REPORT

Rising current: America's growing electricity demand

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Executive summary

Americans have been demanding more electricity recently, a sudden shift from nearly two decades of low U.S. load growth. What's more, the growth trend is rapidly accelerating, potentially leading to the greatest era of load growth since post-World War II nationwide electrification.

Artificial intelligence (AI), cloud-based services, and cryptocurrencies are driving demand for new data centers and computing power as quickly as they are driving new business opportunities. A wave of new technology manufacturing and oil and gas production is revitalizing the country's industrial base—and industrial electricity demand with it. Homes and businesses are increasingly choosing electric vehicles, heat pumps, and other electricity-hungry products.

This report discusses how demand for electricity will grow over the next 25 years, where it will grow, and the potential impacts on the reliability and affordability of electricity in the United States.

Our analysis shows that U.S. electricity demand is now expected to grow 25% by 2030 and 78% by 2050 from 2023 levels. Similarly, U.S. peak electricity demand is now expected to grow 14% by 2030 and 54% through 2050. This is a dramatic increase, not just from historical growth over the past two decades, but also from the future growth projections made as recently as last year.

Rising electricity demand is expected to lead to higher electricity bills for Americans. The extent of the increase is expected to vary from utility to utility based on underlying market dynamics. Looking at residential retail rates for a sample of utilities, ICF's modeling forecasts an increase between 15% and 40% by 2030 compared to 2025, depending on the market. By 2050, electricity rates could double for some of these utilities.

To offset cost pressures, electric system stakeholders are looking to leverage demand-side management programs that promote demand response, energy efficiency, and behind-the-meter capacity such as rooftop solar and battery storage. Broad promotion of these programs could help meet 10% or more of electricity demand by 2030 compared to 8% in 2025.

In addition to demand-side management programs, new generation capacity additions will need to rise to about 80 GW per year from 2025-2045, up from about 40 GW per year installed over the past five years.

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Residential retail rates could increase between **15%** and **40%** by 2030, depending on the market.

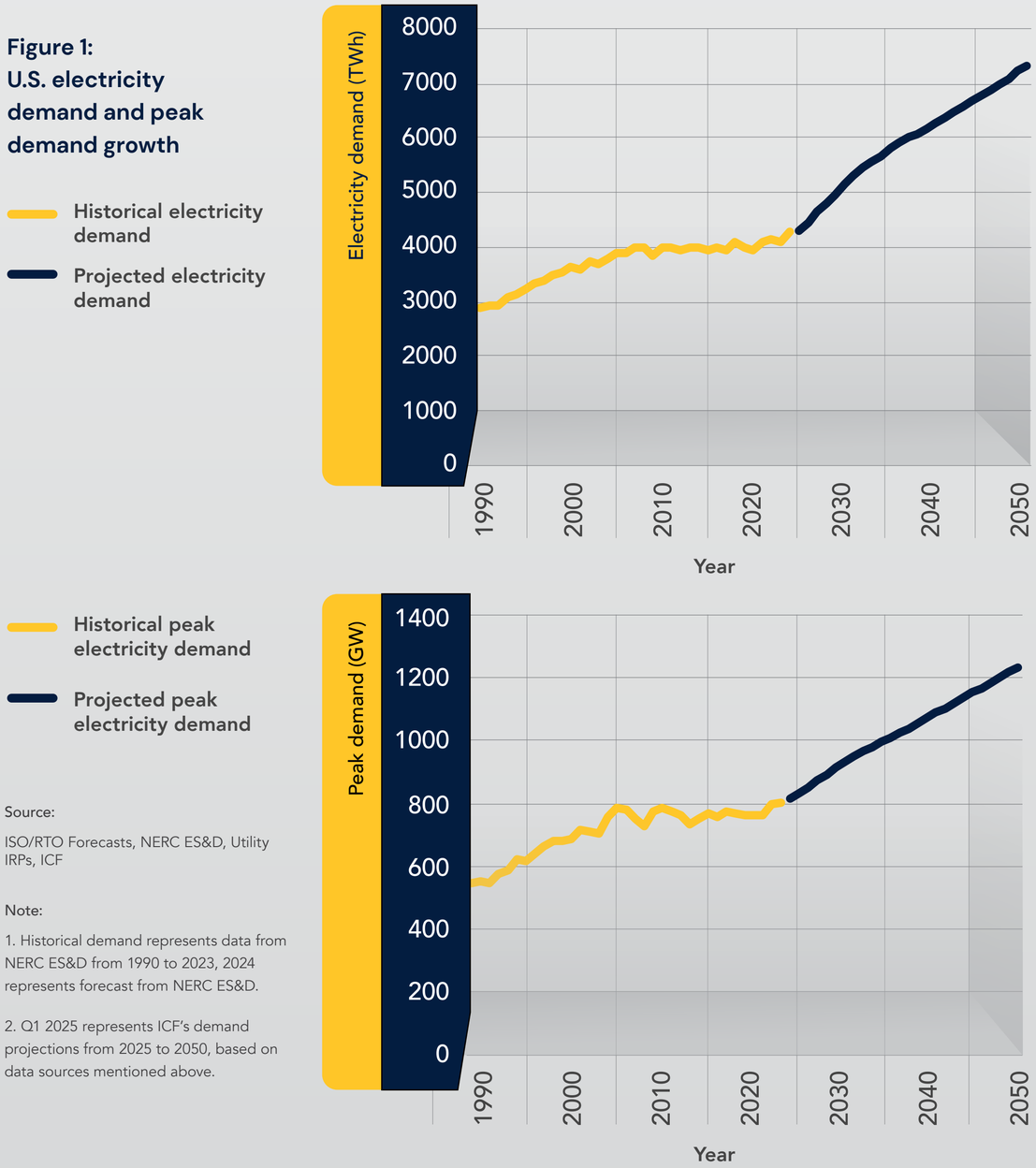
Electricity demand forecasts on the rise

Energy experts did expect electricity demand to rise, given the drivers of U.S. economic growth. However, the rapid spikes due to data center use and industrial demand were not predicted to occur as quickly as they have. As such, forecasters have engaged in a continuous cycle of raising demand growth projections over the past two years to match the reality of accelerating electricity demand growth.

Electricity demand is now expected to grow 25% by 2030 and 78% by 2050, compared to 2023 levels, as shown in Figure 1. That's an annual growth rate of 3.2% through 2030 and 2.2% through 2050 and contrasts with the previous two decades when U.S. electricity demand was essentially flat.

In addition to rising overall electricity demand projections, peak demand is increasing. Compared to 2023, U.S. peak electricity demand is now expected to grow 14% by 2030 and 54% through 2050. Peak demand is crucial because utilities must ensure they have the infrastructure to deliver enough electricity at times when it is needed most, even if that level of electricity is only needed for a few hours on a few days per year. Although peak demand traditionally occurs in the evening and often in the summer, electrification taking place across the country may shift these peaks, making it essential for utilities and other grid stakeholders to adapt to new patterns of electricity usage.

Figure 1:
U.S. electricity demand and peak demand growth



Source:

ISO/RTO Forecasts, NERC ES&D, Utility IRPs, ICF

Note:

1. Historical demand represents data from NERC ES&D from 1990 to 2023, 2024 represents forecast from NERC ES&D.

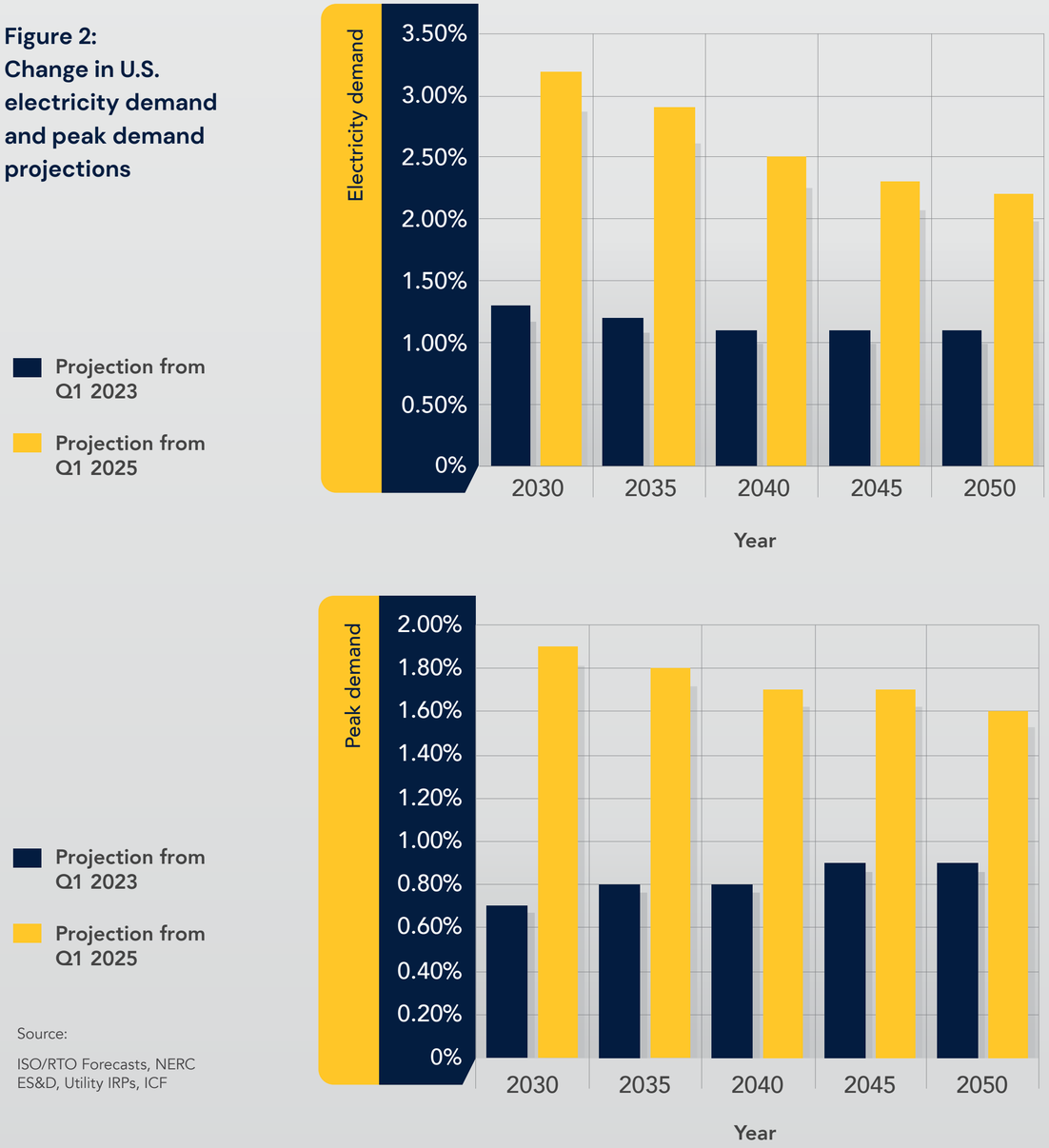
2. Q1 2025 represents ICF's demand projections from 2025 to 2050, based on data sources mentioned above.

It's important to note that overall demand is growing at a faster rate than peak demand. That's because the lion's share of new demand sources are data centers and industrial sites, which have an "always-on" load profile. The industrialized demand will require increased baseload generating capacity and demand-side management—issues this report will explore in the section on generation mix forecasts.

Complicating electricity demand growth, the forecast for demand growth is rapidly increasing. Just two years ago in the first quarter of 2023, national forecasts predicted 1.3% annual electricity demand growth through 2030. The forecast from the first quarter of 2025 in this report predicts 3.2% growth for the same time period. Figure 2 shows just how much electricity demand and peak demand projections have changed in recent years.

Moreover, the demand growth projections compiled in this report are higher than many other industry forecasts, because this report includes the most recent projections. For example, the Energy Information Agency 2025 Annual Energy Outlook report projected 12% demand growth by 2030 and 60% demand growth by 2050, compared to 2023, under their high economic growth scenario. But the EIA forecast does not include the latest demand forecasts from PJM, ERCOT, MISO, and SERC-Southeast that are included in this report. The difference between the Energy Information Agency forecast and the forecast in this report further illustrates just how quickly demand growth forecasts are changing.

Figure 2: Change in U.S. electricity demand and peak demand projections



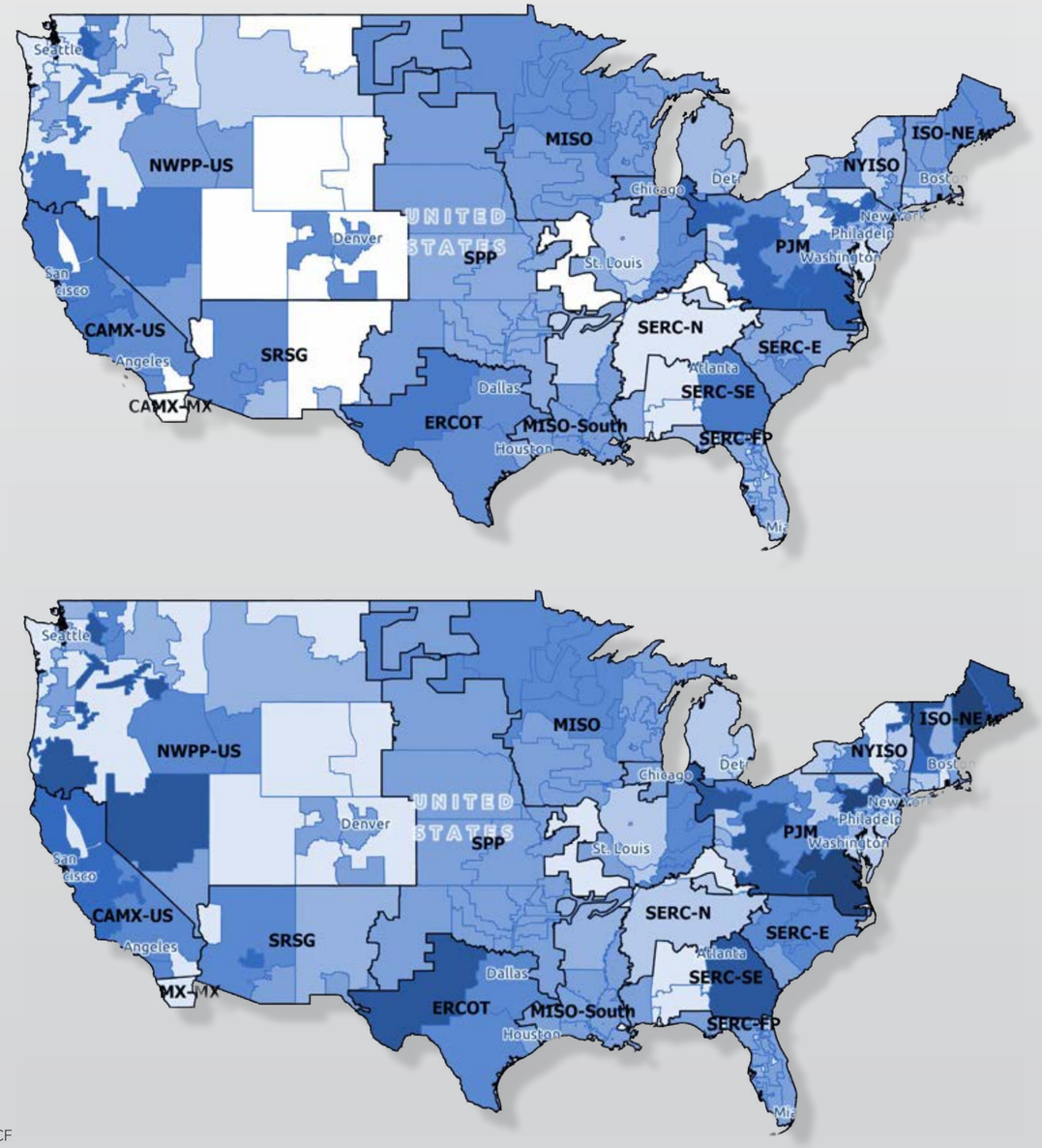
Source:

ISO/RTO Forecasts, NERC ES&D, Utility IRPs, ICF

What's causing demand growth—and where?

Increasing electricity demand will not be felt equally across the country. The Dominion service territory within PJM, Southern Company service territory within SERC, and ERCOT West zone in West Texas are among the areas expected to have the highest growth. Those service territories are forecast to see total electricity demand growth exceeding 7.1% and peak demand growth exceeding 5.6% through 2035 compared to 2025 levels, as shown in Figure 3.

Figure 3:
U.S. regional electricity demand growth and peak demand growth (2025–2035)



Source: ISO/RTO Forecasts, NERC ES&D, Utility IRPs, ICF

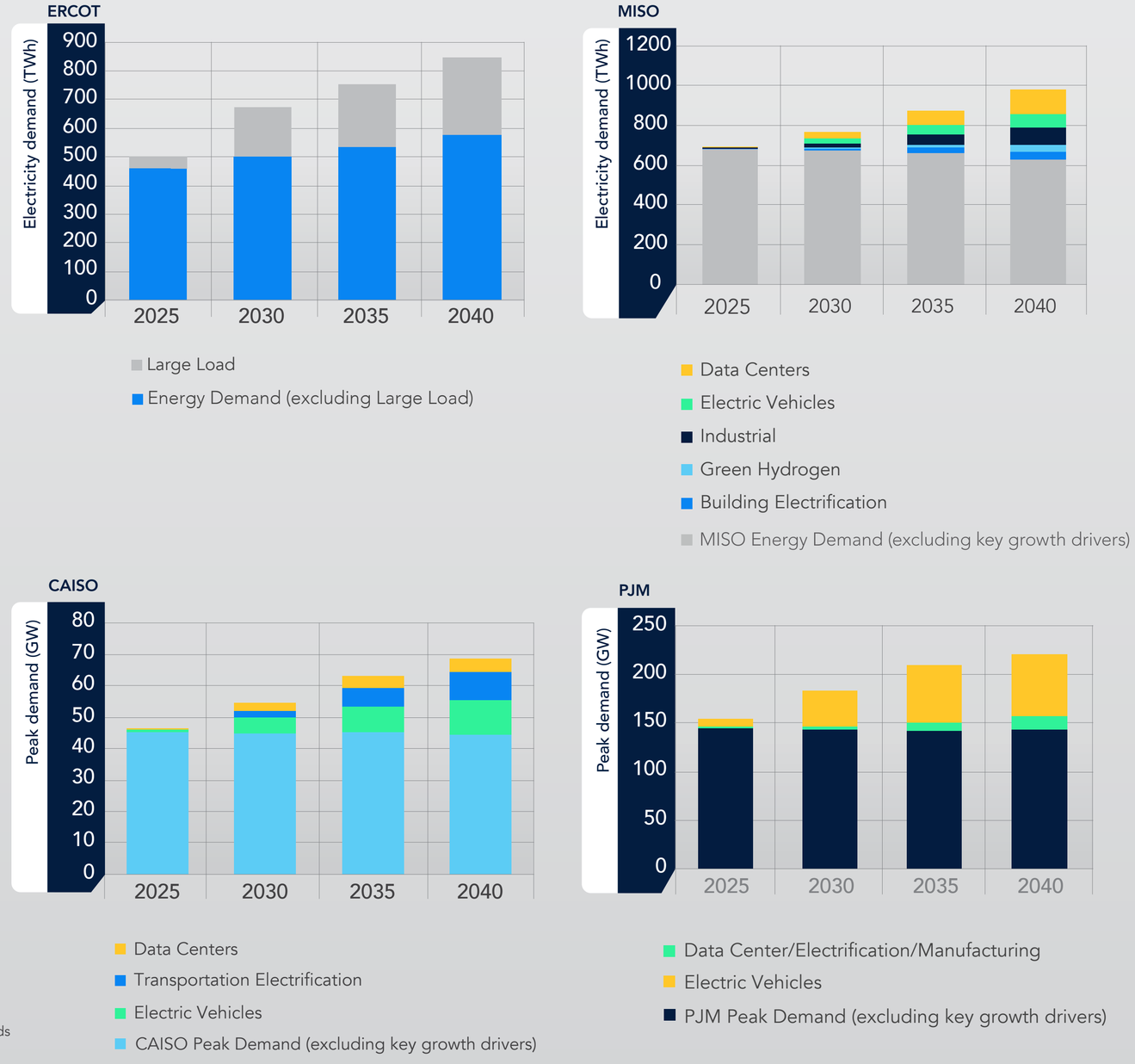
Demand growth is driven by different factors in different regions as shown in Figure 4.

In California's CAISO territory, 35% of electricity demand forecast by 2040 is attributable to new data centers, electric vehicles, and building electrification.

In ERCOT, which covers most of Texas, nearly one-third of load is attributable to large load sources, such as cryptocurrency mining operations. In PJM, with territory spanning 13 mid-Atlantic and Midwest states as well as Washington, D.C., all three drivers are significantly present. Data centers, building electrification, and semiconductor manufacturing along with electric vehicles account for 35% of projected load through 2040.

As America's economic transformation takes shape, many additional areas of the country could be pulled into dramatic demand growth paradigms.

Figure 4: Regional electricity demand key growth drivers



Source:
ISO/RTO Forecasts, ICF

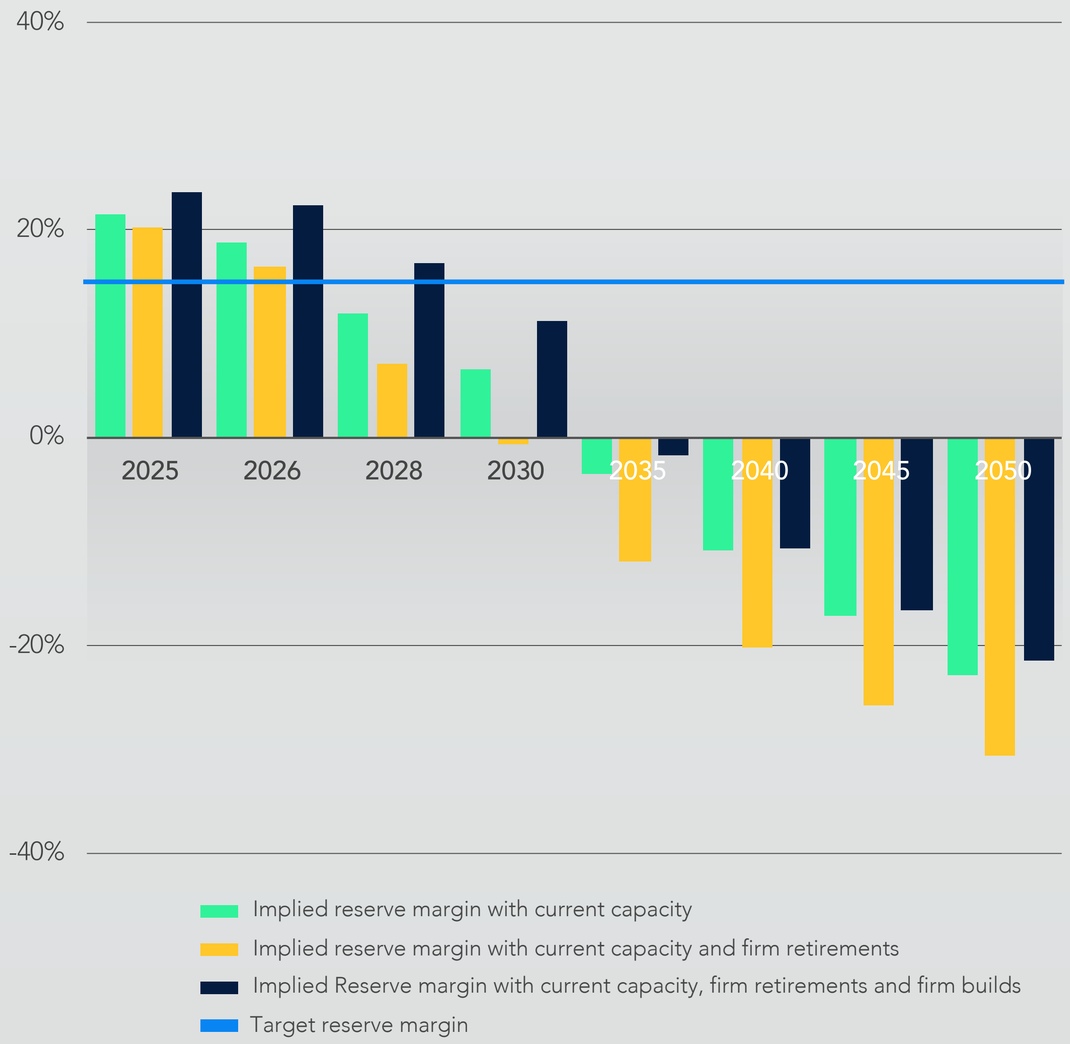
Note:
ERCOT Large Load includes Data Center, Crypto load, Industrial loads and Hydrogen production.

Implications for reliability

All of this demand growth has significant implications for the reliability of electricity. Utilities, grid operators, and regulators use reserve margins—the difference between the available generation capacity and the expected peak demand—as a key tool to predict the electric grid's reliability. A reserve margin of 15% of generation capacity over forecast peak demand is generally considered healthy. Fortunately, today, reserve margins are relatively strong. As shown in Figure 5, the implied reserve margin with current capacity, firm builds and firm retirements across the U.S. is around 24% in 2025.

However, mapping demand growth estimates against generating capacity online today, including the impact of firm builds and retirements, shows that much of the U.S. will experience below target reserve margins as soon as 2030. This situation could be exacerbated by supply chain hurdles. In a hypothetical scenario in which no generation is added to the mix and current peak demand growth forecasts hold, capacity would not be able to meet peak demand in the U.S. by 2028, as shown in Figure 5.

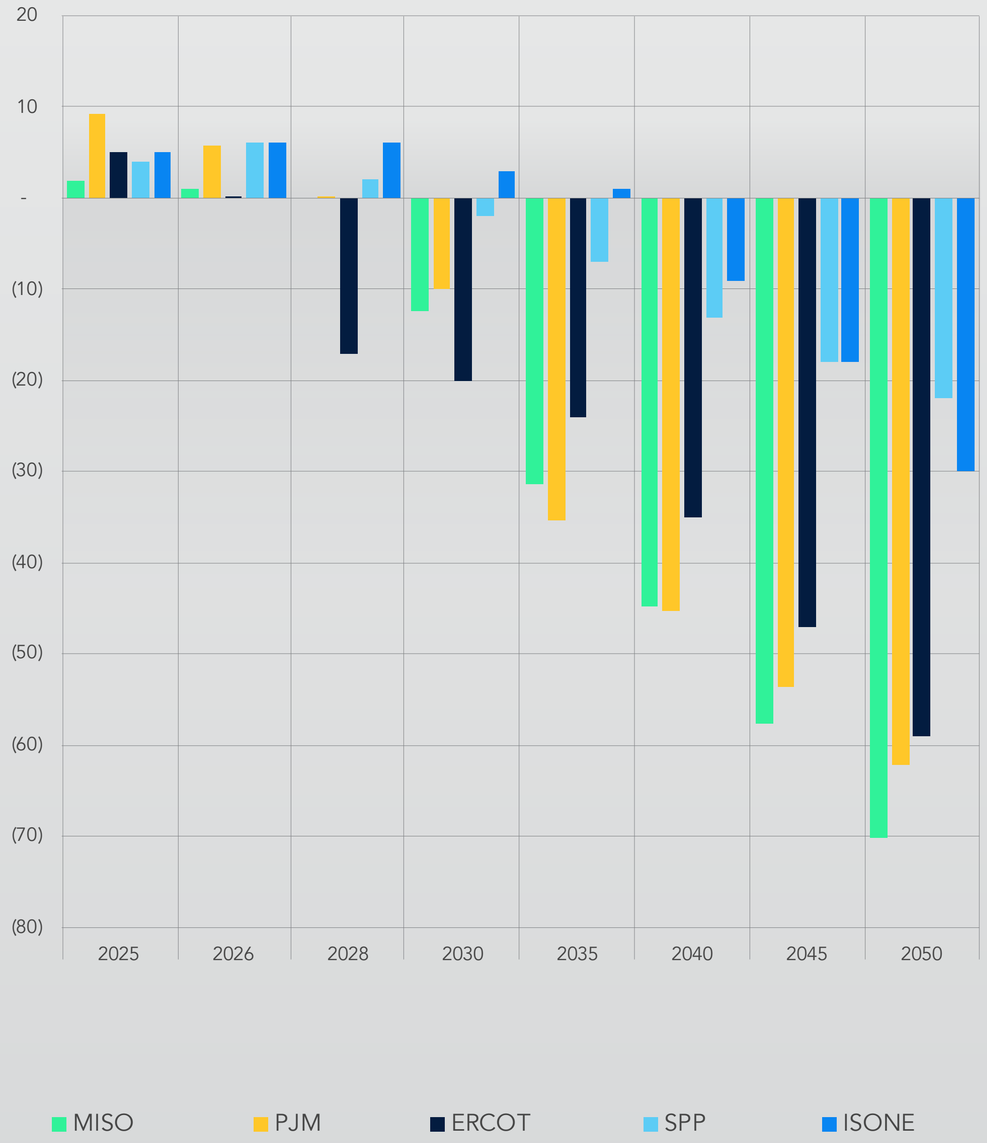
Figure 5: Illustrative U.S. reserve margins based on current capacity, firm retirements, and firm builds



Source:
ICF, U.S. Energy Information Administration (Form EIA-860M)

Notes:
Existing Capacity reflects effective load carrying capacity (ELCC) available as of 1/1/2025 from the ISOs; capacity over time reflects ICF's views of ELCC evolution. Firm Retirements include plants that have filed deactivation requests or have announced their retirement plans. Firm Builds reflect projects that have executed Interconnection Agreements, are under construction, have cleared in a capacity auction, or meets two of the following three criteria: (i) fully permitted; (ii) fully financed; (iii) has a PPA for at least 50% of the output.

Figure 6: Illustrative capacity surplus/deficit with firm builds and retirements (GW)



Source:
ICF, U.S. Energy Information Administration (Form EIA-860M)

Notes:
Existing Capacity reflects effective load carrying capacity (ELCC) available as of 1/1/2025 from the ISOs; capacity over time reflects ICF's views of ELCC evolution. Firm Retirements include plants that have filed deactivation requests or have announced their retirement plans. Firm Builds reflect projects that have executed Interconnection Agreements, are under construction, have cleared in a capacity auction, or meets two of the following three criteria: (i) fully permitted; (ii) fully financed; (iii) has a PPA for at least 50% of the output. Illustrative capacity surplus/deficit shown above to not consider the potential for economic builds and retirements.

To be clear, the U.S. is unlikely to run out of electricity. New generation capacity will be built in the coming years, with ISOs like PJM and MISO already working to fast track new resources that make reliability contributions. Ultimately, if grid stakeholders can't ensure enough new capacity is coming online, interconnection requests from new load sources could be denied to reduce the risk of reliability issues.

Another hypothetical scenario of capacity reserves, this time assuming some planned capacity entry and exits in the near term, highlights the challenge: A lot of new capacity needs to be built fast in an environment where it can take years for projects to navigate the interconnection process. Transmission and distribution systems need to be ready to accept this new generation and discharge it in new locations to maintain the reliability of the U.S. power system. The next several years of demand growth could be especially challenging, since the sudden surge in new demand is happening at a relatively fast pace compared to the time it takes to build new generation, transmission, and distribution.

Using the hypothetical capacity reserves estimate, ERCOT would be the first region to face tighter system conditions in 2026 as shown in Figure 6. Even in MISO, the capacity surplus remains very thin in 2026 along with ERCOT. By 2028, MISO and PJM would also join ERCOT in facing tighter capacity reserves. By 2040, the ISO markets including PJM, ERCOT, MISO, SPP, and ISONE regions on a combined basis would face a total shortfall of more than 150 GW capacity available today to meet projected reserve requirement.

Maintaining strong reserves will require reviewing new generation projects in the queue, increasing output of existing generation, and extending the life of existing power generation.

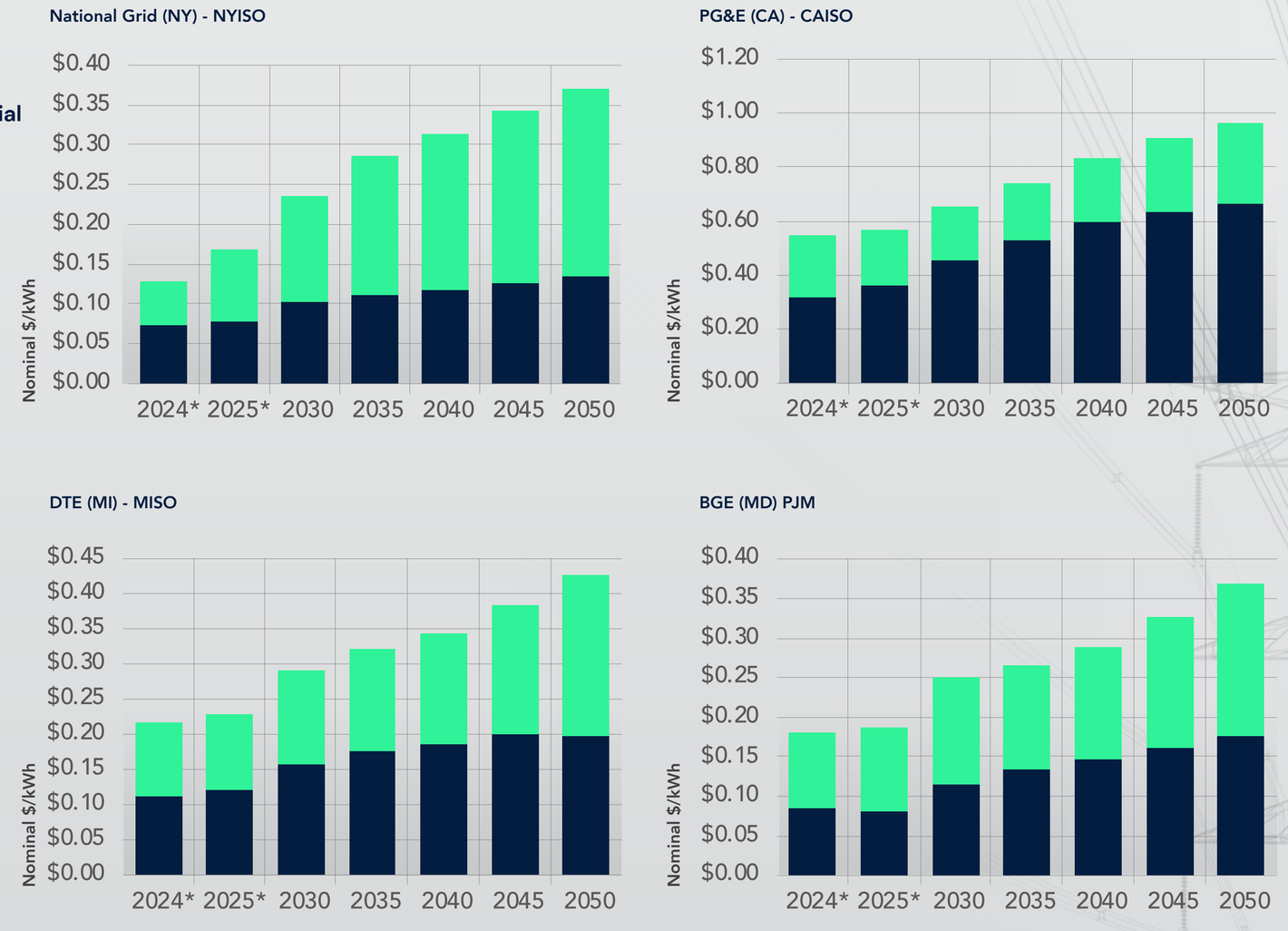
Implications for affordability

Along with reliability, affordability is a foundational priority for utilities and other grid stakeholders.

Rising electricity demand is expected to drive up wholesale electricity prices, the amount paid by electricity distributors—such as utilities—to power generators. Demand growth will also increase capacity prices. Some ISOs and RTOs allow electricity generators to collect fees in exchange for ensuring capacity is available in future years, even if it's not regularly generating electricity. Wholesale electricity prices and capacity prices are, inevitably, passed along to customers. As shown in Figure 7, residential retail electricity rate, the price customers pay for electricity, is forecast to increase in regions across the U.S.

Across a sample of four utility service territories, residential retail rates are projected to increase 15% to 40% by 2030 from 2025 levels. By 2050, retail rates could double.

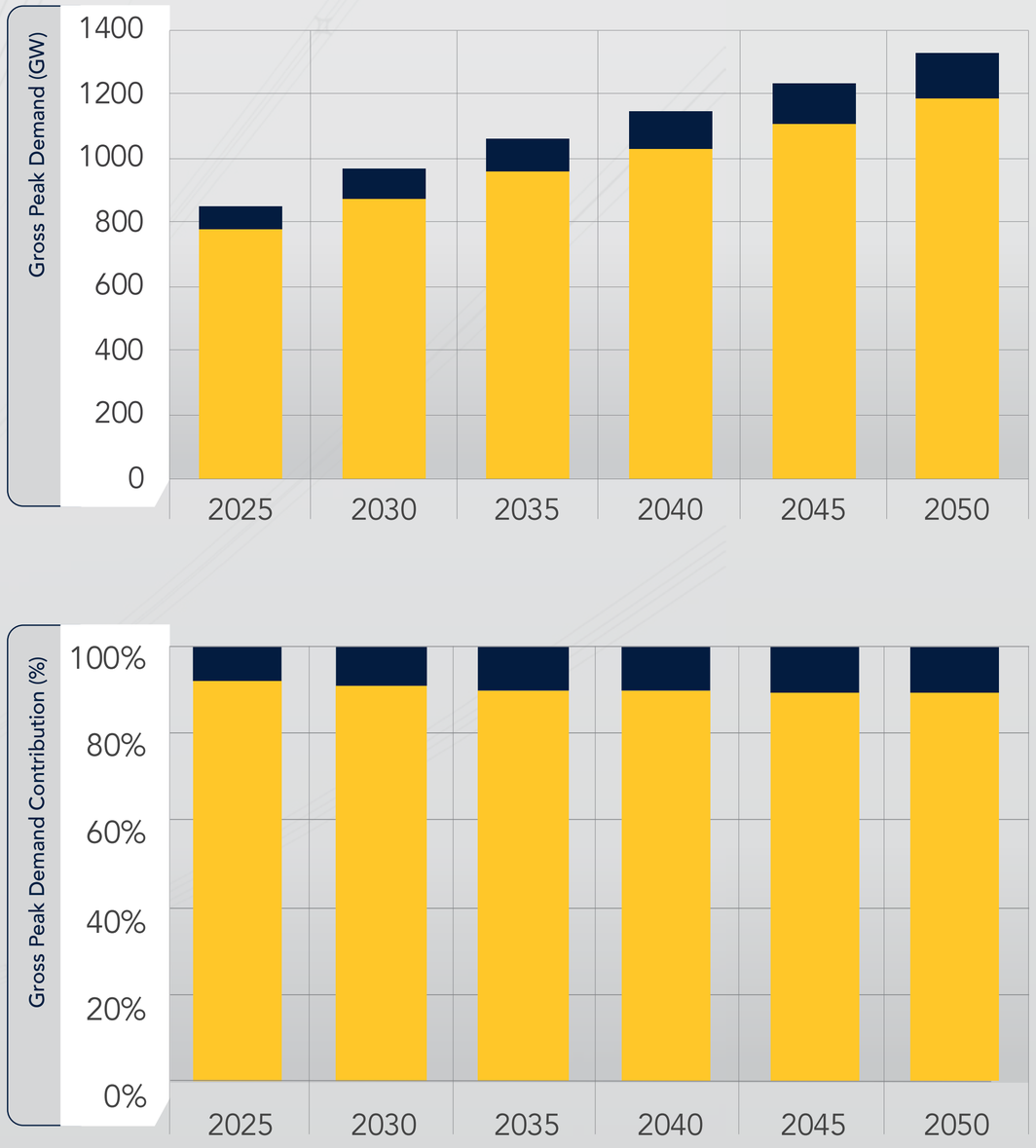
Figure 7: U.S. retail electricity rates paid by residential customers



Source:
ICF

*2024 and 2025 values reflect published rates from utility tariffs. It is based on following utility residential rate schedules in the utilities NY National Grid's SC 1, MI DTE's D1.11 Standard TOU, CA PGE's E-TOU-D, and MD BGE's Schedule R.

Figure 8:
U.S. demand-side management and behind-the-meter resource peak demand offset potential



Source:
ISO/RTO Forecasts, NERC ES&D, Utility IRPs, ICF

All of the above: Outlook for power generation and demand-side resources

Electricity system stakeholders have many tools in their toolbelt to meet rising electricity demand, but some are more desirable than others.

Demand-side management programs—such as programs that promote energy-efficient appliances and rooftop solar, as well as other load management strategies like virtual power plants—are attractive because they offset the need for spending on new generation, transmission, and distribution infrastructure at a much lower cost.[2] They are also much quicker to deploy than new utility-scale generation and, therefore, could help manage early demand growth challenges while there is still a high level of uncertainty in shifting demand projections.

As shown in Figure 8, well-designed customer programs and other load management resources could bring down nationwide peak electricity demand by 10% by 2030 compared to 8% in 2025. In relative terms, customer programs are forecast to outpace new utility-scale generation.

During periods of peak demand, a swing from 8% to 10% is often a difference-maker when it comes to reliable power. Moreover, the last few percentages of peak demand are the most expensive to meet, so shaving that peak by even a few points is very valuable. Additional investment can help ensure customer programs continue to play that critical reliability role in the coming decades.

[2]Energy Efficiency as a Resource, American Council for an Energy-Efficient Economy

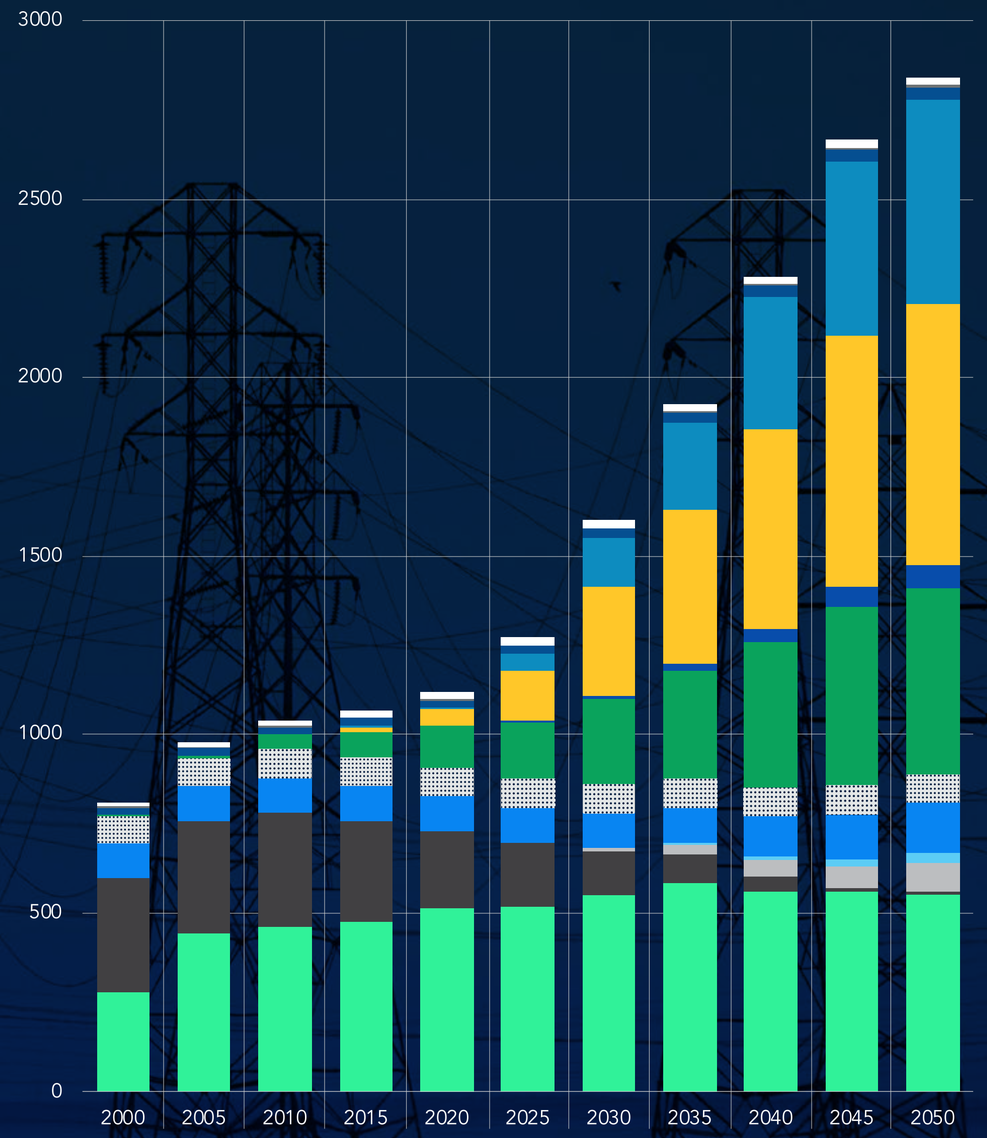
But given the expected scale of demand growth, there's an unavoidable truth: New utility-scale generation capacity is also needed.

And not just generation from one or two types of resources. ICF models indicate that an all-of-the-above generation mix across technologies and fuel types will be required to meet rising demand based on a cost-optimal approach that delivers reliability.

While U.S. installed generation capacity grew at an average of 1.8% per year between 2000 and 2025, it will need to grow at 3.3% per year between 2025 and 2050 to adequately meet demand, as shown in Figure 9. Natural gas, onshore wind, solar, and energy storage are expected to account for most of the installed capacity by 2050, while new nuclear and fossil fuel generation with carbon capture and sequestration emerge as important contributors. After decades of decline, there's renewed excitement for nuclear as some plants return from retirement and advances are made in small modular reactor designs. But a nuclear renaissance also faces significant challenges and limitations that will need to be overcome to determine whether it will expand its role in the energy mix.

Of note, new natural gas plants were an insignificant part of the new generation forecast as recently as a few years ago. However, as a dispatchable power source, new gas has surged back into the forecast due in large part to its ability to serve the around-the-clock power needs of data centers and new manufacturing load connecting to the grid in the next five years.

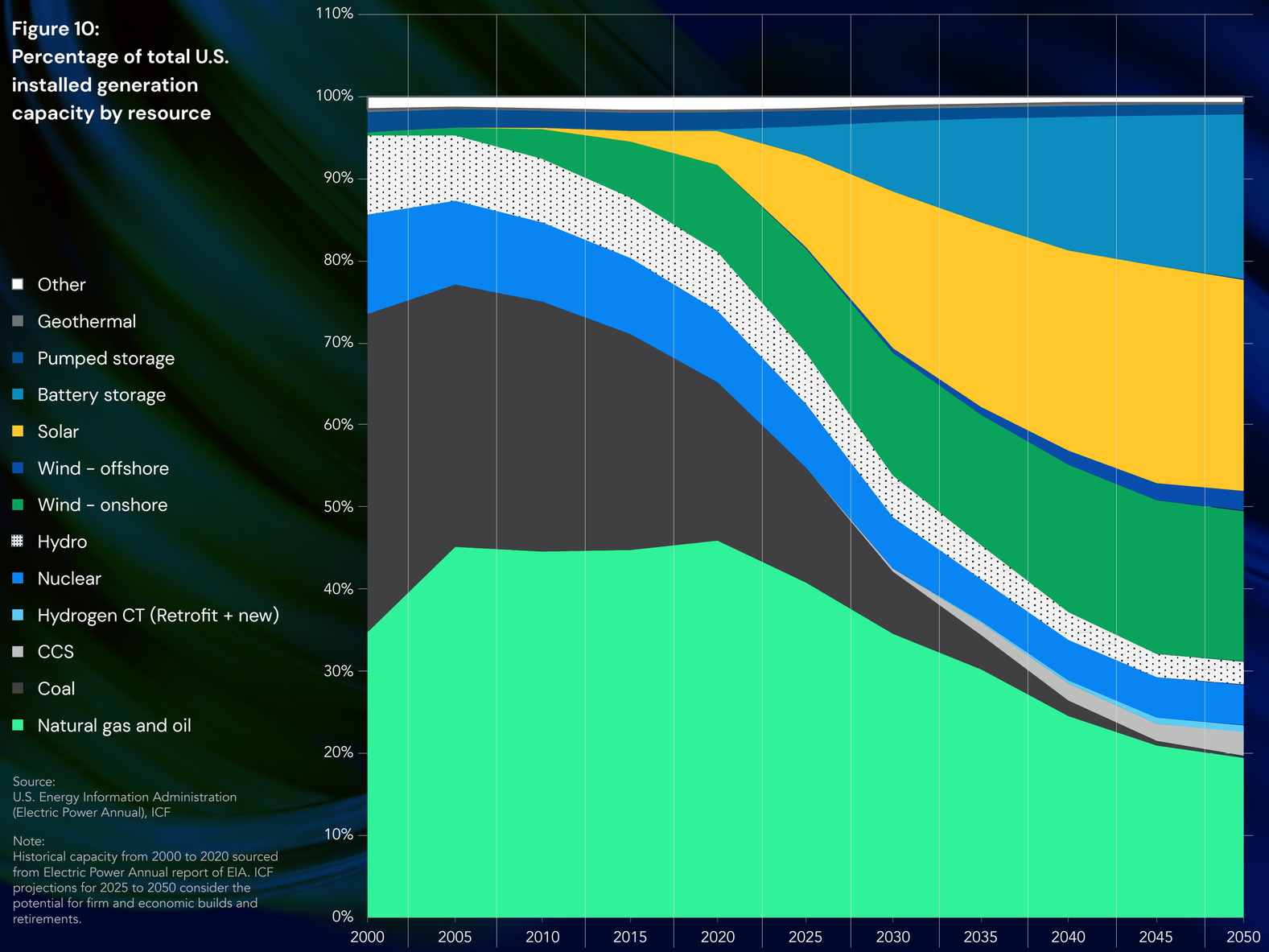
Figure 9: Installed generation capacity in the U.S.: Historical and projected (GW)



Source:
U.S. Energy Information Administration (Electric Power Annual), ICF

Note:
Historical capacity from 2000 to 2020 sourced from Electric Power Annual report of EIA. ICF projections for 2025 to 2050 consider the potential for firm and economic builds and retirements.

Figure 10:
Percentage of total U.S. installed generation capacity by resource



Source:
U.S. Energy Information Administration (Electric Power Annual), ICF

Note:
Historical capacity from 2000 to 2020 sourced from Electric Power Annual report of EIA. ICF projections for 2025 to 2050 consider the potential for firm and economic builds and retirements.

While the installed capacity of many generation resources will grow, Figure 10 shows the overall share of the capacity mix for each technology through 2050. New solar, wind, and energy storage capacity is forecast to be installed more than other generation sources—showcasing the important role of these energy resources in meeting future electricity demand.

Fossil fuel-based generation will also remain an important part of the capacity needed to meet rising electricity demand through 2050, with natural gas expected to account for 19% of installed capacity.

Transmission and distribution constraints

Forecasts of rising electricity demand and the generation capacity needed to meet demand are important, but they miss one important piece of the puzzle: the role of transmission and distribution systems.

Most regional electric grids aren't built to meet a surge in demand. Regardless of how many new power plants are built, the electricity won't get very far if grid infrastructure isn't improved to accept an injection of more electricity. Even if the transmission grid can accommodate an injection of electricity from new power plants, there must also be adequate infrastructure to deliver that electricity to customers through the distribution grid. In addition, as retail electricity prices rise, more homes and businesses are expected to consider behind-the-meter resources like rooftop solar and battery storage, which further complicates distribution grid investment decisions.

Solving the transmission and distribution challenge will require building new infrastructure, but utilities will also need to squeeze every last amp out of their existing infrastructure. One approach is through dynamic line rating. By attaching dynamic line rating sensors to transmission lines, utilities can adjust the amount of electricity that can safely flow through power lines based on real-time weather conditions. Dynamic line rating is far less expensive than building new infrastructure.

While some regions will see more severe grid constraints than others, it is a challenge virtually every region will need to make significant investments to address.

Uncertainty abounds

No one knows exactly how much demand will rise. The projections in this report account for many factors, but significant uncertainty remains.

- Will more efficient AI models reduce energy needs or lead to a boom in AI use?
- Will new federal lands be opened to fossil fuel production, leading to a surge in more economic fossil fuel generation?
- Will new tariffs on foreign countries limit domestic economic growth and complicate supply chains? Or will it kickstart a renaissance in U.S. manufacturing that further drives electricity demand?
- How substantially will behind-the-meter resources grow as a solution for the electricity needs of large loads like data centers and manufacturing sites?
- Will tax incentives for new sources of power generation and energy efficiency continue?

Time will tell, but energy stakeholders can't wait. In the near term, they need to plan for the most likely demand growth scenario. They'll also need to understand the demand growth uncertainties, keep abreast of them, and account for them in planning so that they don't overbuild infrastructure and end up with costly stranded assets.

Recommendations to manage demand growth

Energy developers and investors, utilities, state governments, and federal agencies can take significant steps to help the electricity system meet rising demand in the years ahead. This set of recommendations for each stakeholder group is intended to help accelerate the process right away.

Energy developers and investors

For generation developers and investors, the message is simple: The signals to invest in energy infrastructure are flashing green. Now is the time to deploy funds and aggressively develop projects. The tightening supply-demand balance across the country will support the economics of new generation through higher wholesale and capacity prices. Many federal and state incentive programs remain intact to further support project economics.

That said, while the economic case for developing projects is obvious, the project development process is anything but. Developers must carefully choose the best sites, which are determined by a complex matrix of factors—forecast wholesale and capacity prices, available grid capacity, pipeline capacity for gas generation projects, sun and wind resource levels for solar and wind generation, permitting and land use issues, and many more.

Developers and investors can get a leg up on the competition by tapping the power of platforms that can map all those critical variables to unearth the hard-to-find sweet spots for specific project types.

Utilities

Utility leaders need sophisticated integrated system planning and scenario-based risk evaluation to understand the entire utility system, including the impacts of rising demand, resource options to meet demand, and other goals.

Utilities just getting started with this level of integrated planning can begin with an initial screening scenario. Leaders can tap data-backed analytics and insights platforms to both visualize the impacts of rising demand and model solutions optimized for their unique strategic priorities and operating contexts. With those insights, utility leaders can develop strategies specifically designed to address those differing concerns.

Utilities have also traditionally helped manage electricity demand through demand-side management programs that reduce customer consumption or curtail energy use during peak demand periods. As discussed earlier in this report, these programs are a particularly fast and affordable way to help manage demand growth. By enhancing tried and true program implementation tactics with advanced planning and engagement analytics, utilities can get even more out of these programs than they have historically.

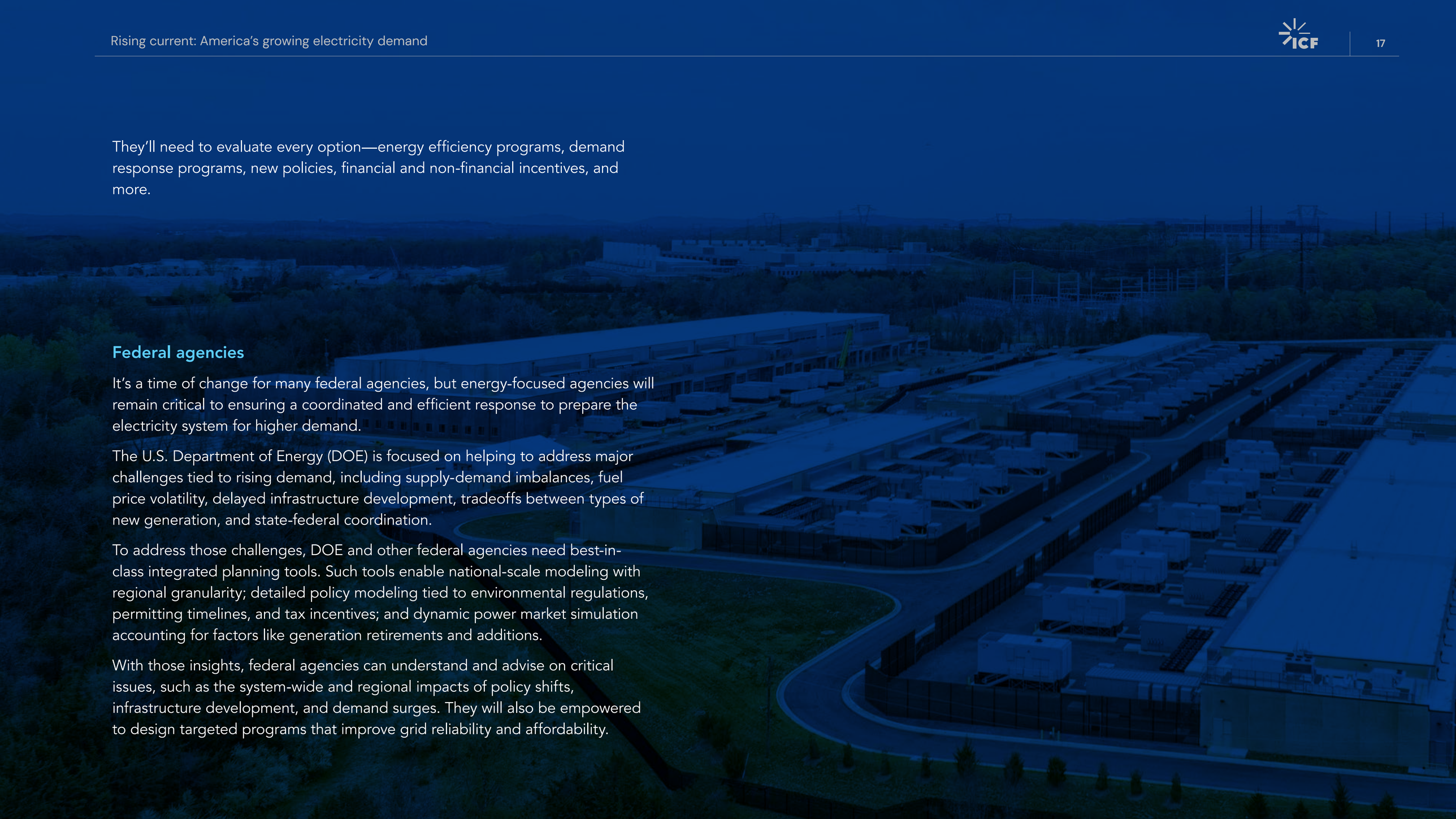
State energy offices

State energy offices ensure affordable and reliable energy resources are available across their state. To support this, they often provide insights to the governor and state legislative offices to help shape state energy policies, supported by comprehensive energy planning through which they analyze current and future energy supply and demand while considering the context of existing energy policies and emerging energy challenges and opportunities.

Their role as educators, trusted information hubs for consumers, and facilitators of public-private partnerships will become more important as states stretch to meet the demand challenge. For example, rising electricity prices create challenges for consumers and potential political pressures. Higher capacity prices will be part of the rising cost in some areas, but those prices signal to investors the need to build, which is essential to preserve reliability. State energy offices will play an important educational role in communicating nuances such as those to help balance the need to attract investment with the imperative to preserve affordability.

To perform those tasks, state energy offices can partner with experts in comprehensive energy planning, program design, and program support.

They'll need to evaluate every option—energy efficiency programs, demand response programs, new policies, financial and non-financial incentives, and more.



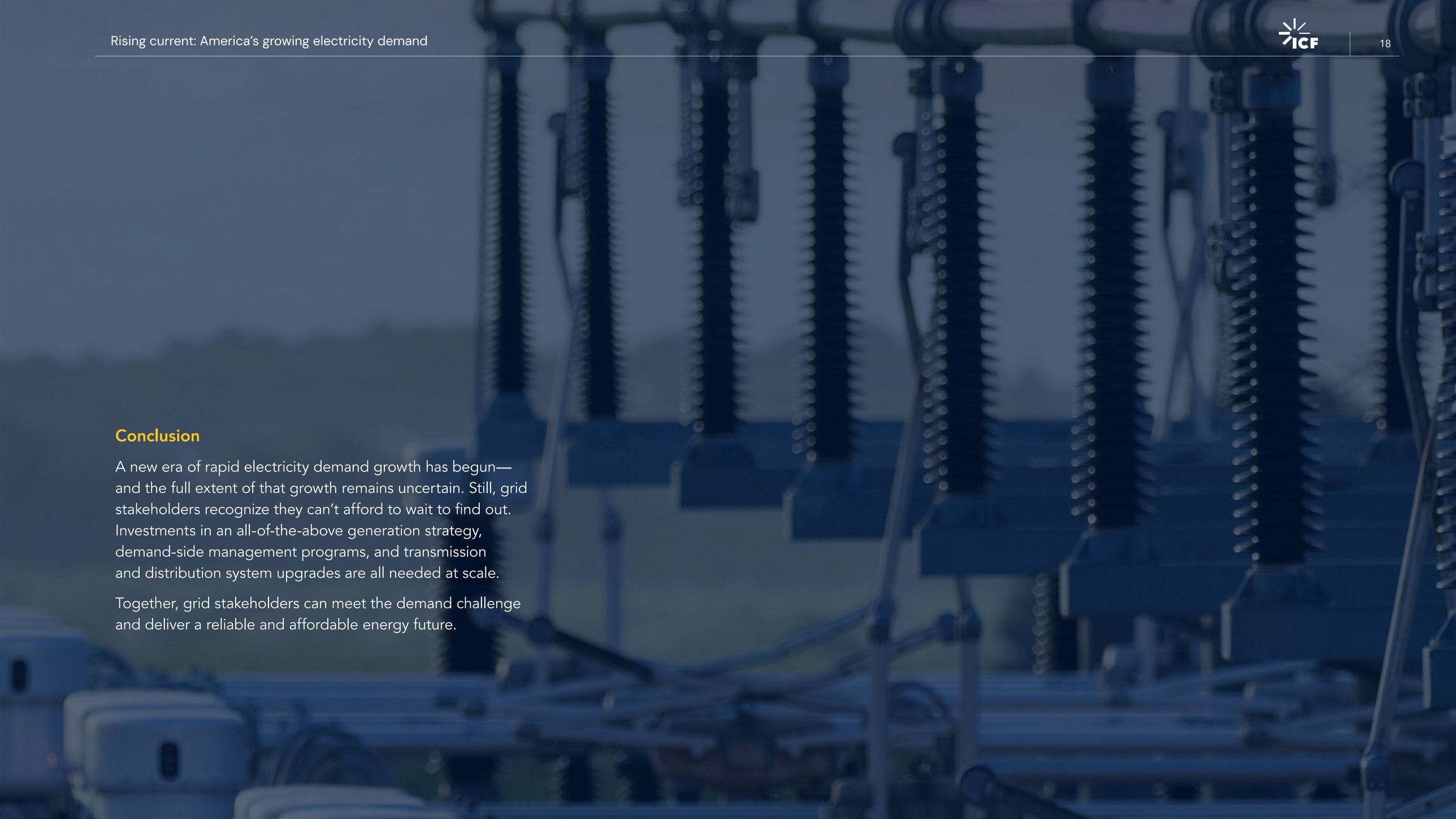
Federal agencies

It's a time of change for many federal agencies, but energy-focused agencies will remain critical to ensuring a coordinated and efficient response to prepare the electricity system for higher demand.

The U.S. Department of Energy (DOE) is focused on helping to address major challenges tied to rising demand, including supply-demand imbalances, fuel price volatility, delayed infrastructure development, tradeoffs between types of new generation, and state-federal coordination.

To address those challenges, DOE and other federal agencies need best-in-class integrated planning tools. Such tools enable national-scale modeling with regional granularity; detailed policy modeling tied to environmental regulations, permitting timelines, and tax incentives; and dynamic power market simulation accounting for factors like generation retirements and additions.

With those insights, federal agencies can understand and advise on critical issues, such as the system-wide and regional impacts of policy shifts, infrastructure development, and demand surges. They will also be empowered to design targeted programs that improve grid reliability and affordability.



Conclusion

A new era of rapid electricity demand growth has begun—and the full extent of that growth remains uncertain. Still, grid stakeholders recognize they can't afford to wait to find out. Investments in an all-of-the-above generation strategy, demand-side management programs, and transmission and distribution system upgrades are all needed at scale.

Together, grid stakeholders can meet the demand challenge and deliver a reliable and affordable energy future.

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