

Texas: Grid Impacts of Geothermal Heat Pumps for Commercial Buildings

Texas' electricity system faces significant strain from high summer peak demand driven by space cooling, a challenge that is expected to grow with continued data center expansion and broader electrification. This analysis is part of a [three-state study](#) — including Texas, Massachusetts, and Pennsylvania — that examines the system impacts of geothermal heat pump (GHP) deployment across climates, building types, and multiple adoption scenarios under both current and future load conditions.

In Texas, the analysis focuses on commercial buildings — primarily office and retail, with additional scenarios for hotel and warehouse — where cooling demand is closely aligned with system peaks, and where building size and land availability are often feasible for GHP systems. GHPs are particularly well-suited to Texas grid conditions due to their ability to maintain higher efficiency during extreme outdoor temperatures, reducing both peak demand and total energy consumption.

The study evaluates the impacts of GHPs in Low (2%), Medium (10%), and High (20%) Adoption Scenarios in office and retail buildings, and 50% office and retail plus 20% hotel and warehouse buildings (Very High) in Texas under Today's timeframe (2025), based on current load profiles, and the Electrified Future timeframe (2040), reflecting electrification across transportation, industry, and buildings, where buildings receive GHPs instead of heat pump rooftop units.

Key Takeaways

- Commercial GHP deployment could reduce Texas peak demand and deliver meaningful utility system savings. Under the Very High Adoption Scenario, GHPs could reduce peak demand by up to 1.9 GW and generate approximately \$4.5 billion in utility system savings in the Today (2025) timeframe.
- While current GHP installation costs exceed quantified utility system savings, continued cost reductions could potentially close the remaining cost gap. Commercial GHP installation costs would need to decline by about 20% to approximately \$5,000 per ton to achieve utility system cost-effectiveness for office and retail buildings. The larger cost gap under the Very High Adoption Scenario reflects the lower utility system savings from hotels and warehouses, indicating that office and retail buildings represent the strongest near-term market for cost-effective GHP deployment.
- Commercial GHP deployment increases load factors. While the magnitude is limited, the consistent increase indicates improved utilization of the electric system, which can help place downward pressure on electricity rates for all customers.
- The Public Utility Commission of Texas, legislature, and utilities can accelerate GHP adoption by adding GHPs to utility programs, aligning utility cost-benefit methodologies with their full system value, setting utility targets that support peak demand reduction and better grid utilization, and establishing a framework to enable large-load customers seeking interconnection to expedite connection by funding GHP deployment.



Peak Load Reduction and Grid Impact

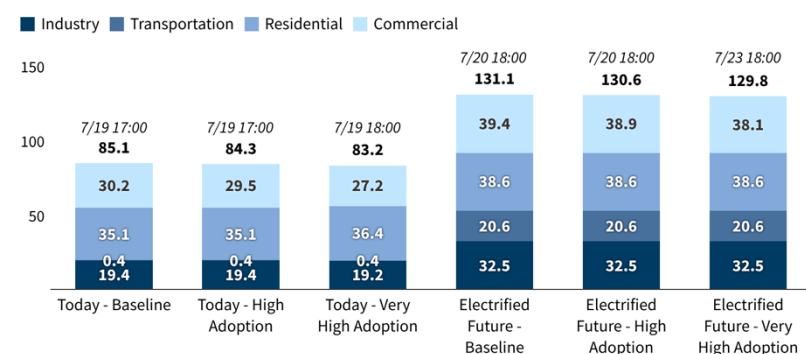
Although statewide peak demand reductions are somewhat modest, GHP deployment consistently reduces electricity demand during peak system hours. Under the High Adoption Scenario (20% penetration in office and retail buildings), statewide peak demand is reduced by 0.7 GW in Today's timeframe and 0.51 GW in the Electrified Future timeframe. Under the Very High Adoption Scenario (50% penetration in office and retail buildings and 20% in hotels and warehouses), peak demand reductions increase to 1.9 GW in Today's timeframe and 1.27 GW in the Electrified Future (Exhibit 1).

Peak demand savings are greater in 2025 than in 2040 because the baseline in the Electrified Future timeframe is more efficient. In the Today timeframe, GHPs replace inefficient existing electric cooling systems and some natural gas heating systems. In contrast, in the Electrified Future timeframe, GHPs replace higher efficiency heat pump rooftop units with electric backup heating, resulting in smaller incremental efficiency gains.ⁱ

As shown in Exhibit 2, peak demand reductions scale approximately linearly with GHP adoption across all penetration levels analyzed, indicating that GHP demand reductions are highly coincident with system peak hours. Higher GHP adoption also increases statewide load factors across all scenarios, with improvements of up to approximately 1% under Very High Adoption Scenario. While the increase is limited, higher load factors indicate improved utilization of the electric system, which can help place downward pressure on electricity rates by reducing the need for infrastructure built solely to serve infrequent peak demand.¹

Exhibit 1

TX peak demand contribution by sector and scenario (GW)



Peak hours vary for each scenario and are noted above.

Source: RMI analysis



Exhibit 2

TX 2025 and 2040 peak load and energy reduction by scenario

Scenarios	2025					2040				
	Peak (GW)	Peak Reduction (GW, %)	Annual Total (GWh)	Total Energy Reduction (GWh, %)	Load Factor*	Peak (GW)	Peak Reduction (GW, %)	Annual Total (GWh)	Total Energy Reduction (GWh, %)	Load Factor*
Baseline	85.1		476,949		64%	131.1		836,387		73%
Low	85	0.1 (0.1%)	476,772	177 (0.04%)	64%	131	0.05 (0.04%)	836,291	96 (0.01%)	73%
Medium	84.7	0.4 (0.4%)	476,064	885 (0.2%)	64%	130.8	0.25 (0.2%)	835,907	480 (0.06%)	73%
High	84.3	0.7 (0.8%)	475,178	1,770 (0.4%)	64%	130.6	0.51 (0.4%)	835,426	961 (0.11%)	73%
Very High	83.2	1.9 (2.2%)	472,189	4,760 (1.0%)	65%	129.8	1.27 (1.0%)	833,857	2,530 (0.3%)	73%

* Load factor is calculated as average load divided by peak load.

Source: RMI analysis



ⁱ The Electrified Future analysis is based on the 2024 Annual Decarbonization Pathway central scenario, which projects that 77% of commercial space heating is electrified by 2040 and 95% by 2050. Although the scenario includes a mix of heating technologies, with air source heat pumps as the predominant technology, this analysis assumes buildings receiving GHPs would otherwise have installed heat pump rooftop units.

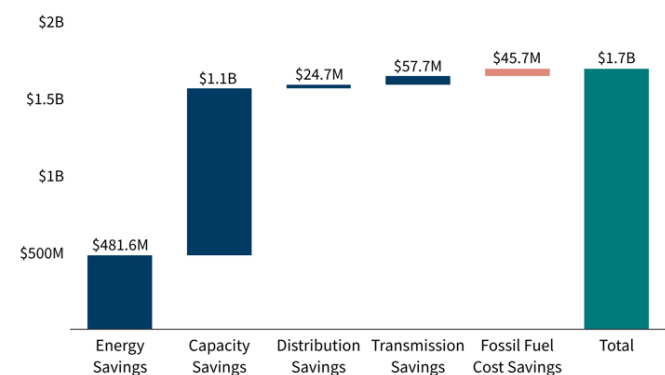
Economic Value

Utility system savings

By reducing both peak demand and electricity consumption, GHP deployment generates utility system savings across all scenarios evaluated. In both the Today and Electrified Future timeframes, capacity and energy savings account for the majority of utility system savings, with capacity savings representing a larger share of total savings in 2040. Similar to peak demand savings, overall utility system savings are greater in 2025 than in 2040 because the Electrified Future assumes a more efficient baseline, resulting in lower incremental utility system savings from GHP deployment.

Exhibit 3

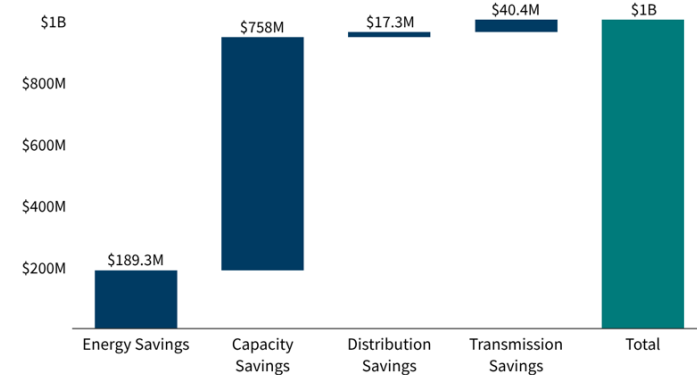
TX 2025 High Adoption scenario utility system savings



Source: RMI analysis



TX 2040 High Adoption scenario utility system savings

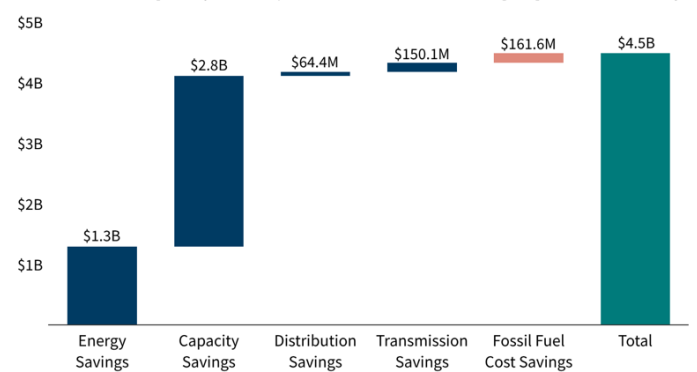


Source: RMI analysis



Exhibit 4

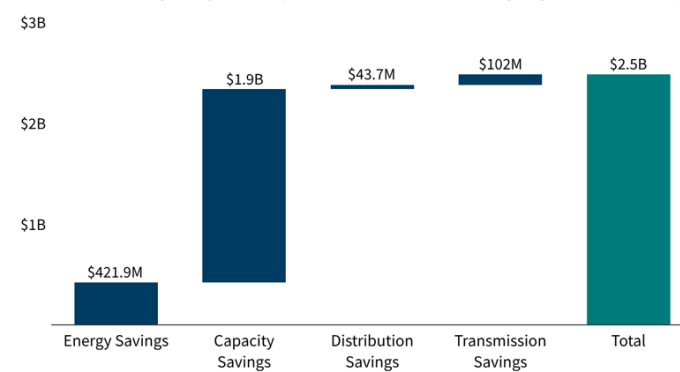
TX 2025 Very High Adoption scenario utility system savings



Source: RMI analysis



TX 2040 Very High Adoption scenario utility system savings



Source: RMI analysis



Customer bill savings

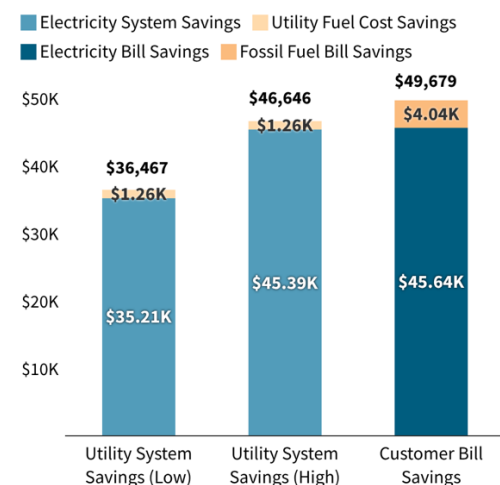
In addition to utility system savings, GHP deployment also delivers customer bill savings. Under the Today timeframe, customer bill savings exceed utility system savings across all scenarios. While this may suggest that under current retail utility rates, customers realize greater financial benefits than those delivered to the utility system, when utility profits, program costs, policy adders, and other components are taken into account, this may not necessarily be the case.

Under the Electrified Future timeframe, customer bill savings remain greater than utility system savings under the low utility system savings estimate but are exceeded by utility system savings under the high estimate. This suggests that as the electric system evolves, the value GHPs provide to the grid may not be fully reflected in customer electricity bills under today's retail rate structures. Because the Electrified Future analysis applies current retail electricity rates compared to future generation, energy, transmission and distribution costs, these results should be interpreted as illustrative rather than predictive.

Exhibit 5

TX 2025 per building savings

20-year net present value



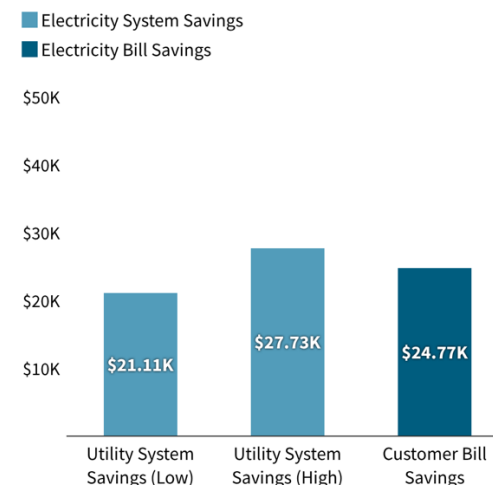
Note: Low and High reflect the lower- and upper-bound generation capacity estimates.

Source: RMI analysis



TX 2040 per building savings

20-Year net present value



Note: Low and High reflect the lower- and upper-bound generation capacity estimates.

Source: RMI analysis



Cost and cost gap

Even though GHP deployment generates substantial utility system and customer bill savings, current installation costs remain higher than the quantified utility system savings across all scenarios evaluated. In the Today timeframe, GHP costs under the low- to high-adoption scenarios are approximately 25% greater than total utility system savings, while costs under the Very High Adoption Scenario are approximately 70% higher. The larger cost gap under the Very High Adoption Scenario reflects the lower utility system savings from hotels and warehouses compared to office and retail buildings.

While a cost gap remains, the manageable magnitude reflects Texas's favorable installation economics. Texas benefits from a well-established drilling industry supported by its oil and gas workforce and supply chain, resulting in lower GHP installation costs than states with more limited geothermal drilling capacity, such as Arizona. In addition, the utility system savings presented here are conservative, as they quantify avoided fossil fuel costs (natural gas and other delivered fuels) but do not include avoided natural gas infrastructure costs or other potential system benefits, such as “speed-to-power” interconnection value.

Taken together, these findings suggest that Texas is already approaching utility-system cost-effectiveness based on quantified utility system value and that continued cost reductions could potentially close the remaining gap. Based on quantified utility system value alone, GHP installation costs would need to decline from an average of \$6,250 per ton to approximately \$5,000 per ton — a 20% reduction and an incremental cost of roughly \$3,500 per ton relative to natural gas rooftop units in the Today timeframe — to achieve cost-effectiveness. This benchmark provides an installed cost target for policies aimed at accelerating market scale and reducing installation costs. Continued market growth and technological innovation, including groundwater-enabled geothermal systems that require fewer boreholes and less drilling, suggest that the cost reductions needed to achieve utility-system cost-effectiveness are attainable.

Exhibit 6

TX GHP total system incremental cost by penetration level

Scenario	Number of Buildings	GHP Tons Across All Buildings	GHP Incremental Cost Against NG RTU (billion \$)	2025 Utility System Savings (billion \$)	GHP Incremental Cost Against HP RTU (billion \$)	2040 Utility System Savings (billion \$)
Low	3,623	48,000	0.2	0.2	0.2	0.1
Medium	18,121	239,000	1.1	0.9	1.1	0.5
High	36,247	478,000	2.3	1.7	2.1	1
Very High	119,217	1,687,000	8.1	4.5	7.5	2.5

Source: RMI analysis

Policy Recommendations

Texas has long focused on managing summer electricity peaks, when demand for air conditioning places significant stress on the electric grid. In recent years, utilities have increasingly adopted demand-side strategies — from time-varying electricity pricing to virtual power plants — to help manage these peak periods. This analysis demonstrates that ground-source heat pumps can complement these strategies by providing highly efficient cooling during periods of extreme heat while also reducing winter electricity demand in areas that rely on electric resistance heating. Several actions by Texas utilities and policymakers can help better capture these grid benefits:

- **Update utility cost-benefit methodologies:** To ensure the full value of GHPs is captured, regulators can update utility cost-benefit methodologies to place greater emphasis on peak demand reduction — not just annual kWh savings — and account for the performance benefits offered by GHPs during periods of extreme heat.
- GHPs are largely absent from major Texas utility programs today. Utilities can **incorporate GHPs into energy efficiency and peak demand management programs**, while regulators can establish utility targets and performance incentives that encourage deployment of technologies delivering long-term peak demand reduction.
- As Texas experiences rapid growth in electricity demand from large loads such as data centers, utilities and policymakers can **establish frameworks that encourage new large loads seeking interconnection to invest in demand-side measures alongside their own demand flexibility to expedite connection**. Such a framework could help offset a portion of the capacity needed to serve these new loads while identifying the demand-side measures businesses could fund, including ground-source heat pumps.

Limitations of the Analysis

1. The economic analysis uses a 20-year NPV period based on the expected lifetime of indoor GHP equipment. However, geothermal bore fields can last approximately 50–100 years, allowing the ground-loop infrastructure to serve multiple generations of indoor equipment. As a result, subsequent GHP replacements would not require the full initial investment, and the longer-term economics of GHP deployment may be more favorable than reflected in this analysis.
2. The GHP cost analysis also relies on a simplified \$/ton approach that combines drilling, equipment, installation, and other hard and soft costs. In practice, these cost components do not all scale proportionally with system capacity: some costs scale more directly with system size (e.g. piping), while others have a higher fixed cost component (e.g. drilling). Because GHP installations can have a significant share of fixed costs, scaling total costs linearly on a \$/ton basis may overestimate costs particularly for larger systems where those fixed costs are spread across greater system capacity.
3. This analysis does not evaluate GHP adoption in the residential sector. While residential buildings are the primary driver of Texas's peak electricity demand, and residential GHP deployment could therefore provide greater peak demand reductions than commercial buildings, cost-effectiveness in the residential market is likely to be more challenging in a warm climate like Texas. This is due to two primary factors: (1) GHP systems have a significant fixed-cost component, making larger commercial projects more economically favorable; and (2) the efficiency gains from cooling in warm climates are less pronounced than the heating efficiency gains achieved in colder climates, where the difference between outdoor and indoor temperatures can be substantially greater. As a result, if the objective is to maximize peak demand reduction, the residential sector should be prioritized. However, if the objective is to maximize cost-effective GHP deployment, commercial buildings remain the stronger near-term opportunity.

¹ Ryan Hledik, Long Lam, and Kate Peters, *The Untapped Grid: How Better Utilization of the Power System Can Improve Energy Affordability* (The Brattle Group, prepared for GridLab and Utilize Coalition, March 2026)