

Keeping the Lights On — The Outlook for American Power



by Dan Connell

The historically staid market for power generation is having a very public moment right now, particularly in the United States. Operating as a set of regional grids, these power markets are straining under the combined weight of aging transmission and distribution infrastructure, evolving market and regulatory frameworks and a largely stagnant nuclear industry. For two decades, these dynamics had been mitigated by relatively modest absolute demand growth along with the implementation of energy efficiency efforts that further curbed demand. These dynamics have shifted with a wave of new demand facing the market – growth in data centers broadly, most recently attributed to increasing generative artificial intelligence (AI) energy requirements, is beginning to outstrip conservation efforts and is projected to drive significant growth. The result is an expected wave of additional investment in power generation, along with related infrastructure and services.

GRIDS UNDER PRESSURE

Regional power generation and related infrastructure have been under pressure for years, with causes varying region to region, highlighted by prominent disruptions or threats thereof. Indeed, as depicted below power outages in the United States have increased both in frequency and duration over the last decade. US Energy Information Agency data tracking both metrics noted meaningful increases from 2013 through 2021.¹

POWER OUTAGES ARE GETTING LONGER AND MORE FREQUENT

The U.S. Energy Information Administration uses System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) as measures of electricity reliability.

Duration of Power Interruptions

SAIDI refers to the number of minutes of nonmomentary electric interruptions a customer experiences in an average year.





SAIFI is the number of interruptions a customer experiences in an average year. It measures the frequency of power outages.



Source: Scientific American: "Increasing Power Outages Don't Hit Everyone Equally." (July 26, 2023)

Regionally, there have been notable, high profile and costly grid failures driven by severe weather events. In the Electricity Reliability Council of Texas (ERCOT) market, these challenges were on display during Winter Storm Uri in February 2021 which saw ~48.6 percent of generation forced out at one point due to extreme weather conditions.² Challenges with natural gas availability due to freezing pipes and inadequately weatherized power assets (thermal and renewable) both played a role, resulting in over 4.5 million Texans losing power, some for several days, and at least 210 deaths. The events of Winter Storm Uri mirrored those from 7 years earlier in January 2014, when the polar vortex wrought havoc on power grids—particularly the Pennsylvania New Jersey Maryland (PJM) regional grid.³

Where extreme cold challenged the PJM and ERCOT grids, it was extreme heat that brought the California Independent System Operator (CAISO) grid to its knees in August 2020. Those blackouts represented the first rolling blackouts in CAISO "since 2001, when Enron and other energy traders manipulated California's market."⁴ Generation outages due to extreme heat and transmission constraints were both cited as factors.

The threat of outages looms over other regional markets. In November 2023, the North American Electric Reliability Corp (NERC) warned that extreme cold weather could threaten 180 million Americans and Canadians due to lacking natural gas infrastructure.⁵ Indeed, transmission constraints and limited natural gas pipeline infrastructure loom particularly large in the Independent System Operator New England (ISO NE), where attempts to add natural gas infrastructure (like the cancelled Northeast Energy Direct project)⁶ and transmission (like the similarly cancelled Twin States Clean Energy Link)⁷ have often been unsuccessful resulting in system constraints.

DEMAND GROWTH FORECASTS

The aforementioned challenges for regional grids occurred despite it being a time when demand growth—and the resultant incremental strain on those systems—had been comparatively muted. Enter the onset of potentially significant growth. Concerns about this trend began several years ago, with the NERC noting in its 2022 Long-Term Reliability Assessment highlighting that "projected growth rates of electricity peak demand and energy in North America are increasing for the first time in recent years."⁸ Electrification and data center growth, primarily from crypto operations, were noted at the time. Inside of two years later, the expectations for growth have accelerated. A report by Grid Strategies filed with the Federal Energy Regulatory Commission (FERC) entitled "The Era of Flat Power Demand is Over" pointed to projected demand growth accelerating to a rate of 4.7 percent from a prior estimate of 2.6 percent year-over-year for expected peak demand in 2028, primarily as a result of data center demand broadly and AI specifically.⁹,¹⁰ Markets like PJM were already anticipating significant growth in peak load requirements from electrification before contemplating significant additional demand pull from the addition of data centers as depicted below.

5-YEAR NATIONWIDE GROWTH FORECAST



Source: Grid Strategies, "The Era of Flat Power Demand is Over." (December 2023)

IMPACTS OF ELECTRIFICATION AND DATA CENTER LOAD ON FORECASTS



Source: PJM, "Energy Transition in PJM: Resource Retirements, Replacements & Risks." (February 2023)

More worryingly, Grid Strategies noted that such forecasts are "likely an underestimate: several more recent updates are adding additional GWs to that forecast. Next year's forecast is likely to show an even higher nationwide growth rate."¹¹ Goldman Sachs, in a recent report on the implications of data center and AI-related demand, drew a similar conclusion noting "an acceleration in U.S. electricity demand CAGR to 2.4 percent through the end of the decade from 0% in the last decade."¹²

THE NEED FOR ADDITIONAL INVESTMENT

With regional grids straining following a period of relatively muted demand growth, it is fair to wonder how they will perform absent significant additional investment. Indeed, Goldman Sachs estimates \$50 billion of additional investment in U.S. power generation capacity will be needed to meet data center demand growth.¹³ Indeed, there are a number of areas that are expected to see increased investment as a result of this forecast growth.

- Power Generation: Renewables will continue to play a significant role in the U.S. power mix, but natural gas fired power generation will continue to play an important role as well. Distributed generation—close to sources of demand—is already critical and likely to become more so, at both the Commercial & Industrial (C&I) as well as residential scale. Indeed, such distributed generation can help sidestep constraints on transmission infrastructure which can be more expensive and requires a longer lead time given regulatory, permitting, and right-of-way complexities.
- Energy Infrastructure: While additions such as transmission are longer lead time and more difficult, it will be critical for some projects to be completed. Natural gas pipeline upgrades are another potential option to help ensure adequate fuel supplies to generators and individual consumers during periods of extreme weather. These projects can difficult and contentious – as evidenced by the aforementioned Northeast Energy Direct pipeline project—but can help provide secure, low-cost supply to constrained markets.
- Energy Storage: Storage investments (such as batteries and pumped hydro) can help obviate the need for some difficult, expensive grid expansion projects while

providing support to localized load growth. Declines in costs for batteries have helped encourage additional development, with significant adoption in some regions like ERCOT.

- **Innovative Technologies**: Opportunities in this category can address both the demand side and the supply side of the power market.
 - Demand Side Management: Long a governor on demand growth, incremental efficiency measures serve a vital function in aiding grid management. More efficient cooling solutions for data centers can help reduce energy requirements and potentially reduce water needs as well. Energy efficiency service providers that can help utilities or load operators shave demand will continue to play a vital role.
 - Supply Side Management: Such solutions

 can take a range of forms, from optimizing the
 production or dispatch from generating assets to
 providing real time monitoring and optimization of
 grid infrastructure (transmission and distribution
 assets). Crucially, these models can potentially
 be less capital intensive and allow for the more
 efficient use of existing infrastructure.

CONCLUSION

The U.S. power market is approaching a period of potentially significant growth, well above what it experienced thus far this century. With grid instability already a challenge in many regions, the need for additional investment in a range of solutions is coming into focus. Power generation, energy infrastructure and energy storage all are likely to see increased investment as a result. Service providers and efficiency solutions are also likely to play an important role in the coming decade as the United States seeks to embrace and manage— a new wave of power demand.

Endnotes

- 1 Scientific American: "Increasing Power Outages Don't Hit Everyone Equally." (July 26, 2023)
- 2 ERCOT: "Review of February 2021 Extreme Cold Weather Event." (February 2021)
- 3 NERC: "Polar Vortex Review." (September 2014)
- 4 Politico: "California has first rolling blackouts in 19 years and everyone faces blame." (August 18, 2020)
- 5 Reuters: "Two-thirds of North America could face power shortages this winter NERC." (November 8, 2024)
- 6 Politico E&E: "Kinder Morgan cancels widely opposed New England pipeline plan." (April 21, 2016)
- 7 S&P Global: "National Grid suspends 1,200-MW New England transmission line project." (March 5, 2024)
- 8 NERC: "2022 Long-Term Reliability Assessment." (December 2022)
- 9 Utility Dive: "US electricity load growth forecast jumps 81% led by data centers, industry: Grid Strategies." (December 13, 2023)
- 10 Grid Strategies: "The Era of Flat Power Demand is Over." (December 2023)
- 11 Ibid.
- 12 Goldman Sachs: "Generational Growth: Al, Data Centers and the coming US power demand surge." (April 28, 2024)
- 13 Ibid.

Important Notes

Certain information contained herein has been obtained from or is based on third-party sources and, although believed to be reliable, has not been independently verified. Such information is as of the date indicated, if indicated, may not be complete, is subject to change and has not necessarily been updated. No representation or warranty, express or implied, is or will be given by The Common Fund for Nonprofit Organizations, any of its affiliates or any of its or their affiliates, trustees, directors, officers, employees or advisers (collectively referred to herein as "Commonfund") or any other person as to the accuracy or completeness of the information in any third-party materials. Accordingly, Commonfund shall not be liable for any direct, indirect or consequential loss or damage suffered by any person as a result of relying on any statement in, or omission from, such third-party materials, and any such liability is expressly disclaimed.

All rights to the trademarks, copyrights, logos and other intellectual property listed herein belong to their respective owners and the use of such logos hereof does not imply an affiliation with, or endorsement by, the owners of such trademarks, copyrights, logos and other intellectual property.

To the extent views presented forecast market activity, they may be based on many factors in addition to those explicitly stated herein. Forecasts of experts inevitably differ. Views attributed to third-parties are presented to demonstrate the existence of points of view, not as a basis for recommendations or as investment advice. Market and investment views of third-parties presented herein do not necessarily reflect the views of Commonfund, any manager retained by Commonfund to manage any investments for Commonfund (each, a "Manager") or any fund managed by any Commonfund entity (each, a "Fund"). Accordingly, the views presented herein may not be relied upon as an indication of trading intent on behalf of Commonfund, any Manager or any Fund.

Statements concerning Commonfund's views of possible future outcomes in any investment asset class or market, or of possible future economic developments, are not intended, and should not be construed, as forecasts or predictions of the future investment performance of any Fund. Such statements are also not intended as recommendations by any Commonfund entity or any Commonfund employee to the recipient of the presentation. It is Commonfund's policy that investment recommendations to its clients must be based on the investment objectives and risk tolerances of each individual client. All market outlook and similar statements are based upon information reasonably available as of the date of this presentation (unless an earlier date is stated with regard to particular information), and reasonably believed to be accurate by Commonfund. Commonfund disclaims any responsibility to provide the recipient of this presentation with updated or corrected information or statements. Past performance is not indicative of future results. For more information, please refer to Important Disclosures.

Published May 2024

This page intentionally left blank





New York, NY 10017 San Francisco, CA 94111 London, United Kingdom Beijing, China

15 Old Danbury Road Wilton, CT 06897 Tel (646) 348-9201 Tel (415) 433-8800 Tel +44 (0) 20 8126 1628 Tel +86 10 8509 8706

Tel 888-TCF-Main Tel (203) 563-5000