]

- **Challenges and future directions:** Despite the progress it has made, New Mexico faces challenges such as the costs associated with grid modernization and the need to balance energy affordability with environmental goals. The state is focusing on enhancing grid resilience, especially in the face of climate change and increasing renewable energy integration.[25]

The Benefits of Geothermal Development for New Mexico's Grid

In addition to the benefits it provides to the state overall, geothermal also offers benefits for the grid in particular:

1. **Enhanced stability:** As a constant power source, baseload geothermal can provide stability and reduce reliance on fossil fuel–based peaker plants.

2. **Improved resilience:** Geothermal plants are less affected by weather conditions than solar and wind. Take the severe storm that struck New Mexico and Texas in February 2021 and caused widespread power outages. Numerous natural gas facilities, wind turbines, and other power plants were inadequately prepared for the extreme cold, leading to shutdowns for safety reasons.[26] Geothermal energy production remains largely unaffected by surface weather and can quickly return to operation after disruptions. By prioritizing investment in geothermal infrastructure, regions prone to severe weather could significantly enhance grid resilience, reducing the likelihood of future outages.

3. **Reduced transmission losses:** If developed close to demand centers, geothermal power can reduce transmission losses and alleviate some transmission constraints. Furthermore, electricity from steady, continuous baseload sources such as geothermal is transmitted more efficiently than electricity from sources that fluctuate with peak demand.

4. **Transmission line capacity:** Geothermal energy's high capacity factor reduces the need for extensive transmission infrastructure upgrades compared with more variable renewable sources. The consistent output of geothermal plants allows for more efficient use of existing transmission lines, reducing congestion and the need for additional capacity. As a matter of fact, no changes to grid architecture, operating principles, or controls would be needed to incorporate additional geothermal generation. Baseload geothermal can seamlessly integrate as a steady power source, while flexible geothermal requires more control systems (which already exist) to manage its variable output.

Additionally, flexible geothermal energy can adapt to changes in demand and supply. Its impact on grid reliability includes the following benefits:

1. **Increased flexibility:** The ability to ramp up or down helps balance supply and demand, especially with high penetration of intermittent renewables.

2. **Enhanced integration:** Flexible geothermal can facilitate the integration of more solar and wind power by providing backup power when renewable sources are not generating.

3. **Support for grid services:** Flexible geothermal can provide ancillary services such as frequency regulation and voltage support, which are crucial for grid stability.

By addressing current and projected reliability concerns, geothermal energy can play a pivotal role in strengthening New Mexico's grid and supporting its transition to a more sustainable energy future.

UNDERSTANDING GEOTHERMAL COSTS—PAST AND FUTURE

Historical Cost Structure (Before 2024)

Geothermal energy has historically been a capital-intensive industry; drilling and plant construction incur significant costs, and that's even before any energy production can occur. As mentioned, New Mexico has one operational utility-scale geothermal power plant, the Lightning Dock Geothermal site in Hidalgo County. Cyrq Energy began operations in 2013 with a 4 megawatt capacity. The initial geothermal plant developed by Cyrq had a total cost of $43 million,[27] translating to an overnight capital cost of $10,000 per kilowatt. In 2018, the plant was renovated to produce 14 megawatts with a novel topside Organic Rankine Cycle (ORC) system from Turboden.[28] Today, emerging technologies are driving down geothermal exploration and development costs, paving the way for significant growth in market potential.

Recent Technological Advances (2023–2025)

In 2024, Zanskar Geothermal & Minerals purchased the Lighting Dock facility, and in 2025, the company reported a major breakthrough with a newly directionally drilled large-diameter geothermal well achieving a productivity index of 50 gallons per minute/pounds per square inch (GPM/psi) and temperatures near 325°F (163°C).[29] The thermal capacity is estimated to exceed 200 megawatts per well, enough to feed the 14 megawatt electrical (MWe) power production plant, which would make the well one of the most productive pumped geothermal wells in the United States. Zanskar's approach highlights how data-driven and AI-assisted approaches can support target definition from large subsurface data sets and dramatically boost output without completely new field development. Geothermal development costs could be substantially reduced by adopting AI-assisted exploration techniques similar to those used in the oil and gas industry.

The Utah Frontier Observatory for Research in Geothermal Energy (FORGE) project, in operation since 2016, remains the leading U.S. field laboratory for advancing next-generation technologies.[30] Recent experiments successfully demonstrated circulation between well pairs and improved fracture control in hot, impermeable granite, significantly advancing EGS viability.[31]

The FORGE project has demonstrated the impact of the learning curve on drilling costs, as the project has significantly reduced both time and expense by applying a physics-based approach. The operational team was trained to understand the physical dynamics of bit dysfunction and other nonbit limitations. This understanding helped the team mitigate these issues in real time.[32] This methodology is now being widely applied to geothermal projects around the world.[33]

A number of companies are benefiting from the trailblazing activities undertaken by FORGE, including both the characterization of the granite basement in Utah and removing risks based on the team's findings and the demonstration of drilling, completion, and stimulation technologies. Between 2023 and 2025, Fervo Energy expanded its success from Project Red at new EGS deployments in Utah and Nevada. By refining horizontal drilling, real-time fiber-optic monitoring, and closed-loop reservoir management techniques, Fervo increased system efficiency and reduced drilling time by 70% compared with earlier projects,[34] leading to an overall cost of less than $400 per foot.

In 2023, Eavor Technologies, in partnership with Helmerich & Payne, Inc., ran a demonstration project near the Lightning Dock site that achieved depths of 18,000 feet true vertical depth (TVD).[35] The company successfully validated the use of insulated drill pipe, demonstrating both its thermodynamic and mechanical performance along with an increased rate of penetration enabled by shock cooling. It also achieved effective isolation of the upper fractured, permeable zone using casings, which facilitated the drilling of multilaterals into the deeper, low-permeability basement rock. This was followed by the application of the company's Rock-Pipe™ technology to seal the wellbore—a method designed to provide reliable isolation without the need for casings, which significantly reduces completion costs.

These advancements will also make next-generation geothermal competitive with other renewables for firm, dispatchable generation.

Policy Support and Cost-Reduction Incentives

As explained in other chapters of this report, in recognition of geothermal's potential, New Mexico established a $15 million Geothermal Projects Development Fund in 2024 to reduce upfront project costs. This incentive, combined with advancing technologies, positions geothermal projects for lower overall capital expenditures and operational and maintenance expenses moving forward.

As these technologies scale and financing mechanisms mature, geothermal development is projected to become more cost competitive, which will in turn support broader deployment of clean energy across the state.

Royalty Cost Considerations in Land Leasing for Geothermal

The economic potential of geothermal development for property owners is an important part of the economic benefits to New Mexico overall. As Chapter 6, "Who Owns the Heat?" explains, geothermal resources are typically handled similarly to oil and gas leases.

Leases for resources such as oil and gas in New Mexico include several key components: (i) lease duration and terms for extension or renewal; (ii) bonus payments, usually an upfront payment to the mineral right owner stated in per-acre terms; (iii) royalty rate, meaning the percentage of revenue generated from the extracted resource; and (iv) annual rentals of a per-acre fee paid whether production occurs or not. There may also be requirements for development during a specific time frame and land restoration required as a result of damage during the extraction process.[36]

Of course, the biggest upside for a geothermal rights owner is usually the royalty if valuable resources are extracted. For related surface and subsurface leases, royalty rates have varied by land type. Royalty rates for onshore oil and gas leases on federal lands recently increased from 12.5% to 16.67%.[37] Royalty rates for oil and gas leases on land owned by the state are capped at 20%. Attempts have been made to increase this cap to 25%, which would equal the oil and gas lease royalty rate for Texas lands.[38,39] Royalty rates for oil and gas on private lands are negotiable, and nationwide these rates generally range from 12% to 25%.[40] The rates are influenced by state rates as well as the region. Royalty rates of between 18% and 20% are typical in the Permian Basin in New Mexico.[41]

For revenues from geothermal resources, royalties are typically charged on revenues generated, either from electricity sales or direct-use applications. Royalties from geothermal resources on state lands, per New Mexico statute, range from 2% to 10%.[42] Royalties from geothermal resources on federal lands range from 1.75% to 10%.[43] The most recent competitive federal geothermal lease sale took place in November 2021, when 3,987 acres in Sierra County and Hidalgo County were auctioned with a high per-acre bid of $6.00.[44] In general, geothermal royalty rates are lower than oil and gas royalty rates.

Other mechanisms also provide a minimum level of compensation to a rights holder and align incentives for the extraction or development of the mineral resources.

PROJECTIONS OF NEW MEXICO'S GEOTHERMAL CAPACITY

Researchers have done numerous projects studying the state's heat potential. Here are some summaries:

International Energy Agency's (IEA's) *The Future of Geothermal*: In late 2024, IEA published an analysis of the technical heat energy provided by geothermal resources around the world. The analysis relied on subsurface data calculations from Project InnerSpace's GeoMap tool to detail the resource potential. The report calculated the recoverable quantities of geothermal energy at various price points given today's technology.[45] Project InnerSpace's data shows that if New Mexico were to develop all available geothermal resources within the first 16,400 feet of subsurface, the state would have a geothermal potential of 163.32 gigawatts, or more than 15 times its 2023 installed capacity. If costs come down with improved technologies, Project InnerSpace estimates that almost 300 gigawatts of geothermal could be available at or below a levelized cost of electricity of $100.

NREL's *Enhanced Geothermal Shot Analysis* for the Geothermal Techonologies Office: This 2023 analysis outlines ambitious targets for the advancement of EGS. The initiative aims to reduce the cost of EGS by 90%, with a target of $45 per megawatt-hour (MWh) by 2035. Achieving this cost reduction could unlock substantial geothermal capacity across the United States. The analysis projects that geothermal capacity in New Mexico could reach between 1 gigawatt and 1.5 gigawatts by 2030, with further increases to between 3 gigawatts and 5 gigawatts by 2050. These milestones depend on technological advancements, supportive policies, and investment in geothermal infrastructure. Although specific figures for New Mexico are not detailed, the state's significant geothermal resources mean it's in a good position to benefit from these advancements. The successful implementation of EGS technologies could enable New Mexico to develop a considerable portion of the projected national geothermal capacity by 2050. These developments underscore the transformative potential of EGS for enhancing geothermal energy deployment, particularly in resource-rich states such as New Mexico.[46]

***Nature Energy* article "The Role of Flexible Geothermal Power in Decarbonized Electricity Systems":** In this 2024 study, the authors examined the impact of operational flexibility in EGS within the western United States. The research highlights that EGS plants capable of load-following generation and in-reservoir energy storage can significantly enhance their role in cost-effective, decarbonized electricity systems. Specifically, flexible EGS operations can increase optimal geothermal deployment and reduce overall electricity supply costs compared with an inflexible EGS or systems without an EGS. In scenarios where flexibility is incorporated, two categories of capacity are defined: baseload capacity, which reflects the steady-state output aligned with the sustainable flow rate of the wellfield, and flexible capacity, which captures additional generation enabled by temporarily elevated flow rates. Baseload capacity represents the total developed subsurface resource and includes full wellfield and reservoir development costs, while flexible capacity can be added at substantially lower marginal cost. According to the author's data, 2.85 gigawatts of EGS can be realized as baseload capacity, with an additional 1.74 gigawatts achievable through flexible operation under optimized conditions in New Mexico by 2045. The study also notes that flexible geothermal plants can shift their generation on diurnal and seasonal timescales, achieving round-trip energy storage efficiencies of between 59% and 93%. These findings suggest that implementing flexible EGS could substantially increase geothermal capacity beyond current levels, contributing to grid stability and reliability in regions like New Mexico.[47]

Oak Ridge National Laboratory's *Grid Cost and Total Emissions Reductions Through Mass Deployment of Geothermal Heat Pumps for Building Heating and Cooling in the United States:* This 2023 study provided national-scale data on the impacts of geothermal heat pump deployment. The following are estimates for New Mexico, using proportional scaling:

- *Primary energy consumption reduction*: New Mexico accounts for approximately 0.5% of the U.S. population. Assuming similar energy-use patterns, the state could see a 2.96 terawatt-hour (TWh) reduction in primary energy consumption annually by 2050, proportional to the national savings of 593 terawatt-hours.

- *Carbon emissions reduction:* Based on New Mexico's energy usage profile and Oak Ridge's projected 7 gigatons CO_2-equivalent national reduction, the state could avoid 35 million metric tons of CO_2 emissions by 2050 with the adoption of geothermal heat pumps.
- *Electricity generation savings:* Extrapolating from Oak Ridge's 593 terawatt-hours savings, New Mexico could save approximately 3 terawatt-hours annually in electricity generation by 2050, particularly in residential and commercial cooling applications.
- *Peak demand mitigation:* Geothermal heat pump deployment in New Mexico's high-temperature zones could contribute to reducing peak summer electricity demand by between 5% and 10%, which would help alleviate grid stress during heat waves.

These estimates highlight the potential benefits of scaling geothermal heat pump deployment in New Mexico, particularly in reducing energy consumption, emissions, and peak grid loads. This extrapolation is based on Oak Ridge's national findings and adjusted for New Mexico's size and energy usage patterns.[48]

Caveat: Differences in Model Assumptions and Their Impact

The reviewed studies vary in their treatment of geothermal expansion. Models such as NREL's Enhanced Geothermal Shot Analysis and the U.S. Energy Information Administration's Annual Energy Outlook emphasize EGS, while others may not fully account for this technology. Some models, such as IEA's Net Zero by 2050, consider geothermal conversions for industrial processes, which can significantly impact the energy mix and emissions profiles. Other studies consider the dual role of geothermal power in providing both baseload and flexible power.[49,50] This distinction is crucial to ensure grid stability and to integrate variable renewable energy sources. These differences impact New Mexico–specific analyses by influencing projections of geothermal capacity, cost, and emissions reductions. For instance, a model that includes flexible geothermal deployment in New Mexico may show higher potential for grid integration and reliability benefits than one that focuses solely on baseload capacity.

CONCLUSION

As this chapter shows, by combining New Mexico's electricity demand, its high subsurface temperatures, the legislative goals to further diversify the energy mix, the state's expertise in the robust oil and gas industry, and opportunities from next-generation geothermal, the Land of Enchantment is poised to vastly expand its position as a leader in geothermal energy.

In the years ahead, the successful acceleration of geothermal energy in New Mexico will depend on continued collaboration among policymakers, researchers, industry leaders, and local communities. Investments in research, transmission infrastructure, and regulatory streamlining will be essential to unlocking geothermal's full potential.

With the right policies and a sustained commitment, New Mexico can make geothermal energy a cornerstone of its clean energy economy—one that not only powers homes and industries but also sets a precedent for other states seeking sustainable and resilient energy solutions. By embracing this opportunity, New Mexico can position itself at the forefront of the global geothermal transition, ensuring a cleaner, more secure energy future for generations to come.

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