Rhodium Group

The Value of Electric Power Transmission in a New Energy Context

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Hannah Kolus (hkolus@rhg.com), Ben King (bking@rhg.com), Parker Case (pcase@rhg.com), Anna van Brummen (avanbrummen@rhg.com), Nathan Wiens (nwiens@rhg.com)

Surging electricity demand and constraints on generator supply are increasingly challenging access to affordable, reliable electricity in the US. Evolving natural gas dynamics at home and abroad also have implications for the power sector. Though considerable work has been appropriately focused on expanding new generation on the grid in response, a more robust transmission system also plays a critical role in meeting demand and reducing costs. We find that expanding transmission capacity has the potential to help mitigate rising electricity prices while supporting electricity reliability, especially under conditions that add extra strain on the grid. Easing transmission barriers reduces total US power system costs by $82-130 billion from 2026 to 2040, resulting in 2-3% lower electricity prices nationally in 2040, with greater price impacts in some regions. Expanded transmission drives these lower costs by enabling 9-43% more capacity deployment on the grid through 2040. More extensive interregional transmission networks also allow regions to meet reliability requirements at up to 12% lower costs, since they facilitate the sharing of capacity resources between regions. At the same time, expanded interregional transmission enables access to lower-cost sources of electricity in neighboring regions, driving different decisions on where generators are built and how they are operated.

Transmission value in a dynamic energy environment

After a couple of decades of effectively flat electricity demand growth, surging US electricity demand, largely driven by current and anticipated growth in large AI data centers, has increasingly dominated energy conversations and begun to reshape the US power sector. But electricity demand growth isn't the only factor driving rapid change in the energy sector. Elsewhere on the grid, supply chain challenges, interconnection queue delays, and inflation are driving up the costs to bring new generating capacity onto the grid—at a time when the country needs all the electrons that it can get. Taken together,

these dual challenges are intensifying the focus on rising electricity bills and what can be done about them. At the same time, demand for US liquefied natural gas (LNG) and the corresponding build-out of new LNG export terminals are reshaping domestic natural gas production trends and stand to put upward pressure on domestic gas prices. All of this is playing out against a backdrop of a dynamic energy policy environment, with legislative and executive decisions that are poised to shape how the US meets this increasing demand.

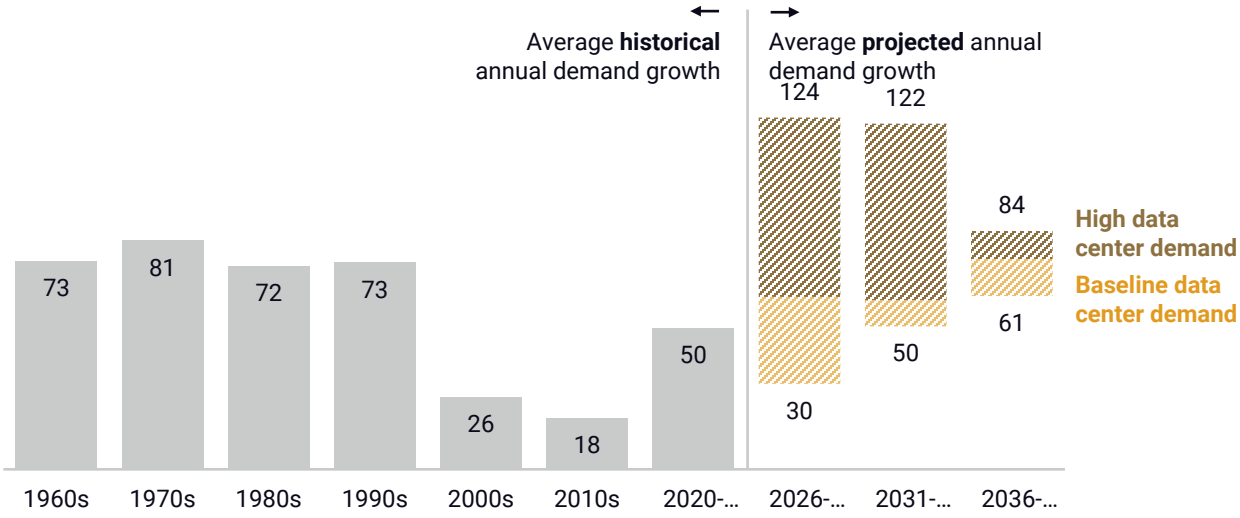
There has been considerable attention on how the US can expand electricity *generating* capacity in response to these trends—building more gas turbines, batteries, solar farms, and the like—but that only tells part of the story. These electrons need to move from generators to end users efficiently and in real time—underlining the critical importance of a robust transmission system for delivering affordable, reliable electricity. The recently released Bipartisan American Affordability and Jobs Act (BAAJA) includes meaningful improvements to federal policy to help bolster the transmission system, underscoring how important a strong grid is for meeting future energy needs. In this note, we briefly describe the new energy context the US is facing and then unpack modeling results that demonstrate how increasing transmission capacity on the grid can help bring more power to the grid, reduce costs, and contribute to reliability.

AI data centers are driving increasing electricity demand but are not the only source

The evolution of US electricity generation since 1960 can be divided into three distinct phases. From 1960 to 2005, electricity generation grew steadily, averaging just over 70 TWh per year, driven by economic and population growth, widespread adoption of electric appliances, and increasing commercial building floorspace (Figure 1). From 2005 through 2019, load growth was flat, averaging just 11 TWh (or about 0.1%) more demand per year due to increasing efficiency of appliances and lighting, a continued shift away from electricity-intensive manufacturing, and the Great Recession. The country is now on the precipice of increasing load growth that could dwarf the previous era of sustained growth, and has already seen a rebound to 50 TWh (2.1%) of year-on-year growth this decade.

AI data centers drive the bulk of future load growth, and assumptions around just how quickly that demand will materialize have an outsized impact on aggregate power demand. That said, the reshoring of electricity-intensive manufacturing (like chipmaking and battery manufacturing) and ongoing electrification of oil and gas operations in the Permian Basin also contribute step changes in demand growth. Increasing demand from large loads is superimposed on broader trends toward electrification via technologies like electric vehicles and heat pumps. All these factors contribute to higher electricity consumption, tighter reliability conditions, and greater pressure on electricity prices in many regions than the US has experienced over the past few decades.

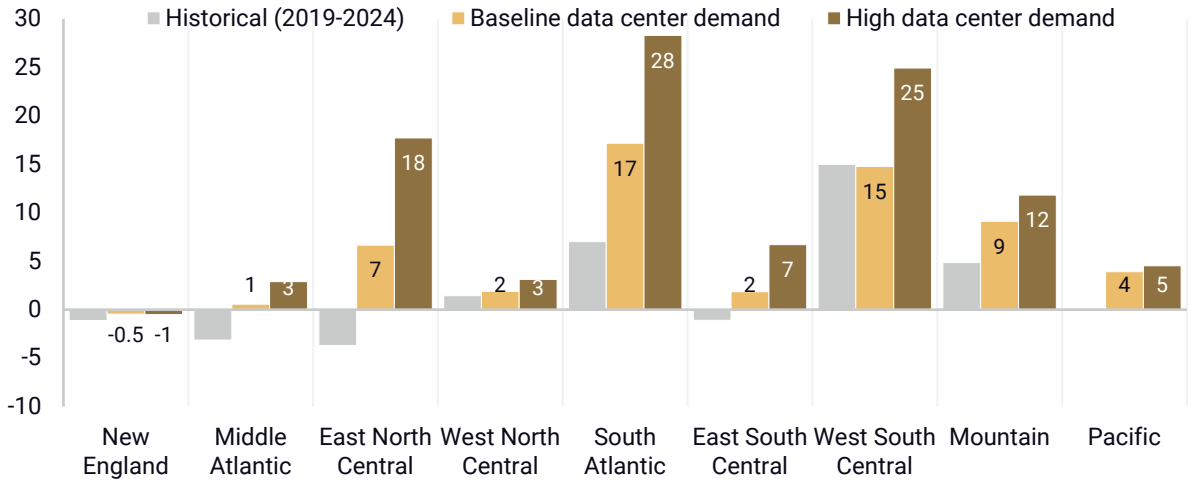
FIGURE 1
Average annual US electricity demand growth, 1960-2040
Terawatt-hours (TWh)



Source: EIA, Rhodium Group. Note: Ranges for projected annual load growth under baseline data center demand assumptions (yellow hatched bars) correspond to the Taking Stock 2026 emissions scenarios with the lowest and highest annual load growth in each five-year period. The dark yellow hatched bars denote the additional annual average load growth we project under high data center demand assumptions.

In our modeling, we find that nearly every region in the US is poised to see higher levels of electricity demand growth over the next fifteen years than in the past five years (Figure 2). Almost every region that historically experienced stagnant demand growth or even demand declines will see sustained demand growth over the coming decade. In regions where electricity demand increased over the past few years, we generally project that the pace of that growth will accelerate through 2040.

FIGURE 2
US electricity demand growth from 2025 to 2040 by census division and data center demand compared to historical trends
Average annual growth (TWh)



Source: Rhodium Group, EIA

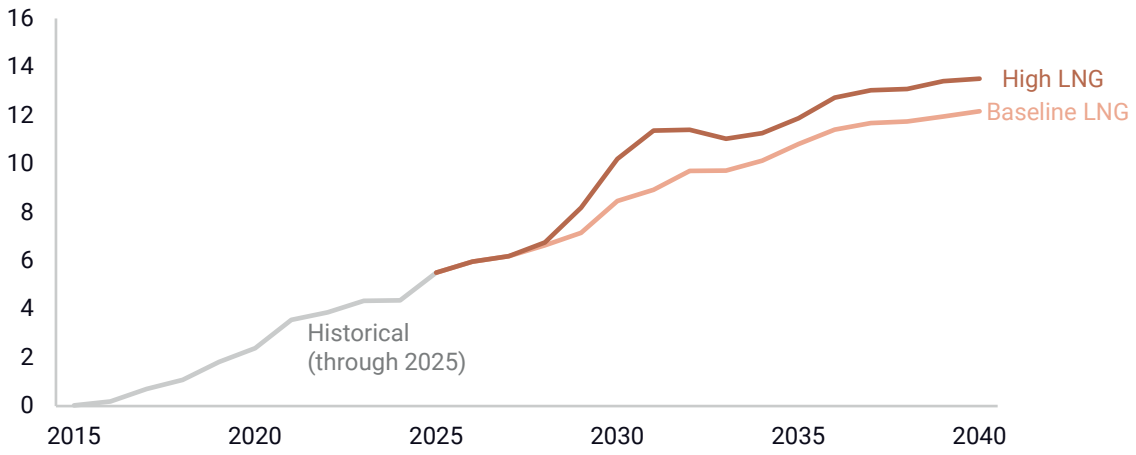
This electricity demand growth varies meaningfully by region, largely driven by expectations around where data center development will take place and at what scale. Under our baseline data center assumptions, which represent a reasonably conservative pace of expansion compared to other recent data center demand projections, Virginia accounts for 23% of data center demand growth through 2040, doubling already high electricity growth rates in the South Atlantic. Data center expansion in Texas (15% of the total) helps maintain high levels of demand growth in West South Central, while expansion in Ohio and Indiana (11% of the total) more than doubles demand growth in East North Central.

Data center demand expectations are highly uncertain and vary widely. Under high data center demand assumptions aligned with the upper range of recent projections, the pace of national electricity demand growth could increase by 80% compared to baseline rates, widening regional differences. This new era of data center-driven demand growth raises the stakes for building cost-effective and rapid grid infrastructure to ensure delivery of reliable, affordable energy.

Abundant, low-cost US natural gas plays an increasingly prominent role in the global energy system

Alongside the need for more electrons, demand is also expanding for US natural gas abroad, and investments to increase export capacity that have been underway for years are well-timed to meet that increased demand. US LNG export volumes have surged in recent years, growing from effectively zero in 2015 to more than 5.5 trillion cubic feet—14% of domestic natural gas production—in 2025. The war in Iran and ensuing closures and limitations on the Strait of Hormuz have amplified demand for US gas. From January through June 2026, LNG exports were up 23% compared to the same period in 2025, driven by increasing demand from Asian markets that were previously largely served by Qatari LNG. This trend looks poised to continue, enabled by currently under-construction projects coming online over the next few years. As discussed further below, we consider two LNG export capacity pathways and find volumes could more than double by 2040, increasing by 121-145% over 2025 levels (Figure 3).

FIGURE 3
US LNG export volumes
Trillion cubic feet



Source: EIA, Rhodium Group

This increasing demand for US LNG does not reduce the amount of natural gas available for use in the power sector. We model increasing demand for LNG along with demand from other sectors and estimate domestic production of gas will increase by 7-8 trillion cubic feet in 2040 (18-20%) in response, building on a period of immense growth in gas production over the last decade. Rather, this global demand drives producers to drill higher-cost wells and increases competition with domestic consumers. As a result, Henry Hub spot prices increase by 10% ($0.50) on average from 2030 to 2040 in the high LNG case compared to the baseline LNG case. In turn, the power sector makes somewhat different investment and operational choices, with power generation from natural gas decreasing by 7% in the high LNG case in 2040. As we unpack below, more available transmission has a different impact on this less gas-heavy grid.

The US needs a grid that provides affordable, reliable electricity

The grid is made up of three interconnected systems: generating assets that convert natural resources into electricity; the transmission system, which connects these generating assets to concentrations of electricity demand; and the distribution system, which moves electrons from the transmission system to end users. While adequate supply of generating capacity is necessary to provide affordable and reliable energy, the transmission system plays a crucial role in connecting supply and demand. It ensures that generation can meet load reliably, at the right time and place, and at the least cost. Our focus in this analysis is on the importance of transmission to the grid.

The transmission system can be further subdivided into three major categories of assets: lower-voltage lines that connect individual generators to the bulk power system (spur lines), medium-voltage lines that make up the bulk of the transmission system moving electricity around within an individual grid region (regional lines), and higher-voltage lines that connect larger grid regions together (interregional lines; in our case 25 individual electricity regions).

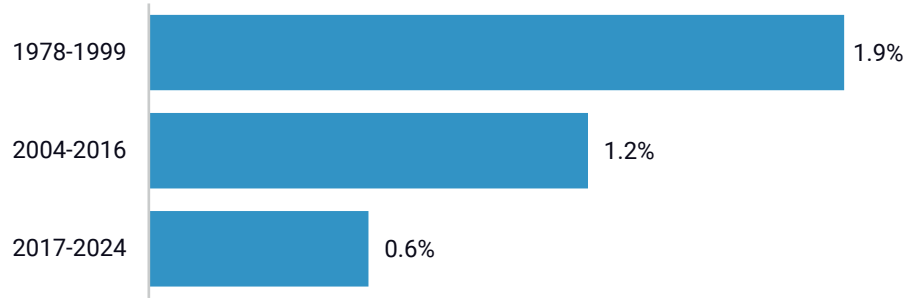
Taken together, these components add value to the grid in several important ways. First, the transmission system supports the reliability of the entire power system by enabling

power to flow from places where it is abundant and cheap to places where it is needed—both of which might change depending on the time of day or time of year. By sharing resources across regions, the grid as a whole can meet its reliability standards at a lower overall cost.

Second, transmission can expand access to geographically diverse supplies. Some types of generators, especially renewables like solar, wind, geothermal, and hydroelectric power, have resource endowments that are not located proximate to population centers and other sources of load. Adding transmission can enable new and existing resources to meet increasing demand. Finally, transmission can help reduce costs by reducing congestion at key chokepoints on the grid, allowing lower-cost generation to places that would otherwise be reliant on more expensive generation, helping to improve grid asset utilization.

Despite the value that transmission brings to the power system, the US has been building less transmission in recent years (Figure 4). Part of this is because transmission expansion has been less critical in a period of low load growth. Beyond that, federal, state, and local siting and permitting challenges have also slowed the pace of deployment and now represent a major bottleneck in this new era of surging demand.

FIGURE 4
Average annual growth of US transmission capacity
Percent



Source: Congressional Budget Office, citing Jenkins et al. (2023) for 1978–1999 and 2004–2016; Congressional Budget Office, using data from Adler (2024) and FERC (2023–2026) for 2017–2024

Despite these challenges, some meaningful transmission investments are moving forward. ERCOT, the grid operator in Texas, has plans to build a 765-kV transmission backbone across the state, largely to help serve increasing load associated with oil and gas production in the Permian Basin. The Midcontinent Independent System Operator (MISO) approved nearly $22 billion in transmission investments aimed at improving reliability, interconnection, and market efficiency. And construction is underway on the TransWest Express transmission project to connect grid regions in the West.

Building new transmission lines represents one of a number of solutions that can improve the performance of the grid by increasing access to generation, relieving congestion, and enabling interregional sharing of resources. Deploying grid-enhancing technologies (like dynamic line rating and advanced power flow controls) and reconductoring existing transmission lines can all improve the efficiency of the existing grid. The use of high ampacity conductors in transmission expansion can maximize the impact of these

investments. Increasing the installation of energy storage of a range of durations and scaling up grid flexibility efforts can help strategically shape the demand that the grid needs to serve. Though the focus of this report is specifically on transmission build-out, an all-of-the-above approach leveraging each of these solutions can help respond to emerging urgent energy system needs.

Scenarios to assess transmission value

There is a considerable body of work that discusses the importance of transmission to an efficient, reliable, low-cost power sector.[1] We aim to add to that work by examining the importance of transmission specifically in the new energy context that we've described above, representing both the current federal and state policy environment and macro drivers of energy system change.

Because the regionality and scale of transmission benefits differ depending on energy market conditions, we evaluated the value of transmission expansion across a range of potential energy system futures. We developed a set of scenarios that capture uncertainty in key dimensions of the US energy system. The **central** scenario largely mirrors our mid emissions scenario from Taking Stock 2026 and assumes moderate oil and gas price projections, moderate clean technology costs, baseline data center demand growth, and planned LNG export capacity that includes all under-construction facilities. We also incorporated additional electricity demand in the Permian Basin from the ongoing electrification of oil and gas operations.

All other scenarios start from the central scenario assumptions and explore a more extreme outcome for one component of the energy system (Table 1). The **high data center** scenario assumes data center demand grows at a faster pace, with total data center demand rising 133% above the central scenario by 2035. The **high LNG** scenario assumes planned LNG export capacity that includes both under-construction and permitted facilities, increasing planned export capacity by 43% and increasing Henry Hub spot prices by 10% ($0.50) on average from 2030 to 2040 relative to central assumptions. The **constrained supply** scenario represents an environment where adding new generating capacity to the grid is more expensive by imposing a cost premium on all new additions when installations exceed thresholds derived from historical annual deployment levels. Together, these scenarios represent a range of possible energy system outcomes given current energy market trends.

[1] See for instance National Transmission Needs Study, Electric Transmission Value and Its Drivers in United States Power Markets, Fewer New Miles: Strategic Industries Held Back by Slow Pace of Transmission

TABLE 1
Scenarios for understanding transmission value

Scenario	Data center demand	LNG export capacity	Supply constraints
Central	Baseline growth	Under-construction facilities	All techs see cost premiums beyond 25% annual growth
High data center	High growth		
High LNG		Under-construction and permitted facilities	
Constrained supply			All techs see cost premiums beyond 10% annual growth

To assess the value of transmission expansion, we used RHG-NEMS, Rhodium Group's US energy system model, to model this set of scenarios under two transmission environments:

- **Business-as-usual (BAU)**: Transmission expansion continues at a similar pace to historical levels.
- **Expanded (Exp.)**: Interregional and intraregional transmission infrastructure, including spur lines, can be developed faster and at lower cost than today.

The expanded transmission environment allows us to evaluate how the US energy system would evolve with fewer barriers to transmission development. We quantified the value of transmission expansion by comparing capacity additions, electricity prices, reliability costs, and transmission deployment in the expanded transmission and BAU environments for each scenario.

BAAJA, the current bipartisan federal permitting reform bill, includes changes to transmission planning requirements, cost allocation approaches, and the federal government's role in permitting interstate transmission lines. We modeled those transmission reforms as part of a broader set of policy changes and recently released a note discussing our findings. We do not model explicitly BAAJA provisions in this analysis and instead take a policy-neutral approach to representing the potential to increase transmission, but our findings here are generally consistent with our BAAJA modeling.

RHG-NEMS captures many benefits of transmission, and it has the advantage of reflecting dynamic natural gas prices to the grid—a key driver of power sector decision-making. However, its representation of transmission is limited relative to more specialized production cost models and, naturally, the actual electricity grid and its operations. RHG-NEMS does not capture benefits that play out on highly granular scales, either in terms of time or geography. RHG-NEMS does not capture within-region congestion, one well-documented source of costs that better transmission access can help improve. Similarly, recent work from Lawrence Berkeley National Laboratory has shown that around 40-60% of the benefits of expanded transmission accrue in just 5% of hours in a year (in their

retrospective modeling approach)—and 20-30% accrue in just the top 1% of hours. RHG-NEMS takes a reduced-form approach to modeling hourly dispatch that doesn't fully capture the benefits that occur in these narrow time slices. Similarly, RHG-NEMS does not anticipate unexpected weather events, which can strain the resilience of the grid and which can be at least partly mitigated by transmission investments. As a result of these limitations, this analysis provides a conservative estimate of the value of transmission.

Expanded transmission reduces prices and enables more capacity on the grid

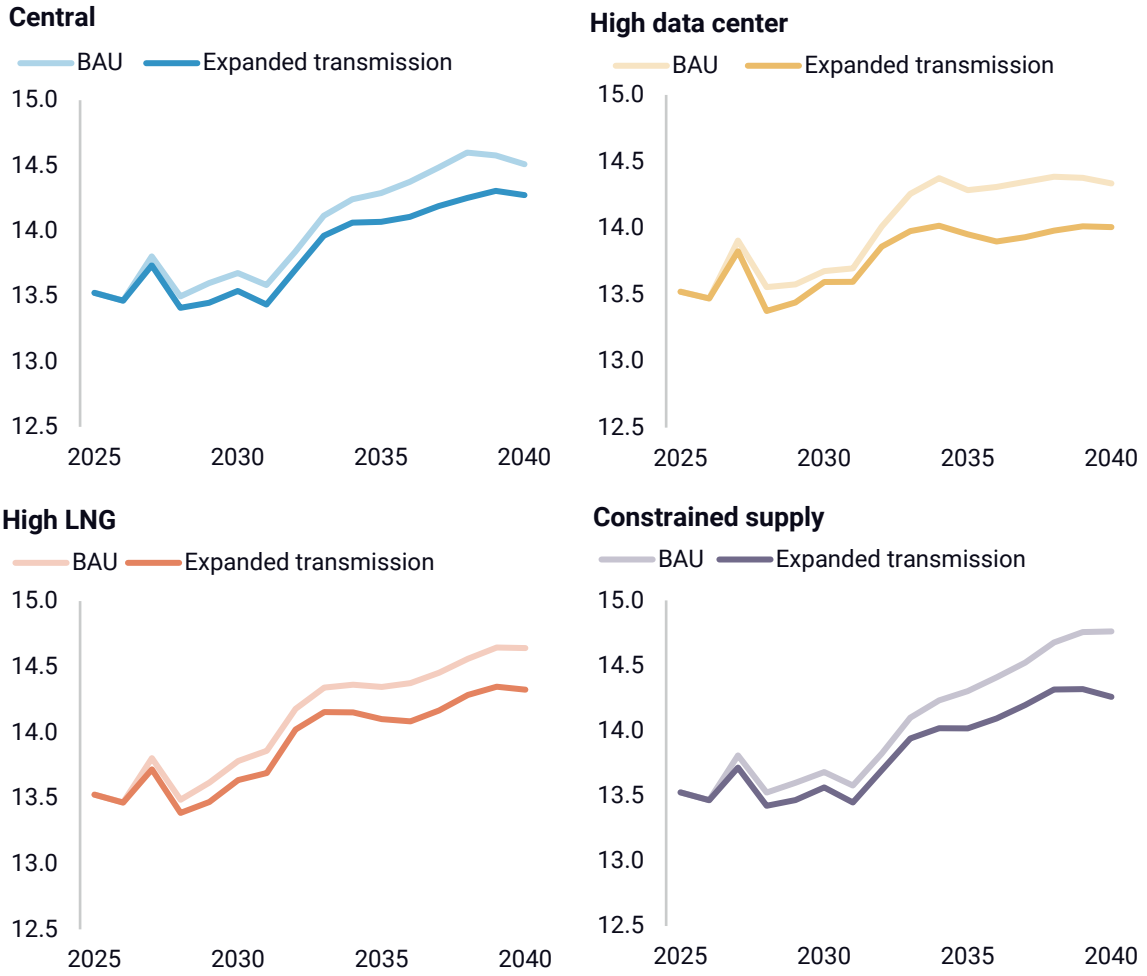
We find that making transmission easier and cheaper to build reduces electricity prices by transforming the US electric grid. Capacity additions increase as it becomes easier to connect power plants to demand centers. The transmission network grows, strengthening existing connections and expanding to connect new regions. Increasing trade between regions impacts the capacity and generation mix while reducing reliability costs.

Lower electricity prices

Making transmission easier and cheaper to deploy reduces costs across the electricity system. We unpack changes to the grid in the sections that follow, but in general, increased solar and natural gas-fired capacity displaces generation from older, inefficient, more expensive fossil plants, reducing fuel costs. Increasing connections between regions allows regions to share resources for reserve margins. Trade between regions also impacts capacity deployment and operating decisions in ways that favor cheaper resources. Taken together, these dynamics combine to lower total system costs in the expanded transmission scenarios relative to BAU by $82-130 billion from 2026 to 2040, a 2-3% reduction.

This reduction in total system costs flows through to electricity prices. Electricity price represents the average amount customers ultimately pay per kilowatt-hour after accounting for the various components of their electricity rates, including fixed and volumetric charges. Between 2027 and 2040, expanded transmission decreases economy-wide national electricity prices modestly across all sectors, with average economy-wide prices falling by 1.6-3.4% (0.2-0.5 cents) in 2040 (Figure 5). Put another way, the average residential customer saves up to $40 on their electricity bill in 2040 with expanded transmission. These price gaps widen over time as cheaper transmission allows more renewable capacity and more efficient natural gas plants to come online, compounding the benefits of transmission investment. From 2035 to 2040, lower electricity prices save residential and commercial customers $4-5 billion and $5-9 billion per year on average, respectively. Like the dynamics in the previous section, transmission expansion reduces electricity prices most in scenarios where the electricity system is most strained: the constrained supply scenario sees the largest price impact, while the central scenario sees the smallest price impacts. Put another way, the affordability implications of expanded transmission are amplified if data center demand or LNG exports grow at a faster pace.

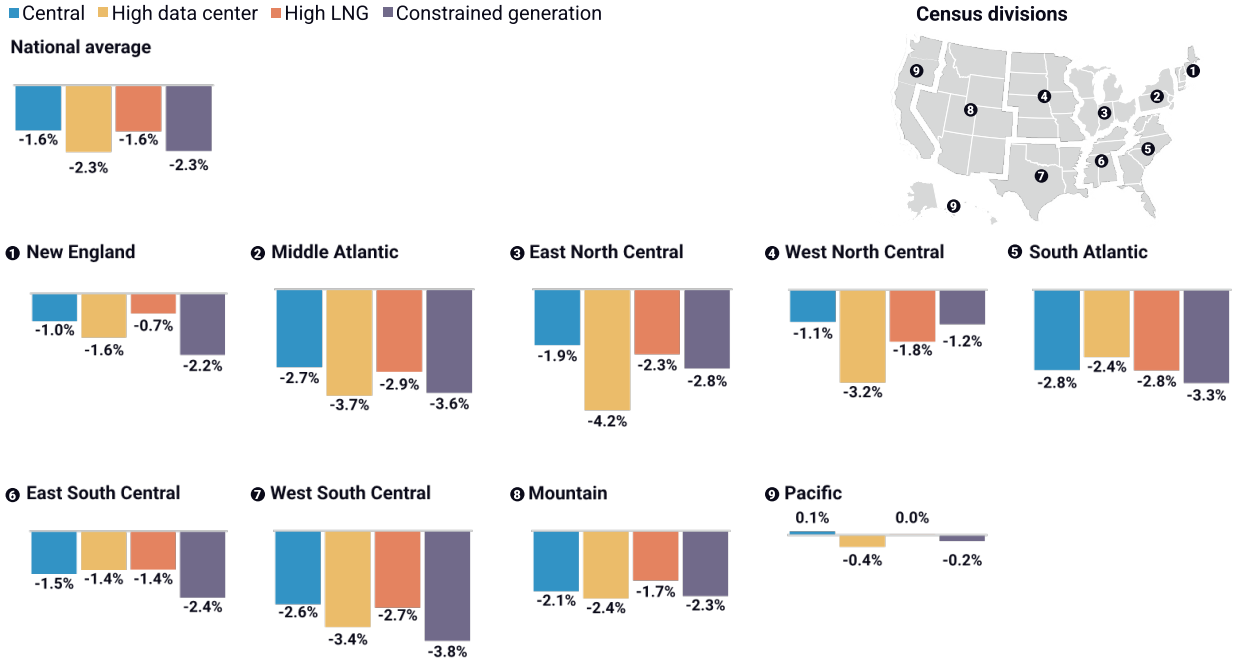
FIGURE 5
National electricity prices under range of scenarios
2025 cents/kilowatt-hour



Source: Rhodium Group

National price decreases mask large regional variation, with the largest price declines often occurring in the same regions across all scenarios. The West South Central, Middle Atlantic, South Atlantic, and East North Central regions tend to see the greatest price reductions in each scenario, ranging from 1.9-4.2% lower prices than BAU (Figure 6). In our modeling, most of these regions (excluding the Middle Atlantic) experience the fastest data center demand growth in the country. More accessible transmission allows them to expand their in-region capacity while tapping into cheaper capacity elsewhere in the grid to meet both demand and reserve margins. Conversely, the Pacific and New England consistently see the smallest reductions in electricity prices. These regions see slower demand growth or have less access to high-quality renewable resources.

FIGURE 6
Change in average electricity price (2035-2040) with expanded transmission
Percent



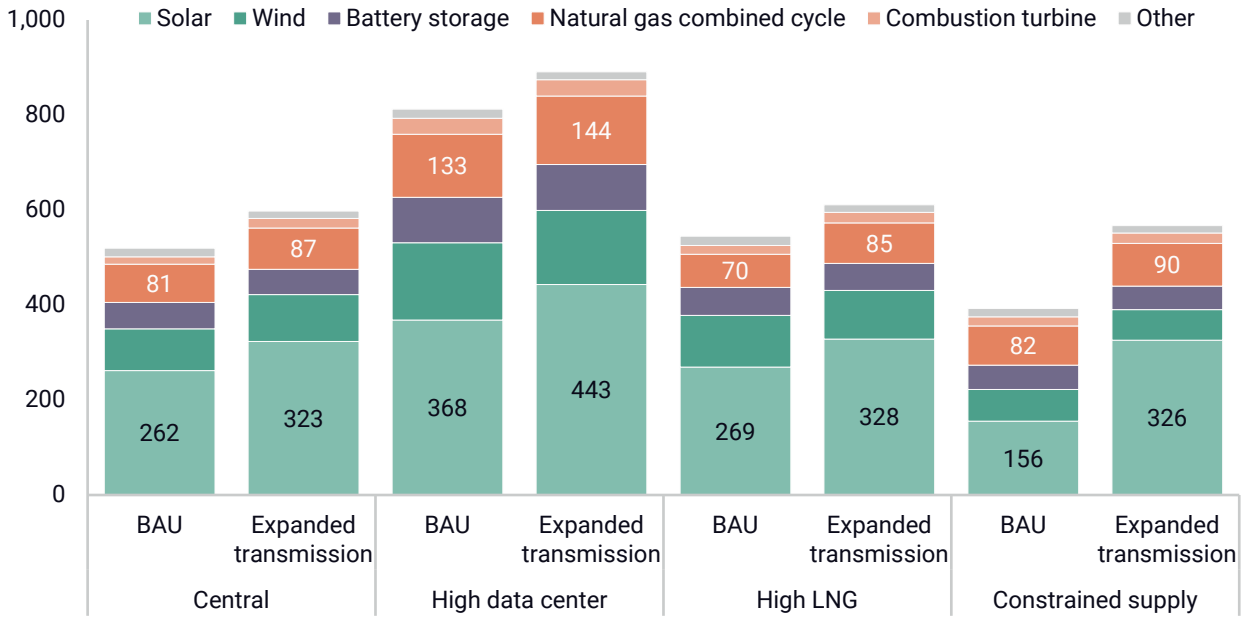
Source: Rhodium Group

More capacity on the grid

Expanded transmission enables more new generating capacity to be built to serve growing electricity demand. In 2040, cumulative unplanned capacity additions increase by 9-43% in the expanded transmission scenarios compared to BAU, with solar and natural gas generators driving the lion's share of the change (Figure 7).[2] As we discussed above, transmission is bringing two values to the grid here. First, improving transmission access means that more capacity can connect to the bulk power system to serve load. Second, this new generation, along with existing generating assets, can expand their reach to a wider geographic range of demand.

[2] All scenarios have the same level of planned capacity additions, which reflect currently announced projects in the development pipeline. Unplanned capacity represents additional power plants beyond what's in the development pipeline that the model determines will need to be built in the future to meet demand and reliability requirements at the lowest cost. By focusing on unplanned capacity, we isolate the impacts of expanded transmission.

FIGURE 7
Unplanned capacity additions in BAU and with expanded transmission (2026-2040)
GW



Source: Rhodium Group

Unplanned solar additions increase by 20-24% (59-75 GW) in the central, high data center, and high LNG expanded transmission cases compared to BAU in 2040. In the constrained supply scenario, solar capacity doubles (170 GW) over the same period with expanded transmission, owing to lower transmission barriers and reduced spur line costs decreasing overall project costs, balancing this scenario's higher supply-related costs and allowing solar capacity to deploy more readily.

Natural gas plants also benefit from a more connected grid. Unplanned natural gas-fired additions increase by 10-19 GW (7-21%) with expanded transmission relative to BAU. Combined cycle plants comprise most of these additions, but peaker plants deploy as well to balance the additional solar capacity and maintain grid reliability. Natural gas additions increase the most with expanded transmission in the high LNG scenario. In this scenario, higher LNG exports drive the average Henry Hub spot price up by 50 cents (10%) compared to prices in the central scenario from 2030 to 2040. As a result of higher natural gas prices, the high LNG scenario under BAU sees the lowest gas-fired capacity of all scenarios. Coming from this lower baseline, expanded transmission has a differential impact on natural gas additions in the high LNG scenario, but total natural gas capacity remains the lowest of all scenarios.

In our modeling, emerging clean technologies like nuclear technologies and enhanced geothermal systems remain too expensive to compete with more conventional resources: nuclear capacity doesn't expand beyond planned uprates and restarts, and geothermal capacity grows meaningfully from today but still represents only a small share of the market by 2040. However, these technologies also benefit from expanded transmission, which can reduce the time and costs associated with grid connection. The economic viability of geothermal projects in particular, which are often located in rural areas,

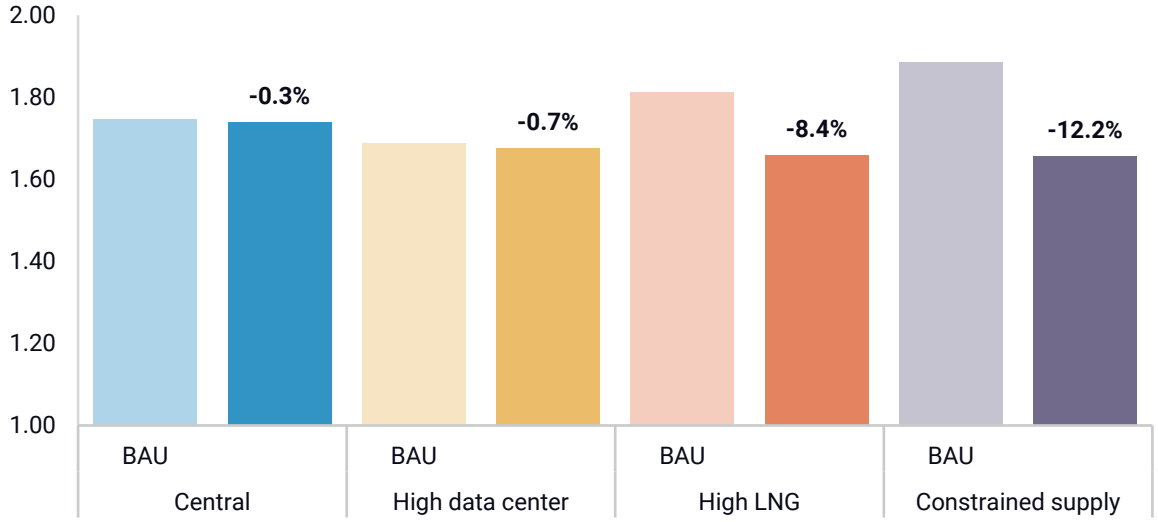
partially depends on the build-out of transmission infrastructure required to connect these resources to demand centers.

These capacity changes impact the generation mix in each scenario. Solar generation shares increase by 2-7% in 2040 relative to BAU, largely displacing gas generation shares despite the increase in gas capacity. Across scenarios, transmission expansion allows older, more inefficient gas-fired generators to run less frequently while increasing generation from new gas plants and solar capacity. Instead of retiring, these older gas plants stay online to provide reliability for growing shares of renewable energy and amid increasing demand. Coal generation also falls slightly as coal retirements increase modestly, and surviving plants operate at lower capacity factors. This shift towards zero-marginal cost resources and more efficient gas power plants reduces generation costs, which helps drive down electricity prices.

Meeting reliability targets at lower cost

Beyond reshaping the generation mix, making transmission cheaper and easier to deploy also lowers the cost of maintaining grid reliability. Across all scenarios, our model optimizes to meet the same targets for resource adequacy and spinning reserves. Expanded transmission reduces the costs of achieving these by up to 12.2% (Figure 8). Enhancing connections between regions allows regions to rely on some capacity in neighboring regions to meet reliability requirements, driving down costs associated with building out extra in-region peaking generation or long-term planning of generation to meet growing load. Regional grid operators currently utilize this strategy to cut costs. For instance, the Southwest Power Pool **saved $8.5 billion** in additional generation capacity investment in 2025 by sharing resources across its footprint. Expanded transmission allows for greater resource sharing and increased cost savings. In our modeling, the high LNG and constrained supply scenarios see the biggest reductions in reliability costs with expanded transmission, because transmission mitigates some of the high generation costs associated with high gas prices or a generation-limited power sector.

FIGURE 8
Reliability costs in 2040
2025 cents/kilowatt-hour



Source: Rhodium Group

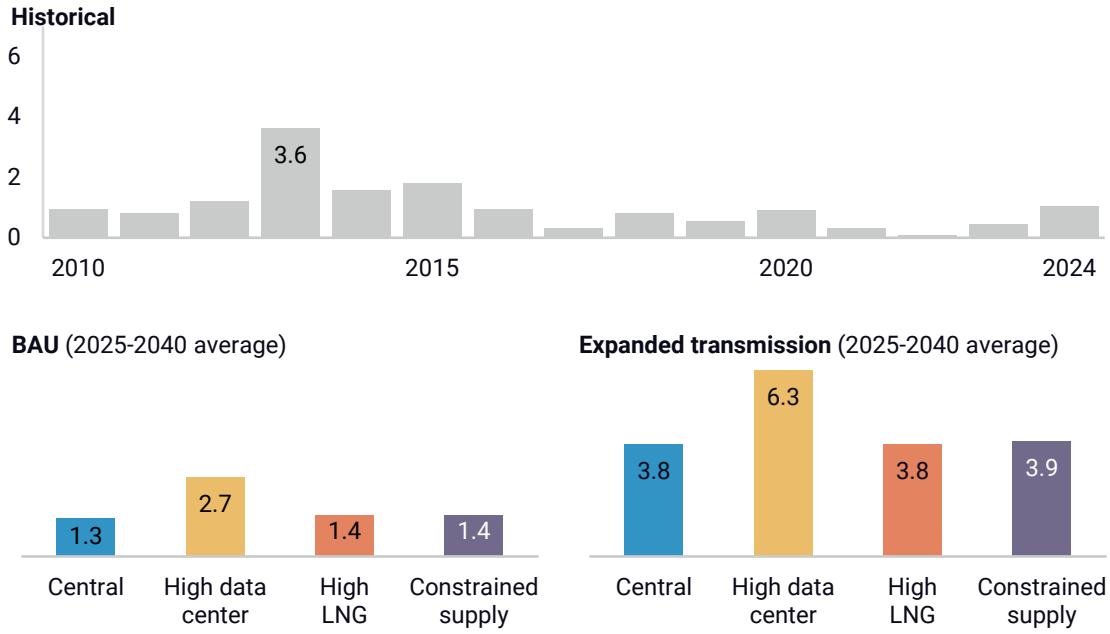
These major grid changes and price impacts are driven by rapid, extensive transmission build-out

As we discussed earlier, high-voltage transmission development in the US has advanced slowly over the last fifteen years, particularly since 2016. From 2010 to 2015, the US built 1.6 TW-mi of high-voltage transmission on average each year, while it averaged only 0.6 TW-mi of annual builds from 2016 to 2024 (Figure 9). The 2013 maximum over this period represents an anomaly in the record: in the second-highest year of transmission expansion, only half as much high-voltage transmission was added to the grid. 2013 represents an exceptional year for transmission development for good reason. Texas' Competitive Renewable Energy Zones (CREZ) program, which invested $6.9 billion in new high-voltage transmission within ERCOT, spearheaded significant transmission expansion around this time. We estimate that CREZ alone was responsible for about a little over half of total high-voltage transmission build-out in 2013. This outlier year is a testament to the dedicated focus and resources across multiple levels of government required to accelerate transmission development.

INTERREGIONAL TRANSMISSION EXPANSION

In our BAU scenarios, projected interregional transmission expansion largely continues at the pace of historical build-out, despite projected acceleration of electricity demand growth. Under baseline data center demand growth—roughly three times the pace of growth in the 2010s—the average rate of interregional transmission development from 2025 to 2040 rivals the average rate of high-voltage transmission build-out in the early 2010s (1.3-1.4 TW-mi). The high data center scenario nearly doubles this average rate but falls well short of 2013's maximum build-out.

FIGURE 9
Historical high voltage transmission builds with projected annual average interregional transmission builds (2025-2040)
TW-miles



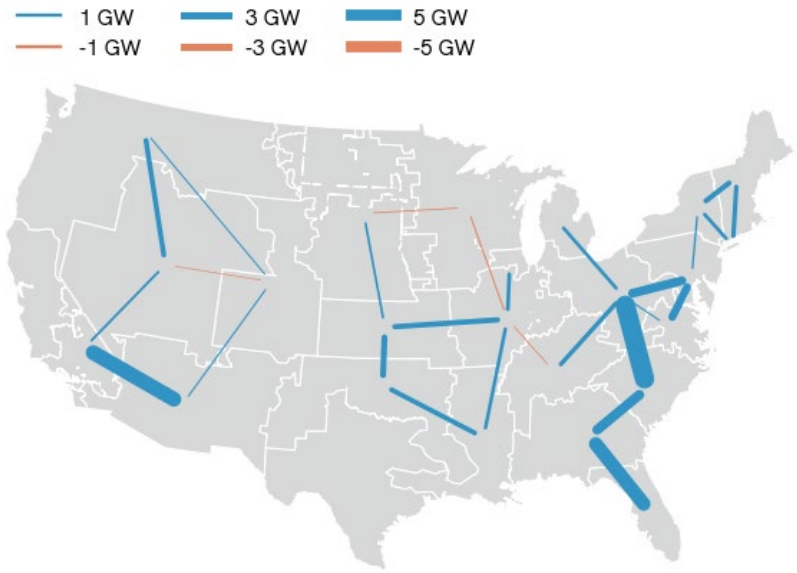
Source: Grid Strategies (historical data), Rhodium Group

Removing barriers to transmission development drives sustained interregional transmission build-out at an average annual pace exceeding rates seen since at least 2010 in all scenarios. Average annual interregional transmission builds through 2040 increase by 2.6-3.8 TW-mi or 131-193% compared to BAU. All told, interregional transmission capacity expands by 46-48% in 2040 compared to today under baseline data center demand, and by 76% under high data center demand.

Under BAU, each scenario builds out interregional transmission primarily in corridors with existing connections. In the central BAU scenario, which broadly represents the geographic patterns of transmission development across all BAU scenarios, new interregional transmission strengthens connections between regions with abundant renewable resources (e.g., the sunny Southwest and windy Midwest) to demand centers like high-population regions or regions with concentrated data center demand. In total, the interregional transmission network expands by 28 GW through 2040, a 21% increase compared to today's network. Maps detailing interregional transmission buildout in the BAU scenarios are included in the appendix.

With expanded transmission in the central scenario, we project 52 GW of *additional* interregional transmission build-out by 2040 relative to BAU—an expansion of 59% relative to today (Figure 10). Nationally, expanded high-voltage networks and greater capacity expansion shift regional trade dynamics compared to BAU, leading to stronger trade between most regions. A handful of regions see small decreases in interregional transmission connections compared to BAU as the system optimizes for lowest-cost generation.

FIGURE 10
Change in interregional transmission builds in the central scenario with expanded transmission compared to BAU (2040)
GW



Source: Rhodium Group
Note: Equivalent figures for the other expanded transmission scenarios are available in the appendix. Maps are illustrative of connections between regions and do not project actual transmission routing.

There are two major dynamics underpinning the additional build-out of high-voltage lines. First, new transmission corridors form between the PJM area down the east coast to Florida—portions of the country that see considerable load growth under both baseline and high data center expectations. This new capacity allows eastern regions to take better advantage of their available resources and reduce their reliance on more expensive or remote resources. For instance, PJM's relatively low delivered natural gas prices make it cheaper to build and operate gas power plants in that region, and PJM deploys more natural gas combined cycle units as a result. Expanded transmission means some of this electricity can flow to neighboring regions, meeting demand growth and supporting reliability. Building more natural gas pipelines between PJM and neighboring regions could also have a resource-sharing effect by lowering delivered natural gas prices and thus improving the economics of new natural gas plants outside of PJM. In this case, expanding natural gas pipeline infrastructure could mitigate the need for extensive transmission build-out between PJM and adjacent regions, though without some of the resilience benefits that accrue from sharing multiple types of generating capacity across wider regions in the face of events like extreme weather. Meanwhile, the sunniest Southeastern regions deploy more solar capacity and less natural gas-fired capacity with expanded transmission relative to BAU. Similar dynamics play out in the Southwest. For example, Southern California imports electricity from Arizona and New Mexico at nearly double BAU levels, distributing the benefits of those states' high-quality solar and geothermal resources more broadly. Connecting these various regions unlocks greater value from region-specific resources.

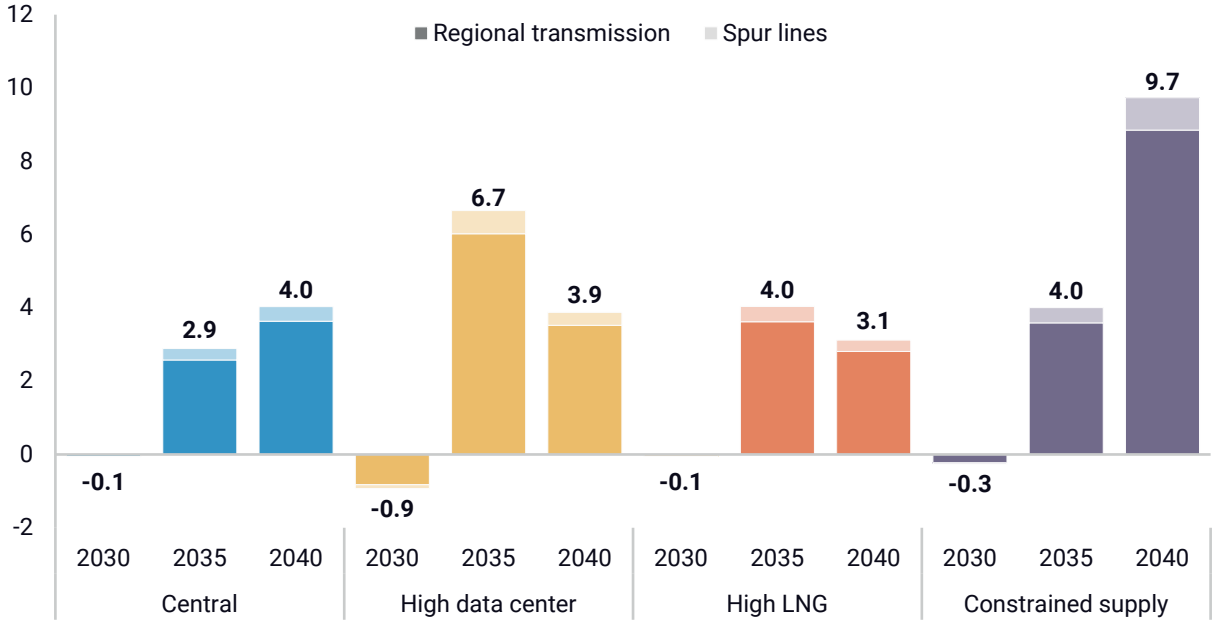
Second, easier transmission builds accentuate expansion patterns present under BAU, particularly in the resource-constrained Northeast as well as the sunny Southwest and windy Midwest.

REGIONAL TRANSMISSION AND SPUR LINE EXPANSION

In addition to expanding interregional transmission networks, easing barriers to building transmission drives more development of spur lines and within-region transmission networks. This type of transmission infrastructure is critical for connecting generators to the grid and reinforcing networks within individual grid regions. In our modeling, spur lines and regional transmission increase as more accessible transmission facilitates greater capacity expansion.

Transmission-enabled capacity expansion takes time to materialize in our modeling, and we see slightly less spur line and regional transmission development in 2030 with expanded transmission compared to BAU in most scenarios (Figure 11). In these cases, early increases in energy-dense interregional transmission build-out help distribute the flow of electricity across regions and modestly reduce the need for extra capacity and the lower-voltage lines connecting this capacity to the grid within a region.

FIGURE 11
Expansion of spur lines and regional transmission compared to BAU
TW-miles



Source: Rhodium Group

By 2035, regional transmission and spur lines together expand by 2.9-6.7 TW-mi (22-35%) relative to BAU scenarios. Like the interregional transmission results, the high data center scenario sees the greatest regional transmission and spur line impacts in 2035, as easier access to transmission allows grid capacity to expand and meet high electricity demand at lower cost. However, transmission impacts in this scenario fall after 2035 as the expanded grid becomes increasingly sufficient to accommodate load growth. By 2040, the constrained supply scenario experiences the greatest impacts to regional transmission

and spur line build-out, with lower voltage transmission expanding by 53% compared to BAU. In this scenario, impacts accumulate over time as capacity additions continue to diverge from the supply-limited BAU.

Conclusions

In this era of surging US electricity demand—coupled with increasing pressure on natural gas prices from expanding LNG exports, elevated costs from supply chain inflation, and non-cost barriers like lengthy interconnection queues—energy reliability and affordability have become critical concerns across the country. A robust transmission network is an essential tool for alleviating some of these cost and supply pressures, as well as accommodating rapid electricity demand growth.

Expanded transmission lowers electricity prices by 2-3% in 2040 compared to BAU, though some regions see larger price impacts. While our modeling doesn't capture local congestion, transmission expansion can also reduce price impacts from congestion, further reducing electricity prices beyond what we've modeled here. These price impacts result from changes in the grid mix and grid operations enabled by expanded transmission.

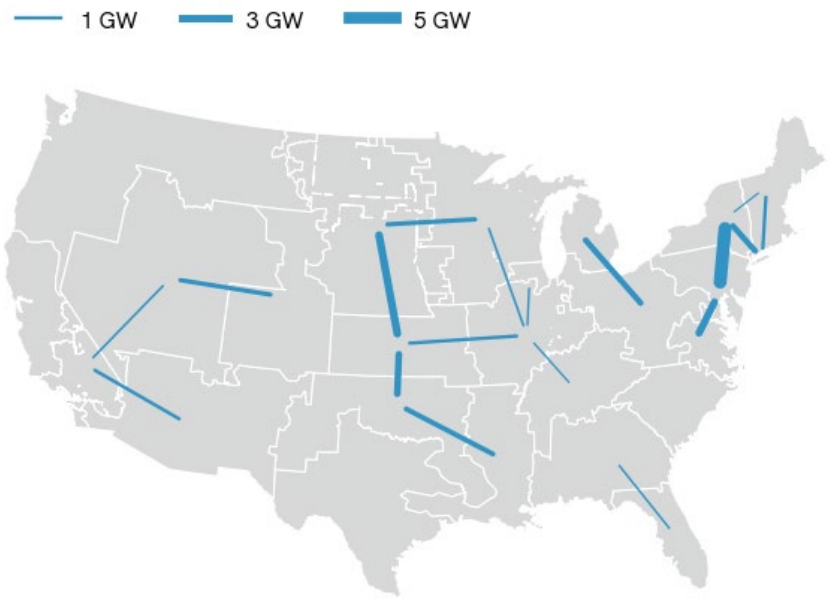
Strengthening and expanding transmission systems enables more capacity to connect to the grid—mostly solar and natural gas in our modeling. Enhancing interregional connections allows regions to share their generation more readily, improving the relative economics of certain types of power in areas with better-quality, cheaper resources than their neighbors.

The grid capacity build-out and changing electricity trade dynamics, driven by expanded transmission, improve electricity affordability. Expanded transmission enables more efficient natural gas plants and renewables to connect to the grid faster, allowing less-efficient, higher-cost resources to retire and reducing the total system costs required to meet growing demand. At the same time, greater trade between regions allows cheaper energy to be delivered to demand centers. Expanded interregional transmission also allows regions to share resources for reserve margins, reducing the costs required to meet reliability standards.

We find that transmission expansion offers the greatest benefits when the US energy system is stressed (e.g., by skyrocketing data center demand or constraints on supply of new capacity). As demand growth continues to accelerate, driven by AI proliferation, domestic manufacturing, and electrification, and global conflicts continue to strain supply chains, the risk of longer-term systemic stressors increases. Our expanded transmission scenarios envision a world in which it's easier and cheaper to build out transmission infrastructure, but this world is far from guaranteed. The path from our current environment to this imagined world requires focused resources and policy development at the federal, state, and local levels.

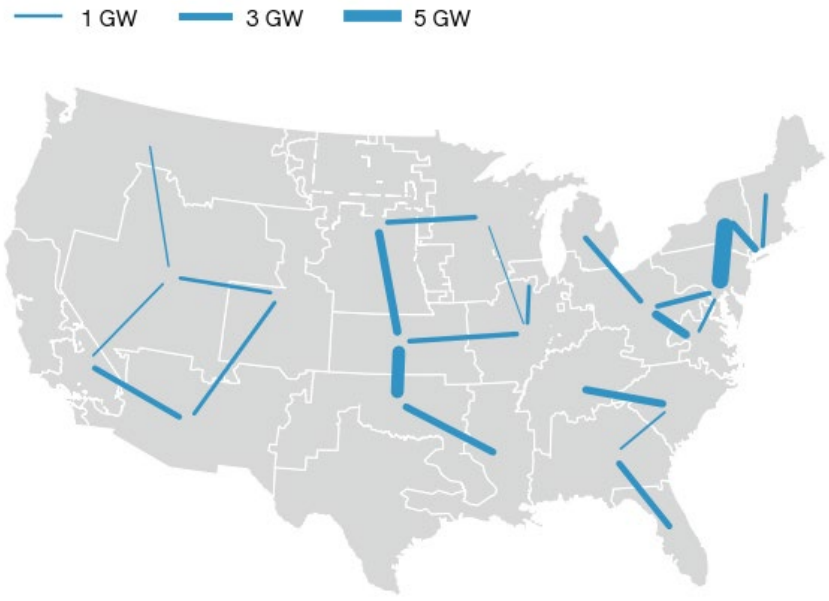
Appendix

FIGURE A1
Interregional transmission builds in central BAU scenario (2025-2040)
GW



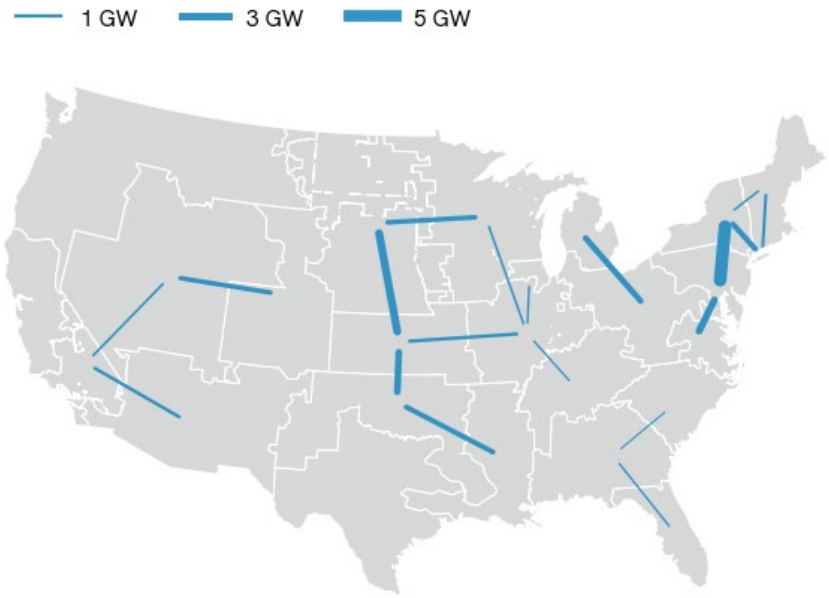
Source: Rhodium Group
Note: Maps are illustrative of connections between regions and do not project actual transmission routing.

FIGURE A2
Interregional transmission builds in high data center BAU scenario (2025-2040)
GW



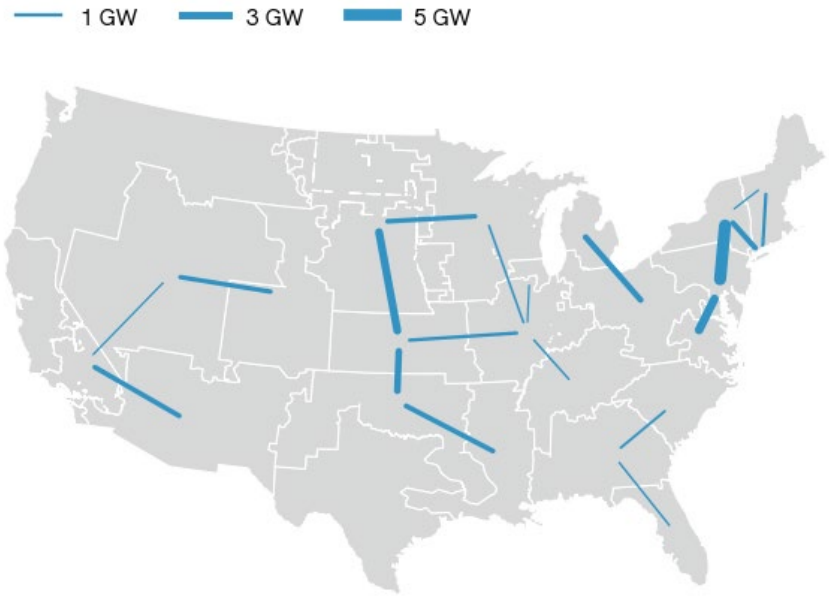
Source: Rhodium Group
Note: Maps are illustrative of connections between regions and do not project actual transmission routing.

FIGURE A3
Interregional transmission builds in high LNG BAU scenario (2025-2040)
GW



Source: Rhodium Group
Note: Maps are illustrative of connections between regions and do not project actual transmission routing.

FIGURE A4
Interregional transmission builds in constrained supply BAU scenario (2025-2040)
GW

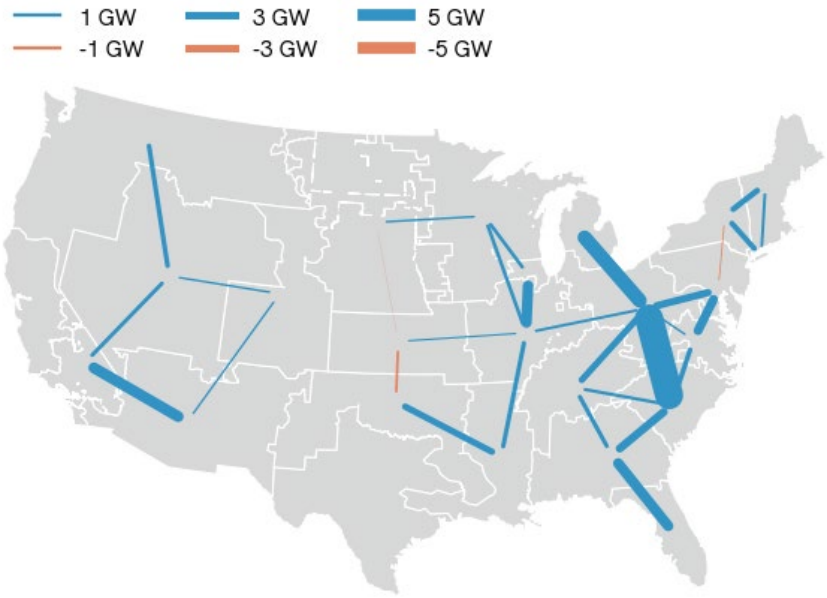


Source: Rhodium Group
Note: Maps are illustrative of connections between regions and do not project actual transmission routing.

FIGURE A4

Change in interregional transmission builds in high data center scenario with expanded transmission compared to BAU (2040)

GW

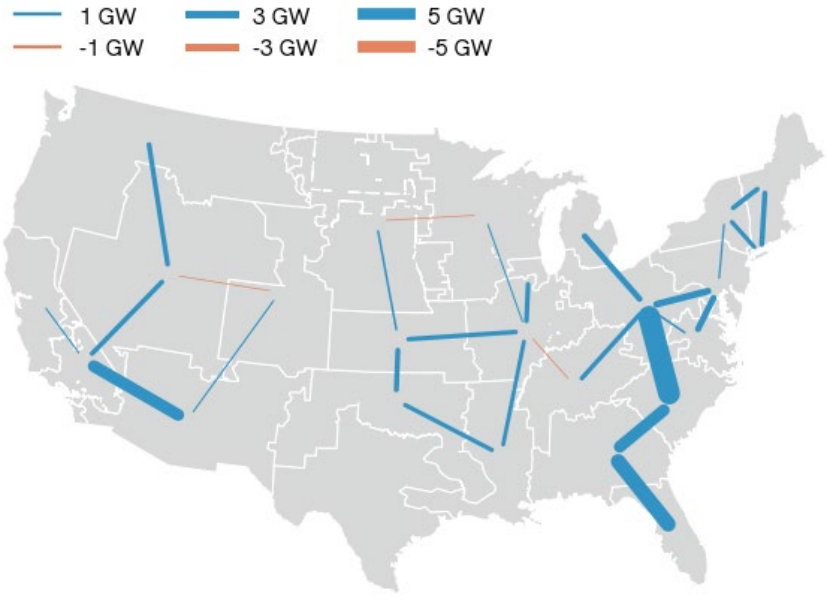


Source: Rhodium Group
Note: Maps are illustrative of connections between regions and do not project actual transmission routing.

FIGURE A5

Change in interregional transmission builds in high LNG scenario with expanded transmission compared to BAU (2040)

GW

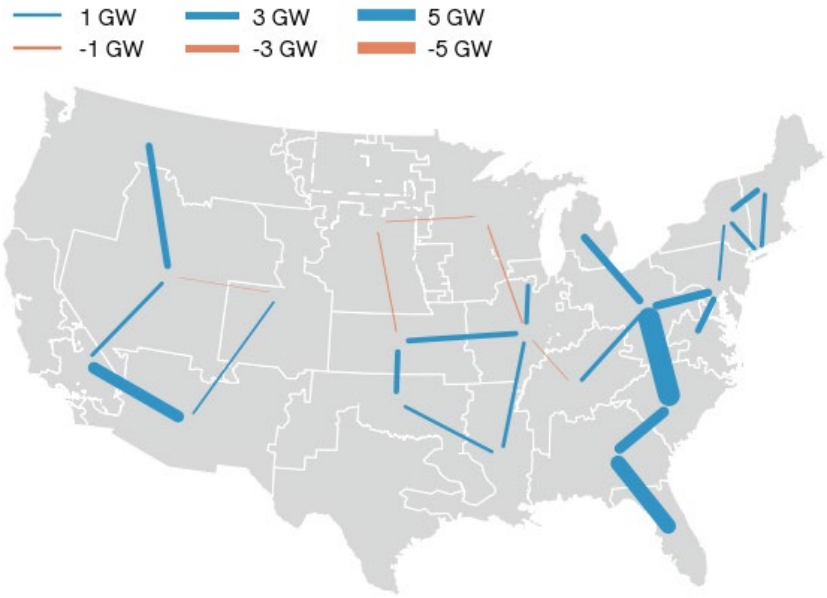


Source: Rhodium Group
Note: Maps are illustrative of connections between regions and do not project actual transmission routing.

FIGURE A6

Change in interregional transmission builds in constrained supply scenario with expanded transmission compared to BAU (2040)

GW



Source: Rhodium Group
Note: Maps are illustrative of connections between regions and do not project actual transmission routing.

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