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Potential Workforce Implications of the Geothermal Industry Across the United States

Gregory B. Upton, Jr.
Ian Lange
Maxwell Brown
Joanna Walker

LSU Center for Energy Studies

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Third Way commissioned LSU-CES to assess the economic impacts of scenarios for a National Geothermal build out for the U.S. economy. Third Way was given the opportunity to review and provide feedback on this report. The analysis and opinions expressed are those of the authors alone.

THIRD WAY

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Executive Summary

In this analysis, we estimate potential contributions of geothermal buildout scenarios in the United States through 2050 to electricity production and national economic activity. We consider three scenarios: the Reference Scenario, which uses the Regional Energy Deployment System (ReEDS), developed by the National Renewable Energy Laboratory (NREL) with model default assumptions; the Vision Scenario, which is based on the GeoVision study; and the Decarb Scenario, which applies the GeoVision assumptions alongside a 100% carbon free electricity target by 2035

- By 2050, installed geothermal capacity is projected to reach 10 Gigawatts (GW) under the Reference Scenario, 36 GW under the Vision Scenario, and 30 GW under the Decarb Scenario.
- Estimated capital expenditures total $20 billion under the Reference Scenario, $139 billion under the Vision Scenario, and $105 billion under the Decarb Scenario, in 2025 dollars.
- Over the next decade, the construction is estimated to support 7,400 to 39,400 total jobs per year in the different scenarios.
- On a net present value basis, construction is estimated to support $7.2 billion to $35 billion in earnings, and $14 billion to $68 billion in Gross Domestic Product, discounted at 4%.
- Once fully operational, geothermal facilities are estimated to support 6,500 to 24,200 jobs nationwide each year. These jobs are estimated to support $470 million to $1.8 billion in earnings per year, and $1.1 billion to $4.2 billion in GDP per year (2025 dollars).
- In total, inclusive of construction and operations, these scenarios are estimated to support a net present value, at a 4% discount rate, of $12.7 billion to $43.9 billion in earnings in the different scenarios.
- Key occupations supported include construction laborers, truck drivers, and maintenance workers. Additionally, drilling crews and well maintenance personnel are required for construction and maintenance of the geothermal wells, including roustabouts, derrick operators, and service unit operators.

Introduction

Geothermal energy accounts for a relatively small share of the energy mix in the United States. Some industry leaders, policymakers and researchers have suggested that it could play a more prominent role in the national energy landscape, drawing parallels to the transformative effects of the domestic oil and gas boom (Finger & Blankenship, 2010). While development to date has been concentrated in the Western United States, geothermal energy also has the potential to expand throughout the U.S. (Robins et al., 2020).

Geothermal resources in Western States have been identified as a potential contributor to national efforts aimed at diversifying energy supplies and reducing greenhouse gas emissions (Geothermal Technologies, 2021). Studies have examined the technical potential of geothermal to supply a portion of U.S. electricity needs and contribute to local and national economic activity (Tester et al., 2007). Project development may also support employment in construction, maintenance, and operations, as well as in fields such as engineering, drilling, and environmental science. Other research has highlighted the geothermal sector's potential role in supporting rural economic development in areas with limited industrial activity (Bloomfield et al., 2003).

States such as California and Nevada have already made notable investments in geothermal infrastructure, increasing their installed capacity over the past decade. Other regions, including Idaho and Oregon, have also begun exploring development opportunities, supported by favorable geology (Blackwell et al., 2011). Although geothermal currently comprises a small share of the U.S. energy mix, it has experienced growth, supported in part by advances in drilling technology and resource mapping (Blankenship et al., 2024; Tester et al., 2021) alongside decarbonization goals.

Prior research has estimated that large-scale development could generate substantial investment, with potential implications for regional economies, wages, and energy sector employment (Bloomfield et al., 2003), although this work was conducted more than two decades before the current analysis. Geothermal has also been included in analyses of long-term decarbonization strategies and energy system resilience (Tester et al., 2021; Vargas et al., 2022).

The geothermal energy industry relies on a wide range of occupations, many of which mirror long-established roles in the oil and gas sector. Geothermal projects require engineers to design and optimize systems, geologists to identify and evaluate subsurface resources, and technicians to operate and maintain facilities (Augustine et al., 2019; Liming, 2012). Installation and upkeep also depend heavily on trades and primary occupations, including installers, mechanical assemblers, and other field-based technical roles (Blankenship et al., 2024; Liming, 2012). Because geothermal development uses many of the same competencies as upstream oil and gas—such as geological analysis, directional drilling, and well servicing—existing occupations like roustabouts, derrick operators, and service unit operators are readily transferable. As a result, a substantial portion of the workforce needed for geothermal expansion is already in place.

Purpose of this Report

The purpose of this report is to estimate the labor market implications of a potential buildout of geothermal energy in the United States. To develop scenarios, we utilize the open-source version of the Regional Energy Deployment System (ReEDS), developed by the National Renewable Energy Laboratory (NREL). To estimate economic impacts of these scenarios, we apply the Jobs and Economic Development Impacts (JEDI)-Geothermal model (NREL, 2023b), also developed and maintained by NREL, in conjunction with the Regional Input-Output Modeling System (RIMS II), which is maintained by the U.S. Bureau of Economic Analysis (Karen J. Horowitz & Planting, 2009). In addition to estimating overall economic and employment effects, this report identifies the occupational categories most likely to be involved in geothermal project development and operation under the modeled scenarios.

Current Electricity Needs of the United States

The United States is the largest producer of energy globally (EIA, 2025) and also has the second-highest electricity consumption globally (World Population Review, 2025). In 2023, electricity consumption in the United States totaled 4,000 terawatt-hours (TWh), which was nearly 2% lower than the 4,067 TWh consumed in 2022 (EIA, 2024a). Although total energy usage in the U.S. economy has been relatively flat over the last decade, the share of energy coming from electricity is projected to increase over the coming decade (Upton et al., 2024). Some have forecast strong electricity demand growth, referencing a new Age of Electricity (IEA, 2025).

Fossil fuels continue to be the largest source of electricity generation in the United States, accounting for approximately 60% of the current electricity mix. Natural gas remains the largest energy source for electricity generation, accounting for approximately 43% of total electricity production as of 2023 (EIA, 2024b). Nuclear is the second largest, accounting for 18.6%, followed by coal accounting for 16%. Combined, all sources of renewable power accounted for 21.4%, which includes wind, hydro, solar, biomass, and geothermal (listed in order of share). As will be highlighted in more detail below, geothermal makes up less than 0.5% of the total electricity mix in the U.S., and an even smaller share of total energy usage.

Overview of Geothermal Energy

Geothermal energy is a renewable energy source that harnesses the Earth's natural heat to generate electricity and provide heating and cooling. Geothermal energy is derived from the Earth's internal heat, which is continuously generated through natural radioactive decay processes and remnant heat from the planet's formation (Barbier, 2002). Approximately 50% of the Earth's geothermal heat originates from sources like radioactive elements such as Uranium-238, Thorium-232, and Potassium-40 (Davalos-Elizondo et al., 2023; Fukuhara, 2016). This vast quantity of geothermal energy can be utilized for a wide range of temperature-related engineering applications, including power generation, direct use for heating and cooling, and industrial processes that require heat (Khankishiyev et al., 2023). Unlike other forms of renewable energy (such as wind and solar), geothermal energy is not intermittent and thus has the potential to be a consistent source of renewable energy across both the hours of the day and seasons of the year.

Geothermal energy in the United States can be classified into three main categories: (1) direct use, (2) enhanced geothermal systems (EGS), and (3) conventional hydrothermal (Blankenship et al., 2024; Jolie et al., 2021). The Western U.S. is the predominant region for conventional hydrothermal resources, which are characterized by significant temperature variations and the presence of water or steam, stemming from the unique geological features of the local environment (Blackwell et al., 2011). Thus, it is unsurprising that geothermal development to date has been concentrated in the Western U.S.

Enhanced geothermal systems harness low-grade geothermal resources, which are geothermal resources with relatively low subsurface temperatures that are generally unsuitable for conventional electricity generation without additional engineering. EGS technologies stimulate subsurface rock formations to enhance the flow of water, thereby creating engineered geothermal reservoirs or improving the productivity of existing low-temperature resources. By increasing permeability and water circulation, the efficiency and energy output of EGS systems can be significantly improved (Smith, 2023; Tester et al., 2021).

Direct-use or moderate-temperature geothermal systems leverage geothermal heat for diverse applications. For instance, they can be used to heat greenhouses, providing optimal growing conditions for plants. The utilization of geothermal energy in this manner showcases its versatility and capacity to meet a variety of energy needs (Davalos-Elizondo et al., 2023; Jolie et al., 2021).

Geothermal power is regarded as a reliable baseload form of energy that can be utilized around the clock. Although still a relatively small share of the energy mix, geothermal power generation has experienced expansion in recent decades (REN21, 2024; Robins et al., 2020).

Geothermal power plants can be classified into four main types: (1) dry steam, (2) flash steam, (3) binary cycle, and (4) engineered geothermal systems. Dry steam plants utilize natural steam reservoirs to directly drive turbines. Flash steam plants generate electricity by depressurizing high-temperature geothermal water, causing a portion of the water to “flash” into steam that drives a turbine, while double flash steam plants improve efficiency by flashing the geothermal fluid twice—once at high pressure and again at lower pressure—to extract additional steam for power generation. Binary-cycle plants employ secondary working fluid with a boiling point below water’s, enabling use of lower-temperature geothermal resources and expanding the geographic range of viable projects (Barbier, 2002; Ricks & Jenkins, 2025). Engineered geothermal systems involve the artificial stimulation of the subsurface to create or enhance underground reservoirs for power generation (El Haj Assad et al., 2017; Kagel et al., 2005; Tester et al., 2021). These systems offer a versatile range of capacities, with single flash or binary cycle plants typically generating between 20 MW and 100 MW, and double flash steam plants capable of producing up to 125 MW of electricity (Barbier, 2002; El Haj Assad et al., 2017).

Current Status of Geothermal Energy in the United States

The United States possesses significant potential for expanding geothermal energy utilization. As of 2023, the nation's installed geothermal capacity stands at 2,670 MW, representing approximately 0.4% of the country's total electricity generation (EIA, 2024b). Some estimates suggest a much higher potential for geothermal power generation in the U.S., with an estimated 30,033 MW of undiscovered resources and an additional 517,800 MW through enhanced geothermal systems (Blankenship et al., 2024; Boyd, 2024).

The western region of the United States, from Texas westward, contains the nation’s most significant conventional geothermal resources, as well as the newly emerging resource class known as stimulation-enhanced geothermal systems (Blankenship et al., 2024). Technical potential for extractable heat has made development of the geothermal resource in this region feasible (Boyd, 2017; Tester et al., 2021). While more extensive exploration efforts might still occur in the future in the Western U.S., the possibility exists that new geothermal reserves could be extracted in the central and eastern areas of the United States as well, thereby expanding the country's geothermal energy portfolio (Blackwell et al., 2011). However, geothermal energy’s share of U.S. electricity production will ultimately be heavily influenced by its cost relative to other alternatives.

As of 2023, approximately 17 million megawatt-hours (MWh) of electricity were generated in the U.S. from geothermal energy sources (Blankenship et al., 2024). Of this production, 95% is from California and Nevada (IEA Geothermal, 2025).

Geothermal energy is also used for heating and cooling through ground source heat pumps and district heating and cooling systems. However, although there is potential for investment in geothermal heating and cooling in the coming decades, these are outside of the scope of the modeling included in this analysis.

Methods

ReEDS

We utilize the open-source version of the Regional Energy Deployment System (ReEDS) from the National Renewable Energy Laboratory to produce geothermal build-out scenarios. ReEDS is a linear program that solves for the cost-minimizing combination of operations and investment for the continental US power system. It considers 134 balancing areas where electricity supply (generation plus net transmission) must meet load. In addition, several reliability constraints are imposed to make sure there are adequate operating and planning reserves for contingency purposes. The model maintains an up-to-date representation of federal and state policies including, but not limited to, state Renewable Portfolio Standards, the Regional Greenhouse Gas Initiative, California's decarbonization target (colloquially referred to as SB100), as well as a full representation of the clean electricity generation incentives in the Inflation Reduction Act.[1]

Specific to geothermal, there are three broader geothermal technology categories represented in ReEDS: enhanced geothermal, hydro-based geothermal systems, and nearfield enhanced geothermal systems. More detail on the parameterization of these technologies is available in the GeoVision study (Augustine et al., 2019). The default capacity costs used here are from the Annual Technology Baseline (ATB), an annual report of various electricity technology costs and their forecasts produced by the National Renewable Energy Laboratory. Notably, geothermal in ReEDS is parameterized using overnight capacity investment costs and fixed operating and maintenance (FOM) costs, but there are assumed to be no variable operating and maintenance costs.

Scenarios and Assumptions

Three scenarios are considered:

Reference Scenario: The Reference Scenario uses the model's default assumptions as of July 23, 2025. As shown below, the Reference Scenario does have continued growth in geothermal buildout, but this is relatively modest. Specifically, the Reference Scenario has geothermal growing from about 0.4% of electricity generation mix today to 0.8% by 2050.

Vision Scenario: The GeoVision, or "Vision" Scenario uses the geothermal costs and performance assumptions from the GeoVision study linked above. Note that this equates to approximately a 50% reduction in capacity and fixed operating costs by 2050, when compared to reference levels. Unsurprisingly, this scenario provides a more aggressive buildout of geothermal. Specifically, the Vision Scenario has geothermal growing to about 3.7% of the electricity generation mix by 2050.

Decarb Scenario: The Decarbonization, or "Decarb" Scenario includes both the cost reductions and performance improvements modeled in the Vision Scenario. It then becomes even more aggressive by imposing a decarbonization target of 100% carbon-free electricity generation by 2035. This accelerated timeline makes the growth modeled in the Decarb Scenario the most aggressive of the three scenarios until 2044, when it is surpassed by the Vision Scenario. Specifically, the Decarb Scenario has geothermal growing to about 2.7% of the electricity generation mix by 2050.

Note that the purpose of this report is not to estimate a geothermal buildout in the U.S., and none of these scenarios should be interpreted as a forecast. Instead, this report aims to estimate the economic implications of these different buildout scenarios.

Scenarios in Perspective

This section provides a comparative overview of the key metrics under the Reference Scenario, Vision, and Decarb Scenarios. Projected capacity buildout, annual generation, and associated capital expenditures are presented to contextualize the projected construction expected under each of the scenarios.

Figure 1 shows projected geothermal capacity through 2050. Installed capacity grows slowly in the Reference Scenario, with more significant additions occurring under the Vision and Decarb Scenarios. The Vision Scenario reaches 36 GW by 2050. The Decarb Scenario achieves earlier capacity additions,

[1] Note that at the time of this writing, other federal legislation is likely to impact some of the subsidies passed in the IRA.

but slows by 2035 at 20 GW, and achieves 30 GW by 2050. The Reference Scenario remains limited, with capacity additions less than 10 GW by 2050.

Figure 1: Projected Geothermal Capacity for Each Scenario

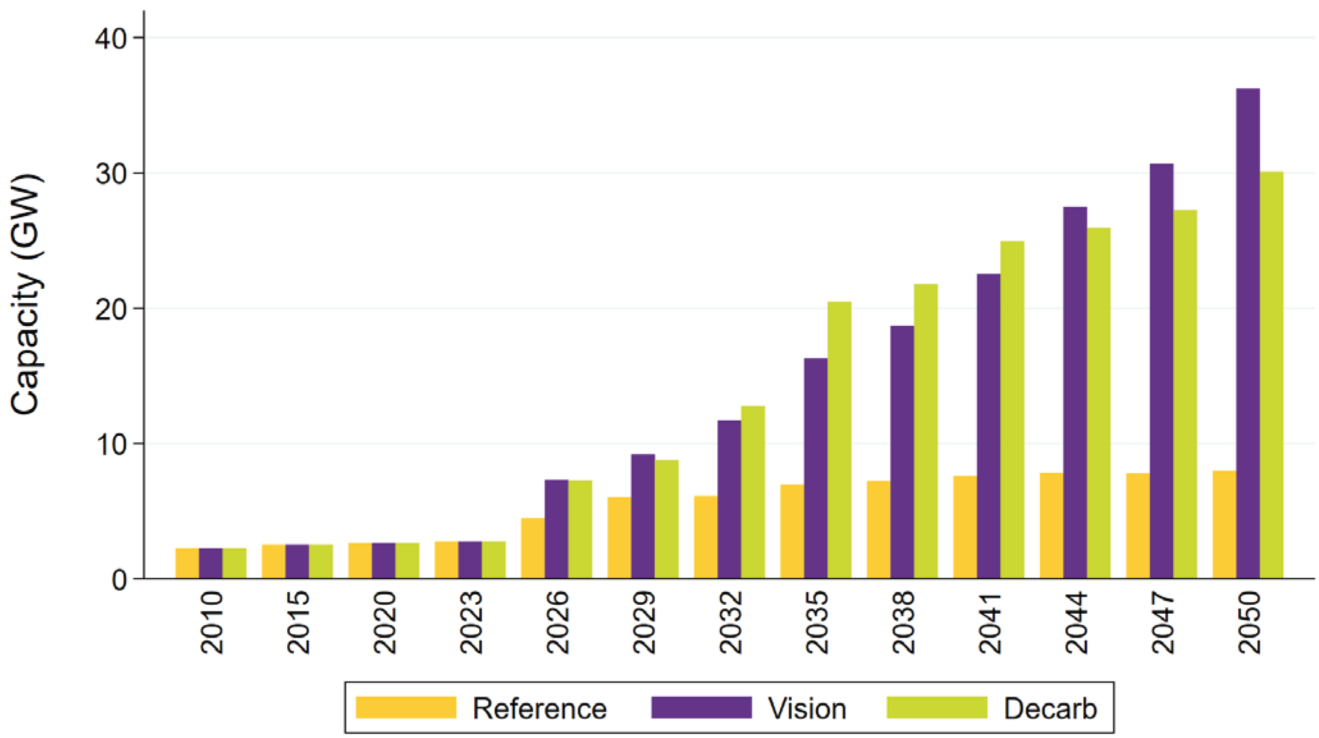
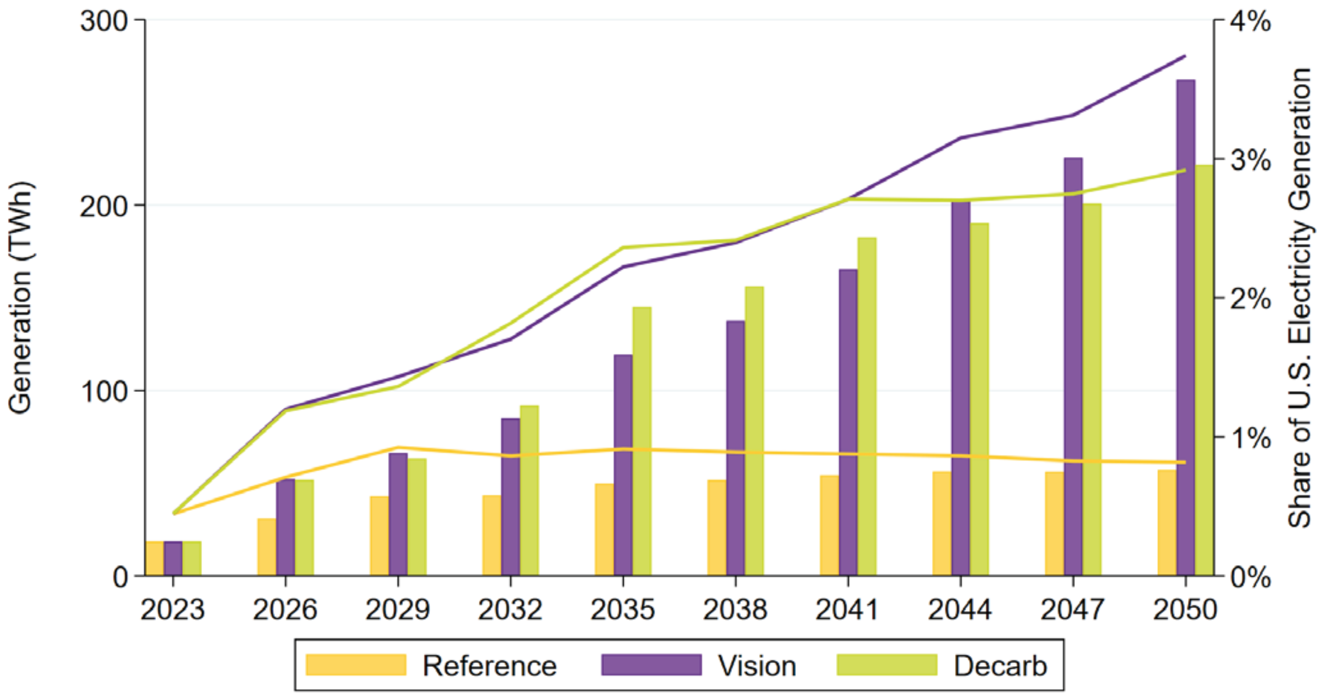


Figure 2 presents projected annual geothermal generation and its projected share of total electricity generation. Generation increases steadily under all scenarios, with more substantial growth occurring under the Vision and Decarb Scenarios. By 2050, geothermal generation reaches approximately 268 TWh under the Vision Scenario and 222 TWh under the Decarb Scenario, compared to less than 60 TWh in the Reference Scenario. The Decarb Scenario models accelerated generation growth in the early years but slows after 2035 as capacity additions stabilize and market growth slows.

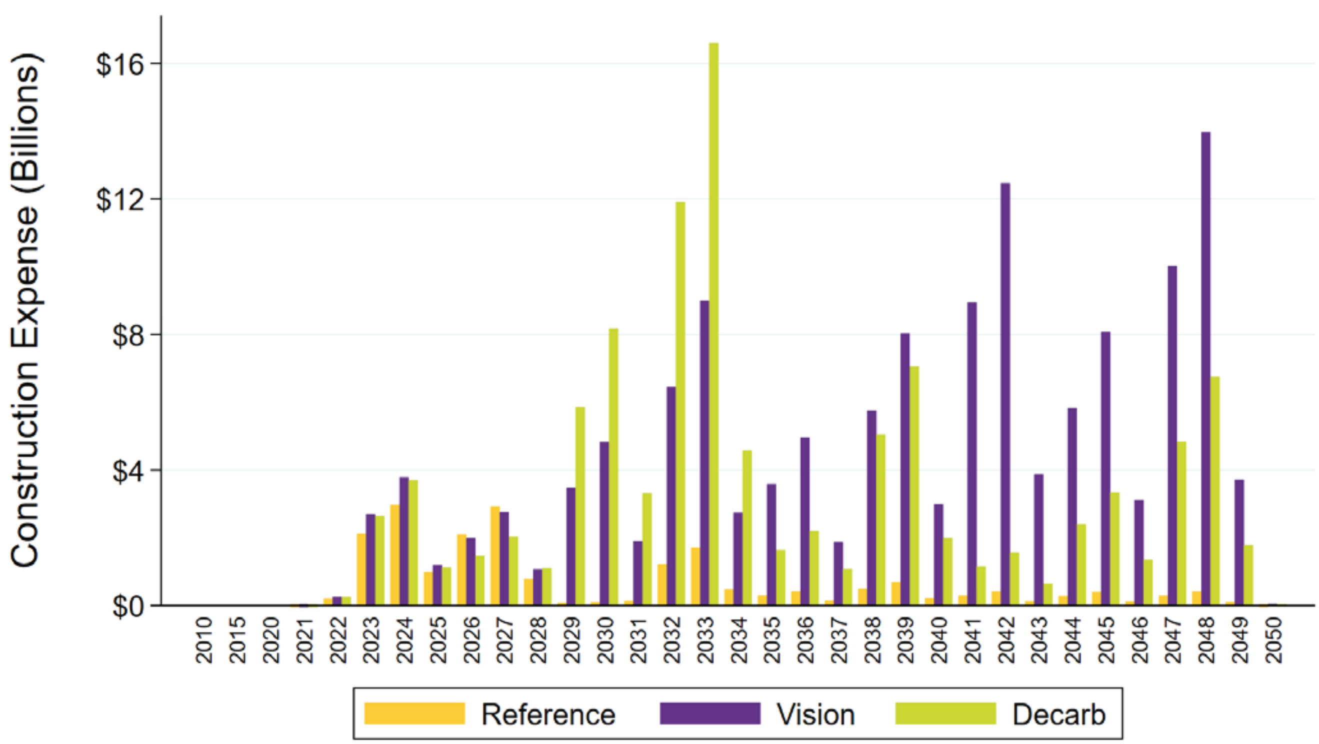
Figure 3 illustrates estimated annual capital expenditures (CAPEX) associated with construction and drilling in each scenario in 2025 dollars. The Decarb Scenario shows a sharp peak in CAPEX during the early 2030s, driven by accelerated capacity additions, with spending reaching nearly $17 billion in a single year. In contrast, the Vision Scenario distributes investments more evenly across the forecast period, resulting in sustained but moderate annual expenditures. The Reference Scenario has the least aggressive geothermal investment.

Figure 2: Projected Geothermal Annual Generation and Share of Total U.S. Electricity Generation



Note: Bars represent generation in TWh (left axis), while the line represents the share of U.S. electricity generation as a percentage of total generation (right axis).

Figure 3: Capital Expenditures Estimated in Each Model



Economic Impacts of a Geothermal Buildout

Next, we estimate the economic impact of the three geothermal buildout scenarios. We consider the economic impacts of both the construction (e.g. buildout) as well as the yearly operations and maintenance (O&M) required once projects are built. We consider the three scenarios described above: Reference, Vision, and Decarb.

Methodology

To estimate the economic impacts of the construction and annual O&M of a national geothermal buildout, we first utilize the Jobs and Economic Development Impacts (JEDI) Geothermal model (NREL, 2023a). JEDI is developed and maintained by the National Renewable Energy Laboratory (NREL). The JEDI geothermal model provides a detailed breakdown of cost categories associated with geothermal projects and provides a cost structure of a representative geothermal power facility, both in terms of construction and operations.

These buildout scenarios are then distributed across time where the construction begins 5 years before capacity comes online. Expenditures are allocated over the construction period[2] to estimate a share of expenditures for each month of construction.[3] Annual operational expenditures accumulate as the buildout capacity comes online over the projection horizon.

Utilizing the cost structure from NREL's JEDI model alongside the buildout scenarios, we next utilize the Regional Input-Output Modeling System (RIMS II) to estimate economic impacts. RIMS II was created and is maintained by the Bureau of Economic Analysis (BEA), part of the U.S. Department of Commerce. RIMS II is an input-output (I-O) model that is based on a detailed set of industry accounts that measure the goods and services produced by each industry. Large underlying datasets trace the flow of goods and services throughout the economy to final users. RIMS II is considered a backward-linkages model, in that an increase in demand for an output results in an increase in demand for the inputs needed to create that output.

Both "Type I" and "Type II" multipliers are provided by RIMS II. Type II multipliers account for both the interindustry and household spending of a final demand change. Type I multipliers only account for the interindustry effect. Thus, Type II multipliers, by definition, are larger than Type I multipliers. Utilizing these multipliers, we further dissect economic impacts into "Direct," "Indirect," "Induced," and "Total" impacts, where total impacts are identical to RIMS II Type II multipliers, and Direct + Indirect impacts are identical to RIMS II Type I multipliers. The direct economic impacts represent the economic activity generated by the geothermal facilities themselves and include impacts associated with capital expenditures during construction and development as well as impacts associated with ongoing operations and maintenance, which are analyzed separately. The indirect economic impacts reflect the economic activity generated by supply-chain firms that provide goods and services supporting those capital and operational activities, while the induced economic impacts capture the additional economic activity resulting from household spending by workers employed in both the direct and indirect industries.

We estimate impacts on employment, earnings, and value added. Employment includes counts of workers at establishments in relevant sectors. Earnings (synonymous with "labor income") include wages and salaries, proprietors' income, and employer contributions to insurance, pensions, and social insurance. Value added represents the contribution to gross domestic product (GDP), and earnings are a major component of value added. The study area in this analysis consists of the United States. Horowitz and Planting (2009) provides more detailed information on RIMS II and interpretation of the multipliers.

[2] This is conducted based on the "overnight cost" literature. Overnight cost refers to the estimated cost to complete an OSW project "overnight". This calculation allows for direct comparison of costs across projects that occur in heterogeneous economic environments Dismukes, D. E., & Upton, G. B. (2015). Economies of scale, learning effects and offshore wind development costs. *Renewable Energy*, 83, 61-66. https://doi.org/10.1016/j.renene.2015.04.002 .

[3] We model construction at the monthly level and then aggregate to calendar years for purposes of estimating economic impacts and presenting results.

Results

Economic impacts are presented for the three scenarios for the study area of the United States. For each scenario, construction impacts are presented along with operations and maintenance (O&M) impacts as the buildouts become operational over time. Estimated impacts are broken down into direct, indirect, induced, and total for employment, labor earnings, and value added. All monetary impacts are provided in 2025 dollars.

Construction Impacts

Table 1 shows estimated economic impacts during the construction phase of the buildouts. The table shows economic impact estimates for the entire continental United States, based on the respective buildout scenarios analyzed. Nationwide, the buildout is estimated to support approximately 7,400 to 39,400 jobs per year. In aggregate, construction is estimated to support a net present value (4% discount) of $7.2 billion to $34.9 billion in labor income and earnings, and $14 billion to $68.1 billion of U.S. GDP. The comparative employment results are also shown by year (Figure 4).

Table 2 shows economic impacts as the buildout becomes operational. Nationwide, the operations are estimated to support approximately 6,500 to 24,200 jobs per year once the respective projected buildouts are complete. Labor earnings of approximately $472.5 million to $1.8 billion per year are estimated to be supported, along with approximately $1.1 billion to $4.2 billion in U.S. GDP. The comparative employment results are also depicted graphically by year (Figure 5).

Table 1: Economic Impacts of Construction

	(1) Average Annual Employment (Jobs)	(2) Earnings (billion $)	(3) Value Added (billion $)
Panel A: Reference Scenario			
Direct	1,700	$2.5	$4.9
Indirect	2,000	$2.1	$3.9
Induced	3,700	$2.7	$5.2
Total	7,400	$7.2	$14.0
Panel B: Vision Scenario			
Direct	5,800	$12.0	$23.9
Indirect	6,700	$10.0	$19.0
Induced	12,400	$12.9	$25.2
Total	24,900	$34.9	$68.1
Panel C: Decarb Scenario			
Direct	9,200	$10.4	$20.7
Indirect	10,600	$8.7	$16.5
Induced	19,600	$11.1	$21.8
Total	39,400	$30.2	$58.9

RIMS II release of May 2025 and author's calculations. Employment is the annual average over the first ten years of construction. Earnings and Value Added in 2025 billions of dollars discounted at 4% over the entire projection period. Discrepancies in totals might arise due to rounding.

Figure 4: Construction Employment Estimated from All Models

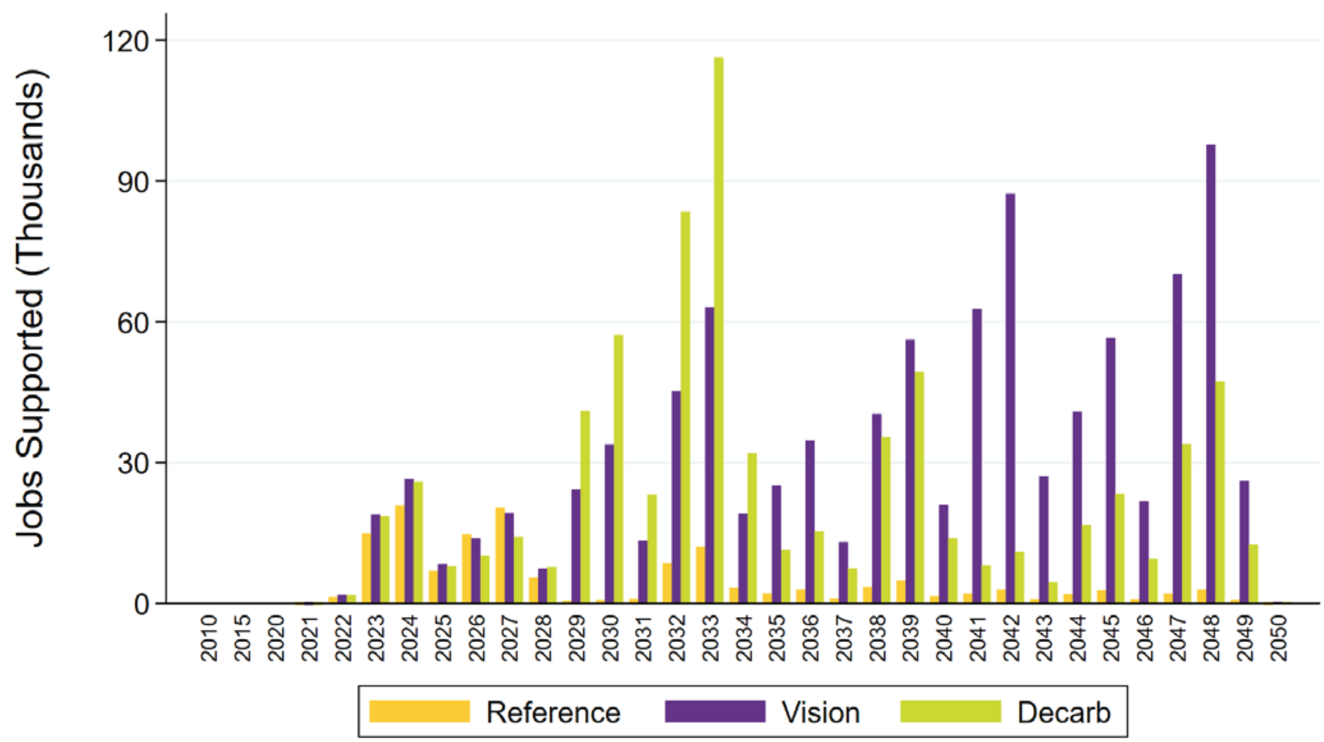


Figure 5: O&M Employment Estimated from All Models

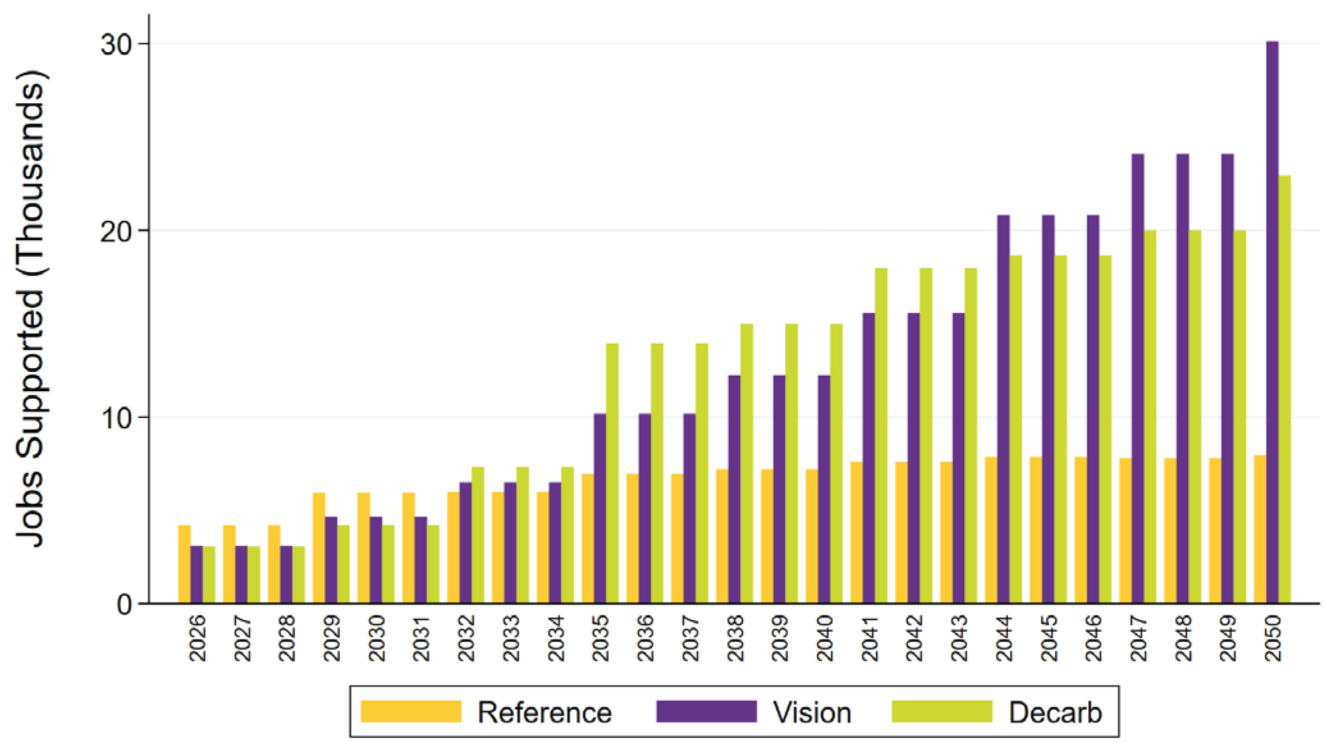


Table 2: Annual O&M Economic Impacts

	(1) Average Annual Employment (Jobs)	(2) Earnings (million $)	(3) Value Added (million $)
Panel A: Reference Scenario			
Direct	1,200	$146.7	$485.0
Indirect	2,000	$151.6	$274.1
Induced	3,300	$74.2	$340.8
Total	6,500	$472.5	$1099.9
Panel B: Vision Scenario			
Direct	4,400	$556.6	$1,840.0
Indirect	7,400	$575.1	$1,040.0
Induced	12,400	$661.0	$1,292.8
Total	24,200	$1,792.8	$4,172.9
Panel C: Decarb Scenario			
Direct	3,300	$424.2	$1,402.4
Indirect	5,600	$438.3	$792.6
Induced	9,500	$503.8	$985.4
Total	18,400	$1,366.4	$3,180.4

RIMS II release of May 2025 and author's calculations. Employment, Earnings, and Value Added were reduced by 0.86% a year over the projection horizon to account for historical efficiency gains in the electric power sector of the economy. Earnings and Value Added in billions of 2025 dollars. Depicted is the supported jobs, earnings, and value added at the end of the buildout, 2050. Discrepancies in totals might arise due to rounding.

Table 3 presents labor earnings and value added impacts, at different discount rates [4], for the construction and operations activity combined. With zero discounting (i.e. without considering the time value of money), the total estimated earnings associated with a national geothermal buildout range from $21.5 billion to $90.7 billion over the projection horizon, and total estimated value added ranges from $46 billion to $185 billion. However, at varying discount rates reflecting the time value of money, the net present value of these earnings in the future is diminished as reflected in the table, with a greater effect as the discount rate increases.

Figure 6 and Figure 7 illustrate employment and value added by year. The Reference Scenario has the smallest effect on employment and GDP, contributing less than 20,000 jobs in all but two years and $1-2 billion in annual GDP. The Decarb Scenario peaks in 2033 at almost 120,000 jobs and contributes over $17 billion to U.S. GDP but then drops steeply as capital expenditures decline. The Vision Scenario has more gradual growth, peaking in 2048 with over 121,000 jobs and $17 billion contributed to U.S. GDP.

[4] The discount rate represents the tradeoff between a dollar today and a dollar in the future. A higher discount rate means that future dollars are valued much less relative to dollars today.

Table 3: Total Earnings and GDP Contributions Supported by Construction and Operations of a National Geothermal Buildout

	(1) Reference (billion $)	(2) Vision (billion $)	(3) Decarb (billion $)
Panel A: Earnings			
No Discounting	$21.5	$90.7	$73.9
2% Discount Rate	$16.3	$62.2	$53.4
4% Discount Rate	$12.7	$43.9	$39.5
6% Discount Rate	$10.2	$31.8	$30.0
8% Discount Rate	$8.3	$23.7	$23.2
Panel B: GDP			
No Discounting	$46.0	$184.6	$152.0
2% Discount Rate	$34.6	$126.4	$109.3
4% Discount Rate	$26.8	$89.0	$80.6
6% Discount Rate	$21.4	$64.4	$60.9
8% Discount Rate	$17.4	$47.9	$47.0

Reflects net present values over 29 years in billions of 2025 dollars. Total impacts include the sum of direct, indirect, and induced earnings.

Figure 6: Projected Annual Employment Supported by Geothermal

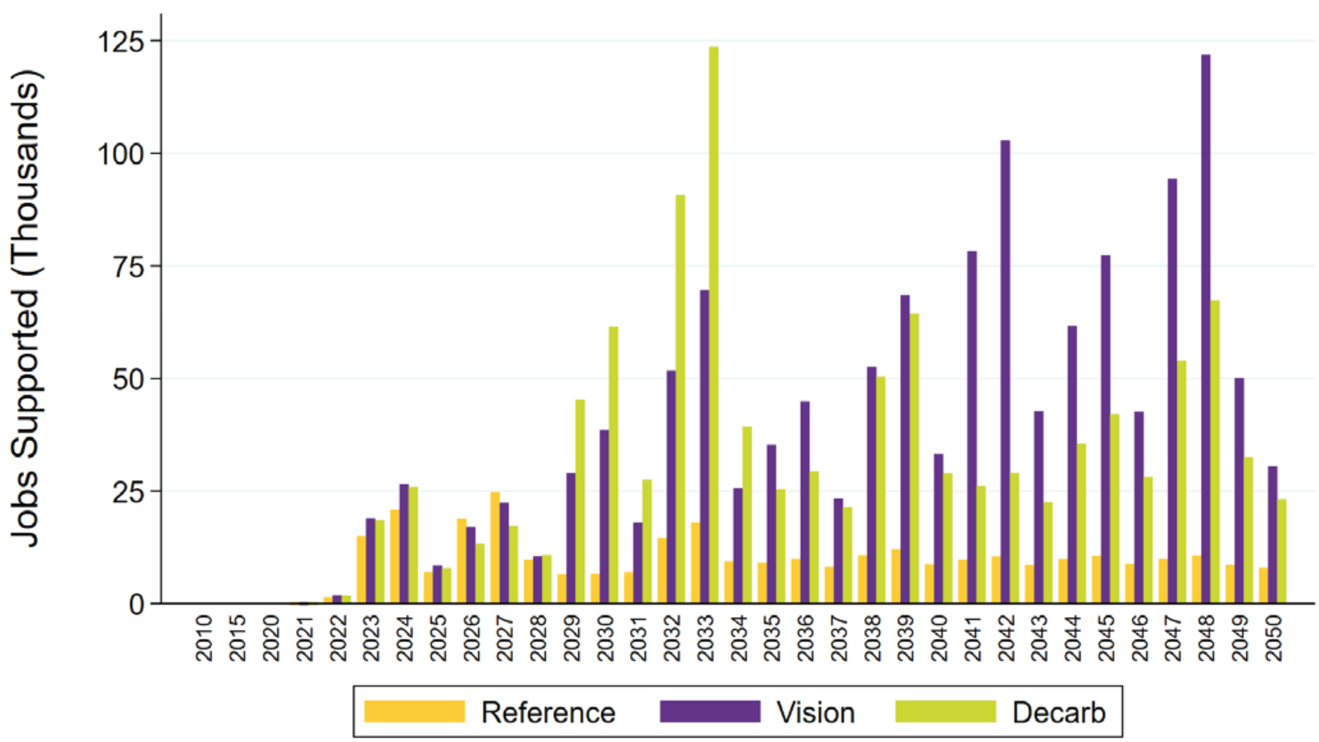
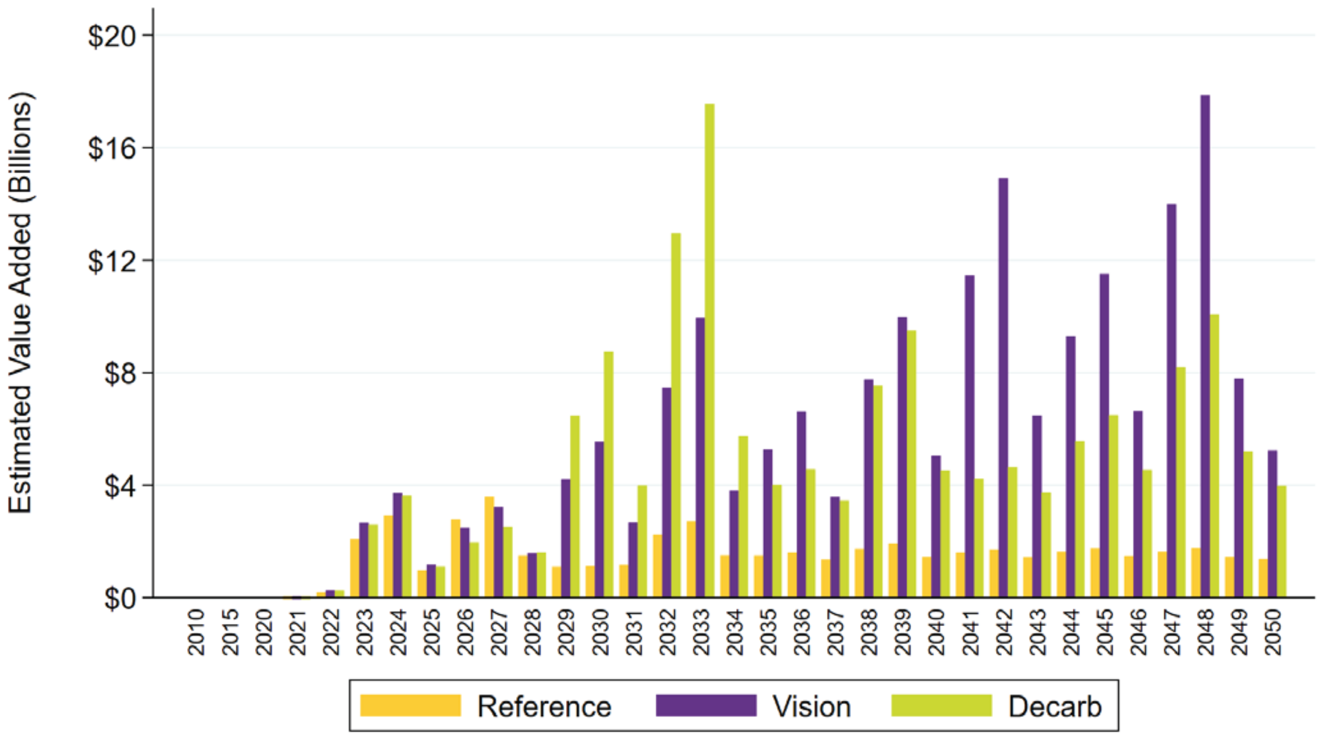


Figure 7: Projected Contribution to U.S. GDP for All Scenarios by Year



Occupational Analysis

This section presents the estimated average annual employment for select occupations resulting from geothermal development under the Reference, Vision, and Decarb Scenarios. These estimates account for both construction and operations and maintenance (O&M) activities.

To estimate the effects of investment on individual occupations, data from the Quarterly Census of Employment and Wages (QCEW) were used in conjunction with results from the economic impact analysis. The QCEW survey, conducted by the Bureau of Labor Statistics (BLS), reports employment by occupation for each 2-digit North American Classification System (NAICS) industry code. Occupational employment shares were calculated by dividing the number of employees in a given occupation within an industry by the total employment in that industry. The economic impact analysis provides estimates of direct and indirect employment by RIMS II industry, which closely align with NAICS codes. These employment estimates were multiplied by the corresponding occupational shares to estimate employment by occupation and industry. Summing across industries yielded total projected jobs by occupation. This total was then aggregated across years to produce job-years, which were divided by the number of years in the forecast period to obtain average annual employment. Construction and operations & maintenance (O&M) employment were combined to estimate the average total jobs created in each occupation over the forecast period. Induced employment is not included in this analysis, as many of these positions fall within sectors unrelated to geothermal development—such as retail and entertainment—and are therefore outside the scope of the occupational focus.

Figure 8 shows the estimated average annual employment for the top 20 occupations in the scenarios. These estimates reflect the first 10 years of the buildout, and consequently the Decarb Scenario shows the highest projected occupation, due to the accelerated timeline, followed by the Vision Scenario. The Reference Scenario shows more limited occupational growth due to lower expected investment.

Employment includes a range of occupations such as construction laborers, truck drivers, and maintenance workers. Drilling crews and well maintenance personnel, including roustabouts, derrick operators, and service unit operators, are critical to drill and maintain geothermal well operations and are among the largest occupations affected. Increased project activity also results in greater demand for supervisors and specialized maintenance roles. Support occupations include customer service representatives, bookkeepers, and secretaries. Electricians and lineman were not among the top 20 occupations, but appear withing the top 40, reflecting their role of connecting geothermal facilities to the transmission grid. Figure 9 shows the average annual wages of those top occupations.

Figure 8: Projected Average Annual Employment by Occupation

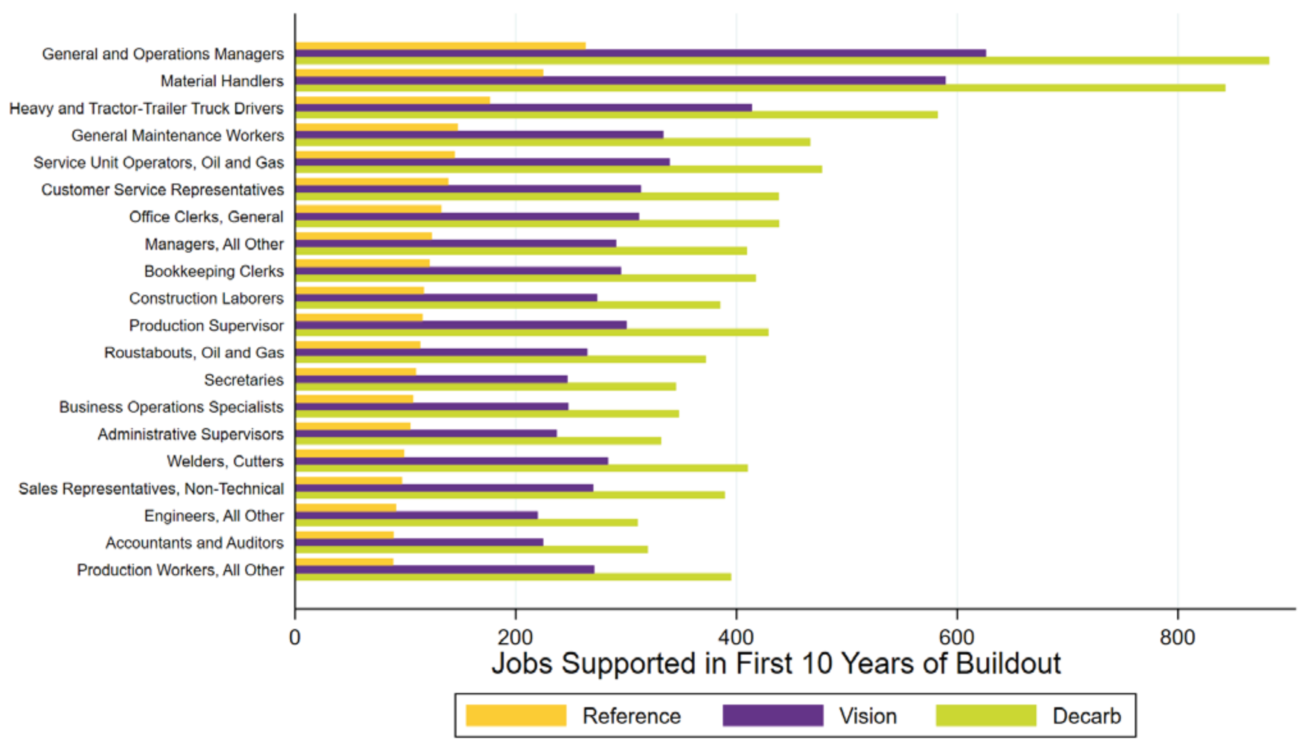
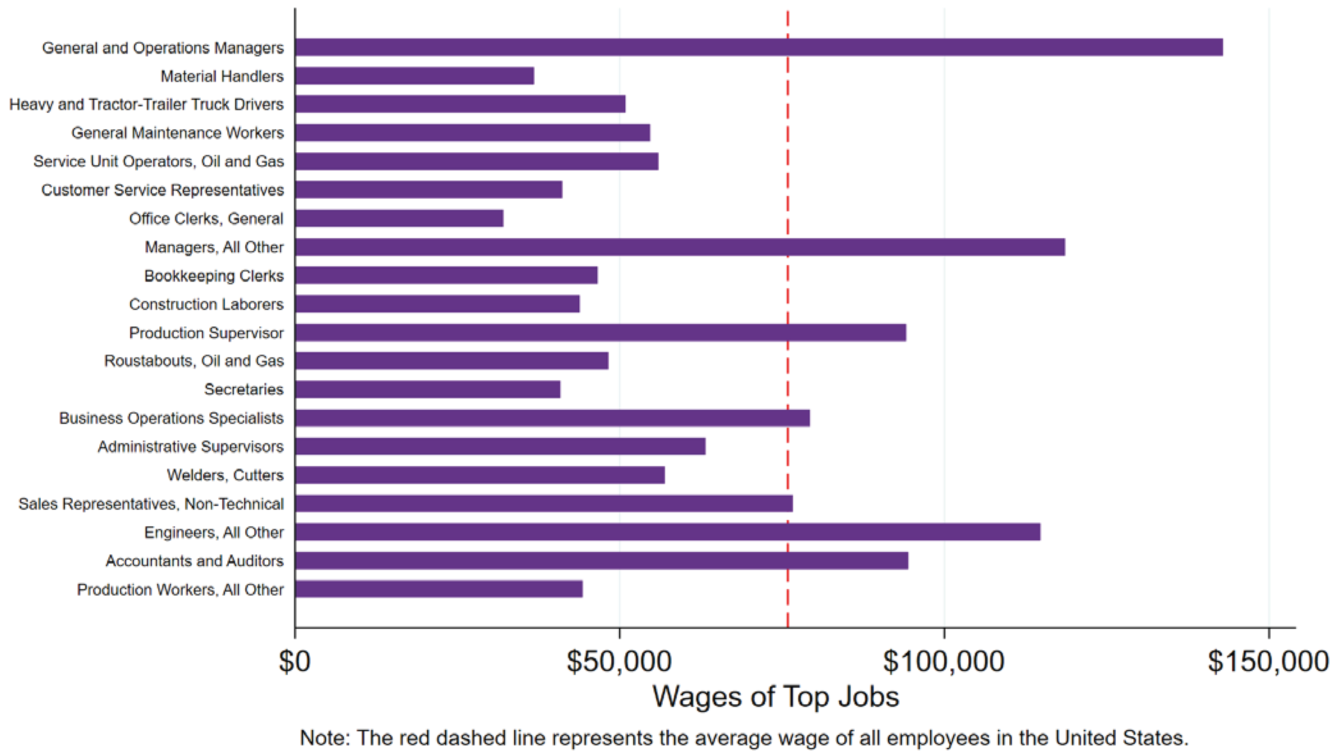


Figure 9: Average Annual Wages of Top Occupations



Conclusion

Geothermal energy has the potential for meaningful growth in the United States, and its future development will be influenced by technological progress, policy choices, and evolving electricity system needs. This report presents three scenarios—Reference, Vision, and Decarb—that illustrate different pathways for geothermal deployment and the associated economic implications.

Across these scenarios, geothermal development is estimated to support between 7,400 and 39,400 jobs per year during construction, with a net present value of $7.2 billion to $34.9 billion in earnings and $14 billion to $68 billion in GDP. Once operational, geothermal facilities are projected to support 6,500 to 24,200 ongoing jobs annually, contributing $470 million to $1.8 billion in earnings and $1.1 billion to $4.2 billion in GDP per year. These activities draw on a range of occupations—including construction laborers, truck drivers, maintenance workers, and drilling personnel—highlighting the strong alignment between geothermal development and existing U.S. workforce capabilities.

References

Augustine, C., Millstein, D., McCall, J., Macknick, J., Nicholson, S., Keyser, D., Jeong, S., & Heath, G. (2019). G*eoVision Analysis Supporting Task Force Report: Impacts-The Employment Opportunities, Water Impacts, Emission Reductions, and Air Quality Improvements of Achieving High Penetrations of Geothermal Power in the United States* (NREL/TP--6A20-71933, 1524769). https://www.osti.gov/servlets/purl/1524769/

Barbier, E. (2002). Geothermal energy technology and current status: an overview. *Renewable and Sustainable Energy Reviews*, 6(1-2), 3-65. https://doi.org/10.1016/S1364-0321(02)00002-3

Blackwell, D., Richards, M., Frone, Z., Batir, J., Ruzo, A., Dingwall, R., & Williams, M. (2011). *Temperature-At-Depth Maps For the Conterminous US and Geothermal Resource Estimates* (GRC1029452). https://www.osti.gov/biblio/1137036

Blankenship, D., Gertle, C., Kamaludeen, M., O'Connor, M., & Porse, S. (2024). *Pathways to Commercial Liftoff: Next-Generation Geothermal Power*.

Bloomfield, K. K., Moore, J. N., & Jr, R. M. (2003). Geothermal energy reduces greenhouse gases. *Bulletin. Geothermal Resources Council*, 32, 77-79.

Boyd, L. (2024). *2022 United States Country Report*.

Boyd, T. L. (2017). Geothermal District Heating in the United States: A Preliminary Report. *Geothermal Resources Council Transactions*, 41, 61-69.

IEA Geothermal. (2025). *2023 Annual Report*. https://www.iea-gia.org/news/2023-annual-report

Davalos-Elizondo, E., Kolker, A., Taverna, N., & Holt, E. (2023). *Assessing Low-Temperature Geothermal Play Types: Relevant Data and Play Fairway Analysis Methods* (NREL/TP--5700-87259, 2001118, MainId:88034). https://www.osti.gov/servlets/purl/2001118/

Dismukes, D. E., & Upton, G. B. (2015). Economies of scale, learning effects and offshore wind development costs. *Renewable Energy*, 83, 61-66. https://doi.org/10.1016/j.renene.2015.04.002

EIA. (2024a). *Electricity end use in the United States from 1975 to 2023 (in terawatt-hours) [Graph]. In Statista*. https://www.statista.com/statistics/201794/us-electricity-consumption-since-1975/

EIA. (2024b). *Electricity explained: Electricity generation, capacity, and sales in the United States*.

EIA. (2025). *In 2024, the United States produced more energy than ever before*.

El Haj Assad, M., Bani-Hani, E., & Khalil, M. (2017). Performance of geothermal power plants (single, dual, and binary) to compensate for LHC-CERN power consumption: comparative study. *Geothermal Energy*, 5(1), 17. https://doi.org/10.1186/s40517-017-0074-z

Finger, J., & Blankenship, D. (2010). *Handbook of Best Practices for Geothermal Drilling*. S. N. Laboratories.

Fukuhara, M. (2016). Possible generation of heat from nuclear fusion in Earth's inner core. *Scientific Reports*, 6(1), 37740. https://doi.org/10.1038/srep37740

Geothermal Technologies, O. (2021). *Identifying Geothermal Resources in Western United States*.

IEA. (2025). *Electricity 2025 Analysis and forecast to 2027*.

Jolie, E., Scott, S., Faulds, J., Chambefort, I., Axelsson, G., Gutiérrez-Negrín, L. C., Regenspurg, S., Ziegler, M., Ayling, B., Richter, A., & Zemedkun, M. T. (2021). Geological controls on geothermal resources for power generation. *Nature Reviews Earth & Environment*, 2(5), 324-339. https://doi.org/10.1038/s43017-021-00154-y

Kagel, A., Bates, D., & Gawell, K. (2005). *A guide to geothermal energy and the environment*. http://www.osti.gov/servlets/purl/897425-q5NDer/

Karen J. Horowitz, & Planting, M. A. (2009). *Concepts and Methods of the U.S. Input-Output Accounts*.

Khankishiyev, O., Salehi, S., Vivas, C., Nygaard, R., & Rehg, D. (2023). Geothermal Energy in Sedimentary Basins: Assessing Techno-economic Viability for Sustainable Development. *GRC Transactions*, 47. https://doi.org/https://doi.org/10.48550/arXiv.2402.14823

Liming, D. (2012). *Careers in Geothermal Energy*.

NREL. (2023a). Advancing Geothermal Research: Fiscal Year 2023 Accomplishments Report (NREL/BK-6A42-87423).

NREL. (2023b). *Jobs and Economic Development Model (JEDI).*

REN21. (2024). *Renewables 2024 Global Status Report Collection: Energy Supply*.

Ricks, W., & Jenkins, J. D. (2025). Pathways to national-scale adoption of enhanced geothermal power through experience-driven cost reductions. *Joule*, 101971. https://doi.org/10.1016/j.*Joule*.2025.101971

Robins, J., Kolker, A., Flores-Espino, F., Pettitt, W., Schmidt, B., Beckers, K., Pauling, H., & Anderson, B. (2020). *2021 U.S. Geothermal Power Production and District Heating Market Report*. https://doi.org/10.2172/1808679

Smith, M. (2023). Oil and Gas Technology and Geothermal Energy Development.

Technology, M. I. o. (2006). *The Future of Geothermal Energy*.

Tester, J. W., Anderson, B. J., Batchelor, A. S., Blackwell, D. D., DiPippo, R., Drake, E. M., Garnish, J., Livesay, B., Moore, M. C., Nichols, K., Petty, S., Nafi Toksoz, M., Veatch, R. W., Baria, R., Augustine, C., Murphy, E., Negraru, P., & Richards, M. (2007). Impact of enhanced geothermal systems on US energy supply in the twenty-first century. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 365(1853), 1057-1094. https://doi.org/10.1098/rsta.2006.1964

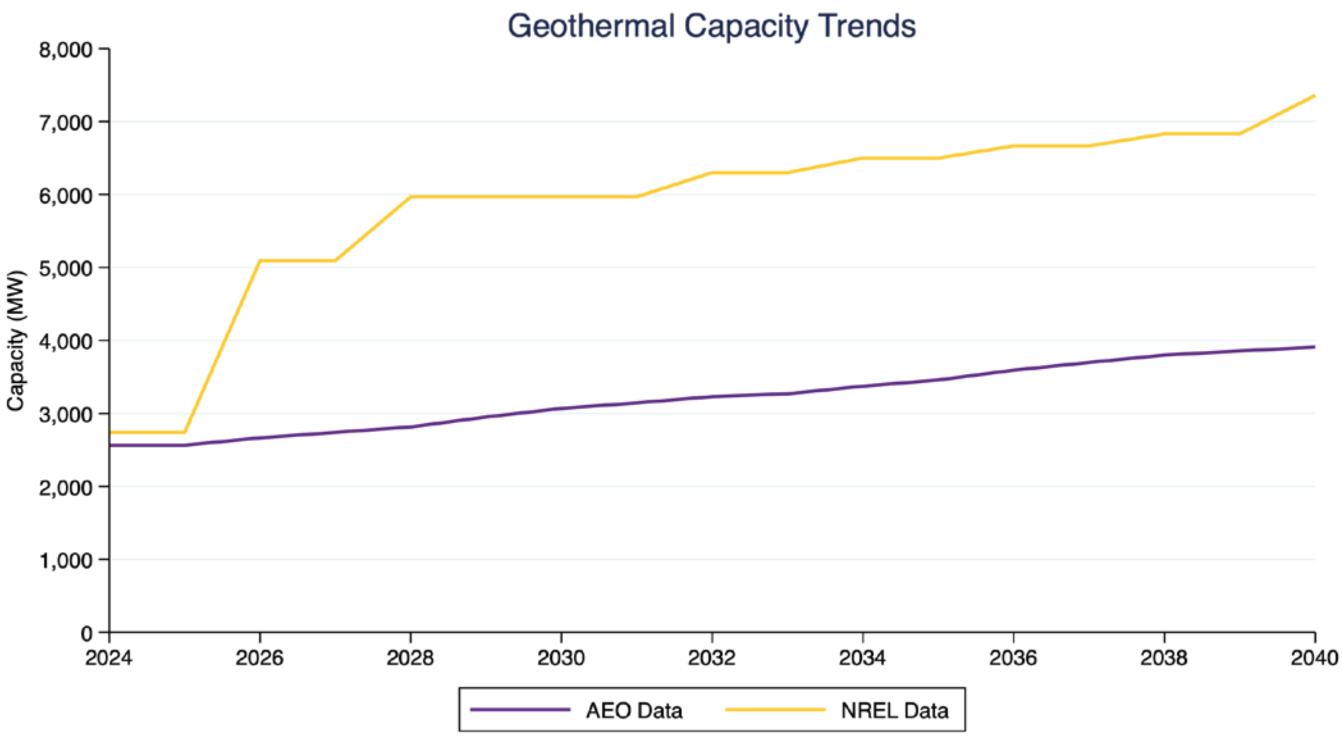
Tester, J. W., Beckers, K. F., Hawkins, A. J., & Lukawski, M. Z. (2021). The evolving role of geothermal energy for decarbonizing the United States. *Energy & Environmental Science*, 14(12), 6211-6241. https://doi.org/10.1039/D1EE02309H

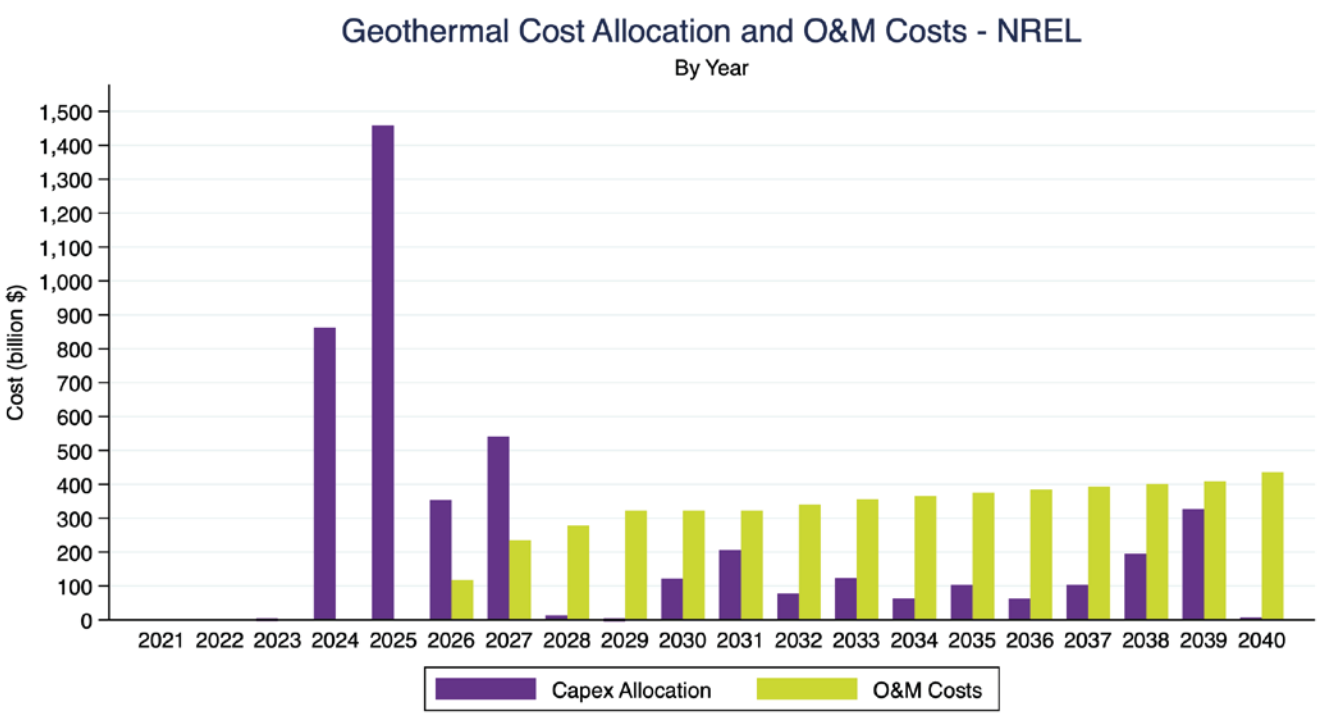
Upton, G. B., Dismukes, D. E., Owens, D. A., & McLindon, C. (2024). *Gulf Coast Energy Outlook 2025*.

Vargas, C. A., Caracciolo, L., & Ball, P. J. (2022). Geothermal energy as a means to decarbonize the energy mix of megacities. *Communications Earth & Environment*, 3(1), 66. https://doi.org/10.1038/s43247-022-00386-w

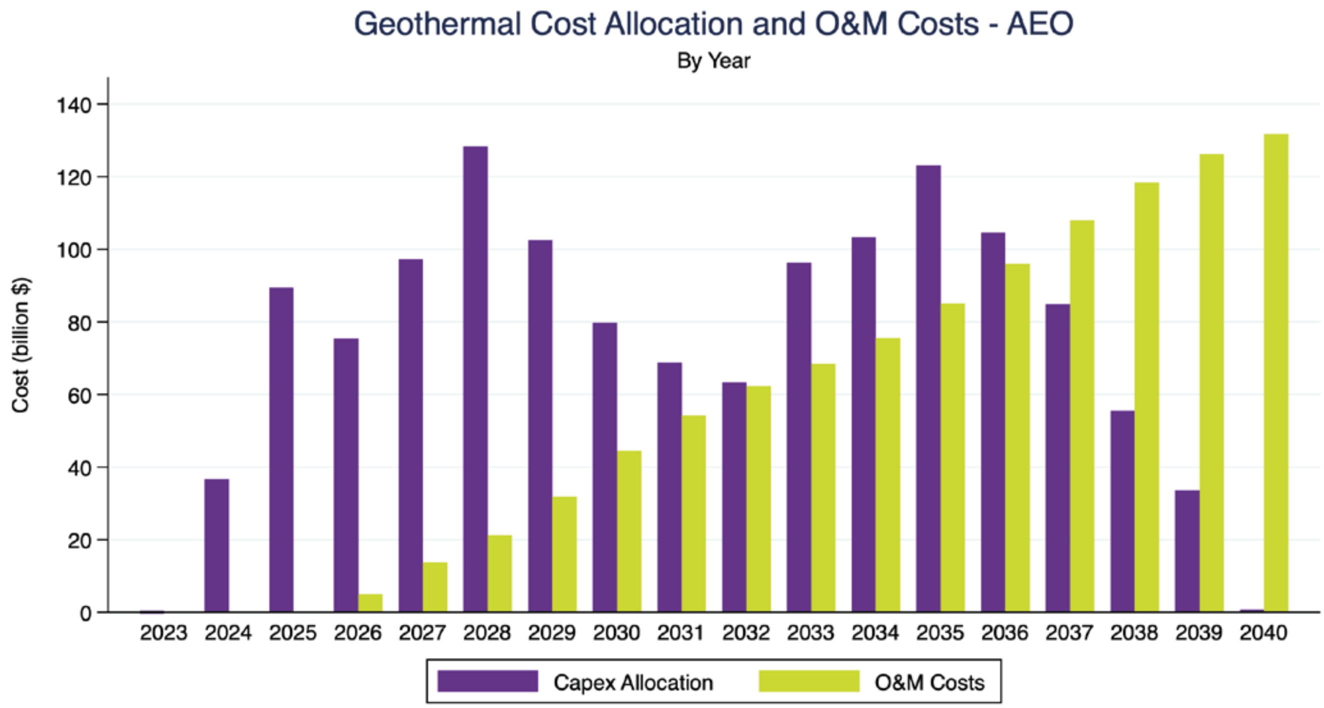
World Population Review. (2025). *Energy consumption by country 2025*. https://worldpopulationreview.com/country-rankings/energy-consumption-by-country

Figures





Source: NREL


Geothermal Cost Allocation and O&M Costs - AEO
By Year
Cost (billion $)
0
20
40
60
80
100
120
140
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
Capex Allocation
O&M Costs

Source: AEO

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