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MANAGEMENT CONSULTANTS

ENERGY INDUSTRY UPDATE

KING FOR A DAY

Volume 24 - Issue 1

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EXECUTIVE SUMMARY
King for a Day

The energy utility industry faces several substantial challenges, all of which require major investment, time to remedy, and a favorable regulatory and business environment. Indeed, all of these challenges might be easily resolved if one were "king for a day." Such a king could order new infrastructure to be constructed to satisfy emerging large loads…or hire the next generation of skilled workers…or fix our gas and power infrastructure and processes to ensure grid reliability, particularly during major weather disturbances.

However, since the United States is not a monarchy, we must use our current regulatory and market processes to advance these objectives and ensure North American energy infrastructure is adequately reliable, affordable, and clean. Navigating these processes will require patience and persistence to achieve outcomes that satisfy stakeholders or (more realistically) dissatisfy all constituencies the least.

Some Highlights of This ScottMadden Energy Industry Update	
Utility Themes	▪ Increasing demand, a changing resource mix, and needed grid investment are driving significant utility capex. Those capex needs and growing costs are driving utility capital needs and increased revenue requirements. ▪ Utilities are navigating rate cases and the capital markets to ensure adequate financial resources to fund this growing spending.
Winter Storm Performance	▪ In December 2022, Winter Storm Elliott affected the power and gas systems in the eastern United States. Some utilities had to implement rolling blackouts to preserve grid stability. A year later, a report on Elliott verified that many ongoing recommendations for improved cold weather operations remain to be implemented. ▪ Regulators and grid operators are refocusing efforts to deal with these storms. The question is will it be enough and in time?
Large Loads	▪ Electricity peak demand and energy growth rates in North America are increasing at a pace not seen in decades. A common driver behind the dramatic increase is the rapid expansion of new and planned manufacturing facilities, data centers, and cryptocurrency mining. ▪ The rapid growth of large loads is prompting stakeholders to respond with a variety of actions. This includes grid operators and electric utilities signaling an urgent need for new generation capacity in larger quantities and on faster timelines than originally anticipated.
Gas Sector Developments	▪ Regulators and natural gas utilities in jurisdictions that have ambitious decarbonization objectives continue to consider effective and affordable ways to reduce emissions such as "clean heat." Several jurisdictions have instituted "future of gas" proceedings that may change "business as usual" practices and operating models. ▪ Meanwhile, other jurisdictions have pushed back on local efforts to constrain customer choice by limiting natural gas as an energy source for retail customers.
Workforce Development	▪ The Center for Energy Workforce Development's biannual Energy Workforce study provides insights on specific challenges facing the energy sector. The results show an energy industry facing a new set of workforce challenges. Concerns about an aging workforce have been replaced with a need to enhance the skills of a younger workforce. ▪ Addressing these challenges will require an integrated workforce planning and development framework. Implementing an integrated approach can provide a strong foundation and support a robust collection of talent strategies.

KEY TAKEAWAYS

Increasing demand, incentives, a changing portfolio of resources, and grid investment are driving significant capex for energy utilities.

Weighing against that are elevated and/or growing costs and capital needs.

Utilities are navigating the capital markets and rate proceedings to ensure sufficient financial resources to satisfy those investment requirements.

Utility Themes

Headwinds and tailwinds characterize the utility sector as the clean energy transition continues.

Utility Cost Pressures Continue to Mount, But One Area of Relief

Since 2020, many costs in both the U.S. and global economies have increased. Costs for utility materials and services are no exception.

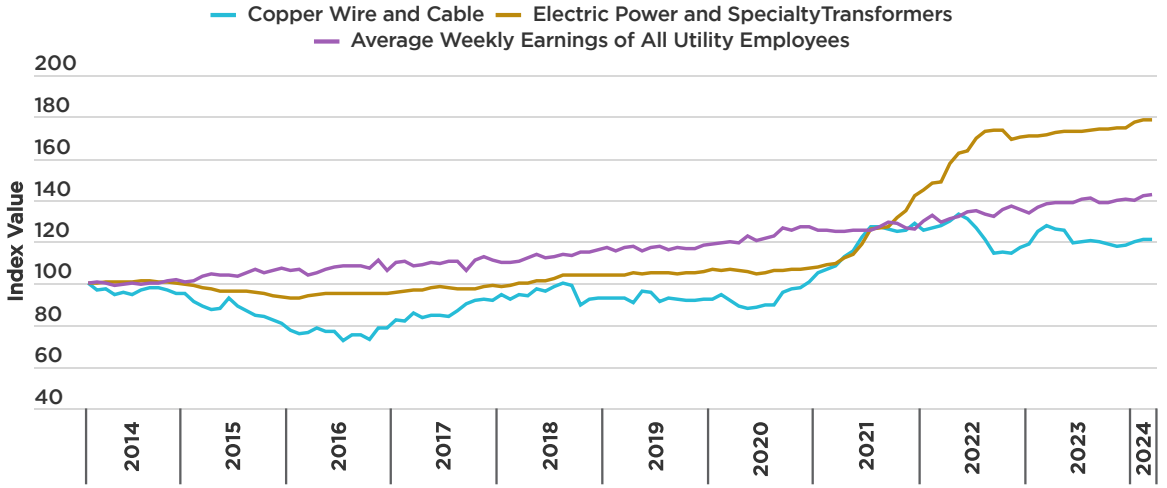
Figure 1.1 shows the increase in certain utility-related commodity and labor costs. The figure shows that since early 2014, utility labor (weekly earnings of all utility employees) has increased more than 40%, while electric transformers have increased 80%.

- Supply chain bottlenecks have been cited as an ongoing issue for large utility equipment.
- While weekly utility employee wages have grown, overall employee headcount has only increased by about 7% during that same period.

Offsetting some of these increasing costs has been the declining cost of natural gas (see Figure 1.2). Natural gas-fired generation continues to serve as the marginal (price-setting) generation cost and the largest fuel source for electricity generation across much of the United States.

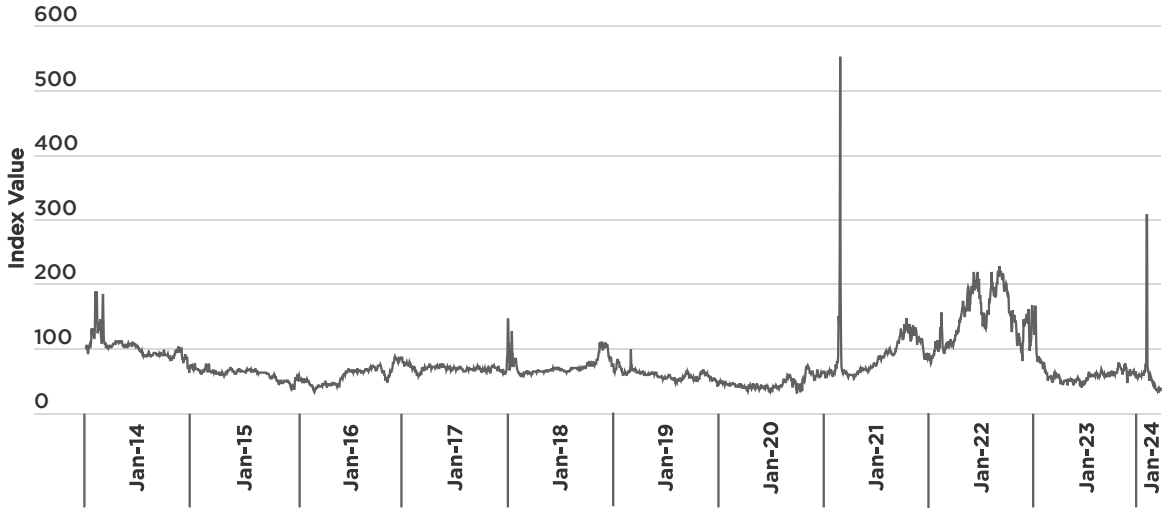
- Average U.S. wholesale power prices for 2024 are expected to range between $30 and $50 per MWh (outside of the Northwest and New England), driven by expected low gas prices.
- As recently as February and March 2024, natural gas prices had settled below $2 per MMBtu. Of course, weather, geopolitical, and other dislocations may affect these subdued prices.

Figure 1.1: **Selected Material and Labor Costs (Jan. 2014–Feb. 2024) (Index: Jan. 1, 2014 = 100)**



Note: Monthly data **Source:** Federal Reserve Economic Data: Producer Price Indexes, Federal Reserve Bank of St. Louis (accessed Mar. 29, 2024)

Figure 1.2: **Henry Hub Spot Natural Gas Prices (Index: Jan. 2, 2014 = 100)**



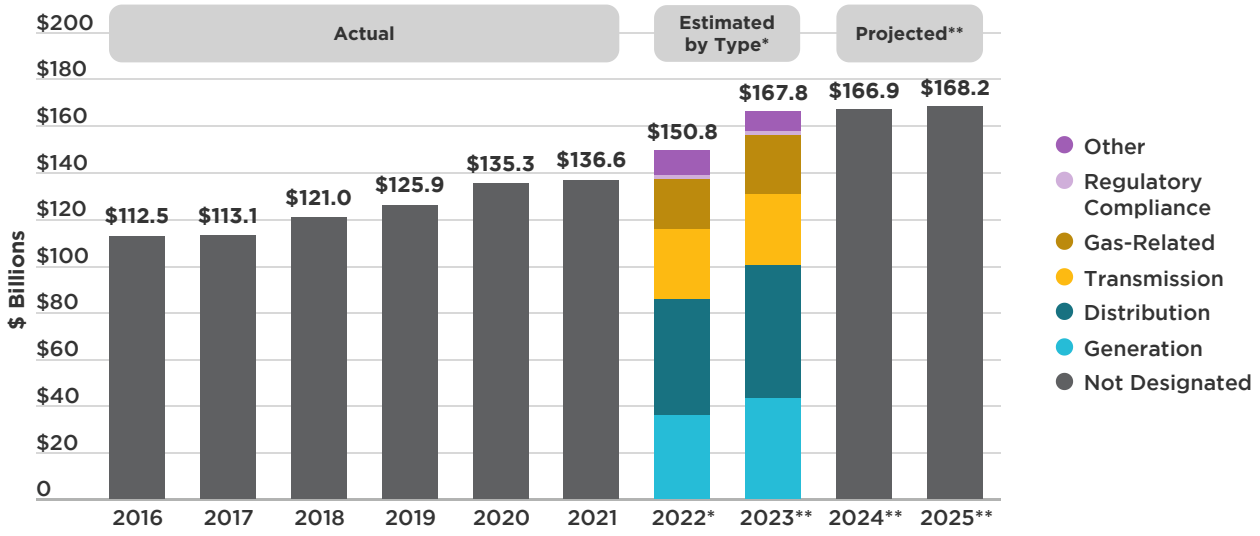
Source: Federal Reserve Economic Data: Henry Hub Natural Gas Spot Price, Federal Reserve Bank of St. Louis (accessed March 29, 2024)

Capital Expenditures Make Their Way to the Sector

Capital expenditures continue to trend upward for both the gas and power sectors (Figures 1.3 and 1.4). Increasing projected capex is a function of several macro phenomena, including:

- Economic and related load growth in many territories
- Clean energy transition investments
- Cost inflation, creating a need to re-assess required project capex

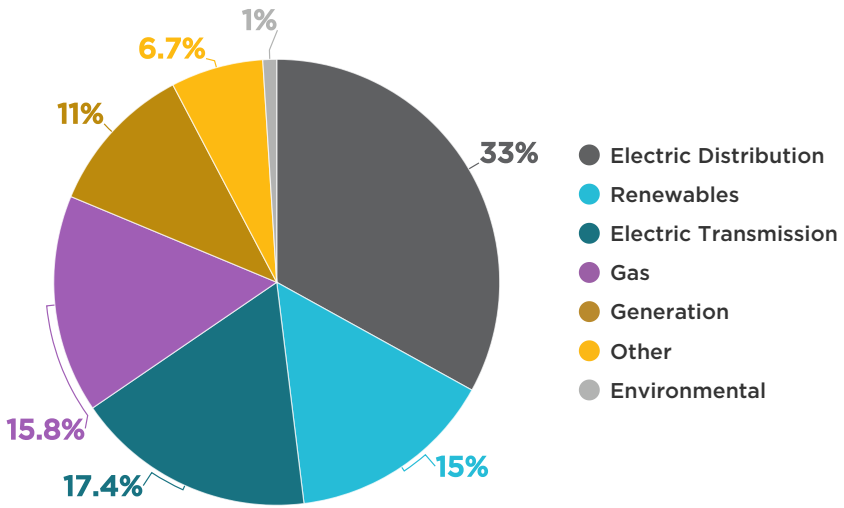
Figure 1.3: **Electric Investor-Owned Utility Capital Expenditures (2016–2025 Projected) ($ Billions)**



Notes: *Projection as of Sept. 2022.
**Projection as of Sept. 2023.
2022 estimates by type based upon Sept. 2022 forecast allocations applied to actual total for 2022.

Sources: EEI Finance Department; company reports; S&P Global Market Intelligence (updated Sept. 2023)

Figure 1.4: **Energy Utility Capex by Business Category (2023–2025 Forecast)**



Source: Regulatory Research Associates, a group within S&P Global Commodity Insights

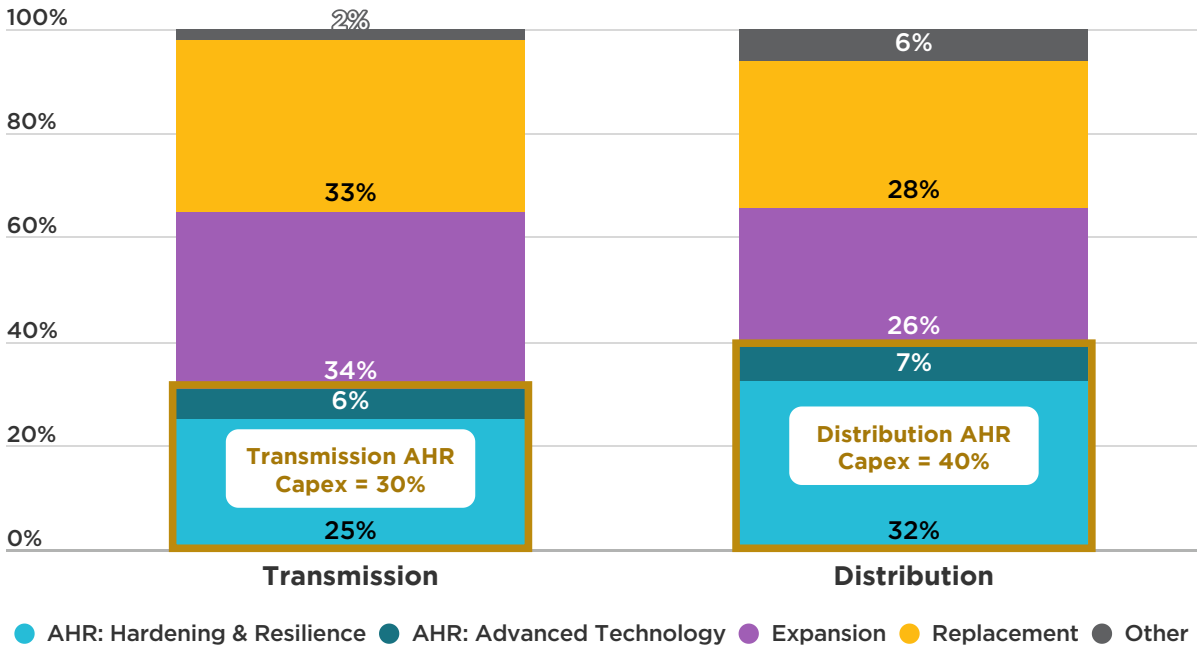
Capital Expenditures Make Their Way to the Sector (Cont.)

A growing amount of investment is for adaptation, hardening, and resilience (AHR), particularly in the transmission and distribution sectors. Figure 1.5 shows survey results that indicate that investor-owned utilities attribute 30% of transmission capex and 40% of distribution capex to AHR.

Generation capacity investment continues to grow, including significant renewables development, to meet policy- and utility-driven targets for decarbonization.

Finally, the Infrastructure Investment and Jobs Act and the Inflation Reduction Act have spurred activity in both generation and grid development. Many programs remain to be funded and implemented.

Figure 1.5: **Adaptation, Hardening, and Resilience (AHR) as a Driver of Future Electric T&D Investment**



Note: Totals may not equal sum of parts due to independent rounding.

Source: EEI Financial Analysis and Business Analytics, EEI member company survey (2023)

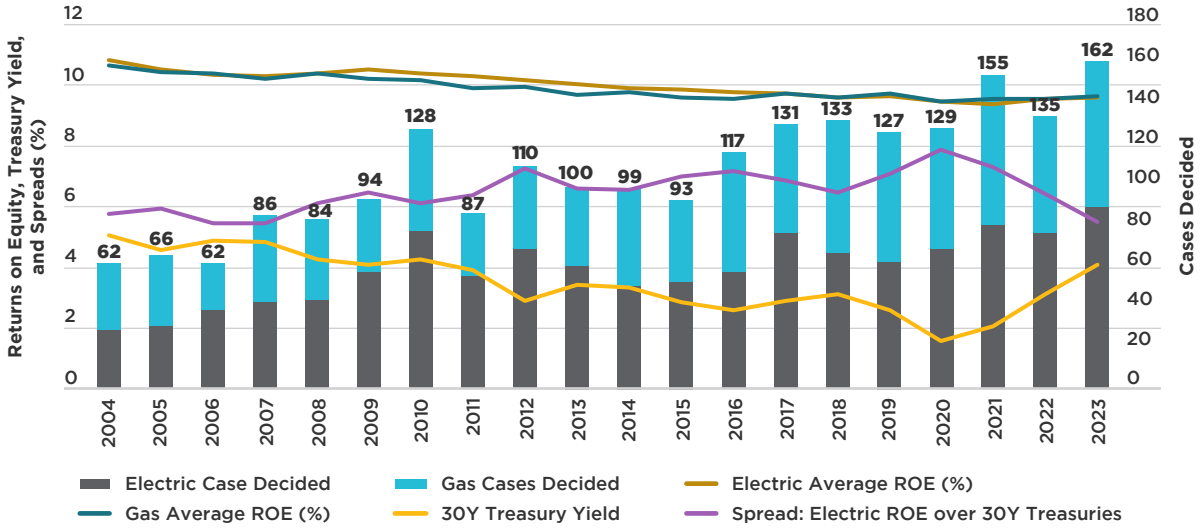
Upward Pressure on Rates to Keep Up with Increased Spending

With increasing capex spend and other operating cost pressures, gas and electric utilities are actively pursuing rate cases in many jurisdictions. State public utility commissions issued more than 160 decisions in 2023 (see Figures 1.6 and 1.7).

This high level of activity continues into 2024. As of March 12, there were 55 electric and 52 gas rate cases pending across 38 states and the District of Columbia. The rate increases sought aggregate to $16.5 billion in net increases, excluding later years of multiyear rate requests.

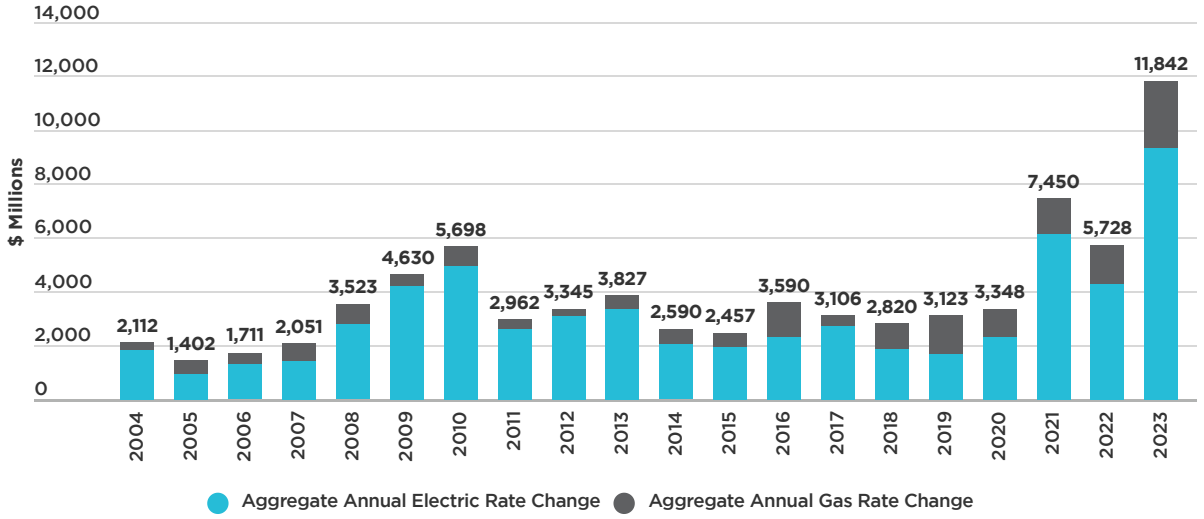
Allowed returns on equity (ROE) have been steadily declining over the past 20+ years in tandem (but at a slightly slower pace) with a historic cycle of ever-declining interest rates. These interest rates have risen significantly since 2020, without a commensurate increase in average ROEs while also raising debt costs.

Figure 1.6: **Average Gas and Electric Authorized Returns on Equity, Treasury Yields and Spreads, and Rate Cases Decided (2004–2023)**



Source: Regulatory Research Associates, a group within S&P Global Commodity Insights

Figure 1.7: **Electric and Gas Rate Change Amounts from Decided Rate Cases (in $ Millions) (2004–2023)**



Source: Regulatory Research Associates, a group within S&P Global Commodity Insights


Source: lucky-photo - stock.adobe.com

Regulators Hesitate and Rating Agencies Monitor

Concerned about customer bill impacts and affordability, some PUCs are resisting the level of rate recovery sought by both power and gas utilities, rejecting or substantially reducing proposed rate increases. In November 2023, for example, PUCs in California and Wisconsin pared back requested utility rate increases citing affordability.

While utilities continue to require capex to fund infrastructure expansion as PUCs challenge revenue requirements, credit rating agencies are monitoring utility balance sheets, free cash flow, and credit metrics. S&P Ratings has pointed to a negative outlook for North American regulated utilities, citing various concerns:

- Rising physical risks (i.e., wildfires) and high cash flow deficits that may not be sufficiently funded in a "credit-supportive manner"
- Limited financial cushion to support "unexpected events" such as higher interest rates (particularly with near-term debt maturities), changes to inflation, delays to offshore wind projects, and rising taxes

Moody's and Fitch Ratings are more sanguine, pointing to "remarkably steady" free cash flow metrics and positive factors such as demand growth and IRA funding.

Dividends have long been a key attraction for utility investors. With expected higher equity needs and financing costs, some utilities may consider lowering payout ratios.

- To date, dividend growth remains strong. Most electric utilities have a target payout ratio of 60% or greater, with the sector's dividend yield averaging 3.8%.
- A development to monitor will be whether lower dividend growth ("invest to grow") will be needed over the next several years. Much depends upon earnings growth as well.

Tailwinds for the Electric Sector

A common theme across the sector is growing power demand, with sometimes significant anticipated near-term load increases.

EEI estimates 4.7% annual growth in net energy over the next five years for North America (compared to estimated 2.6% annual growth as recently as 2022), with an additional 38 GWs in peak demand growth over that period.

Growth is being driven by several factors:

- Data centers and effects of artificial intelligence, with increased computational requirements and 24/7/365 operations leading to increased energy requirements
- Electrification of end-uses, including heating and transportation
- Expansion of manufacturing, including reshoring of industrial production

Figure 1.8 summarizes selected themes from a sample of companies across various types of energy utilities.

Figure 1.8: **Utility Themes from Selected Company Reports and Presentations**

Gas Local Distribution Companies	▪ Added 11 new industrial customers and more than 1,000 new commercial customers. "This growing demand from all customer classes demonstrates the value and vital role natural gas plays in economic development." (ATO) ▪ Carbon neutrality by 2050 will require utilizing Oregon support for RNG. NWN has signed agreements to date to develop or purchase RNG totaling the equivalent of ~3% of current Oregon supply. (NWN) ▪ Record production of 101 Bcfe, an 8% sequential increase, exceeded estimates.... "Record throughput at NFG Midstream...increasing our production guidance range to 395 to 410 Bcfe." (NFG)
Integrated Electric Utilities	▪ Georgia Power's sales growth is projected to be ~9% annually 2025 to 2028, with data centers somewhere around 80% of that. One of the benefits of this sales growth is having the opportunity to put downward pressure on rates for our customers across the board. (SO) ▪ Sales growth of 7.8% for 2023 was dominated by data centers. "We expect this to continue over the next several years as the global demand... accelerates through the growth of AI and other technologies." (AEP) ▪ "Across all of California, we see a need to invest in the grid over the long term through 2045 with the pace of transmission additions needing to be 4X what they've been historically; distribution additions needing to be 10X." (EIX)
Delivery-Only Utilities	▪ $1.6B increase in utility infrastructure investments from 2024 through 2027 versus the prior plan. Offshore wind investments experienced difficulties due to supply chains, rates, and inflation, resulting in projected investment returns substantially below required thresholds. (ES) ▪ "We've received approval to take forward our Propel New York Energy Transmission project with New York Transco...and our offshore wind joint venture was successful...with a provisional offtake award of 1.3 gigawatts.... The last 6 months show that we're now firmly in a new phase of capital delivery for the energy transition." (NGG)
Combination Utilities	▪ $3.1B for Clean Energy Future-Energy Efficiency II program, from January 2025 through June 2027. Sold 25% equity investment in Ocean Wind and examining potential sale of 50% share of Garden State Offshore Energy. (PEG) ▪ Of the 282 retail point of interconnection requests for 2023, 46 of those are between 300 megawatts and 2,600 megawatts individually in size. (SRE) ▪ "We project load growth of 3% to 5% in 2024 and expect 2025 to be well above our historic 1% load growth with emerging trends that indicate continued strength in years beyond 2025." (OGE) ▪ "The economic growth, the expansions that we're seeing in that I-94 corridor are just literally amazing." (WEC)

Note: Company ticker symbols in parentheses. **Sources:** Company annual reports, Form 10-Ks, and investor presentations

Tailwinds for the Electric Sector (Cont.)

For some utilities, federal incentives in the IIJA and IRA and supportive state policy provide momentum for investment in grid improvements, carbon-free generation, vehicle electrification, and new technologies such as hydrogen.

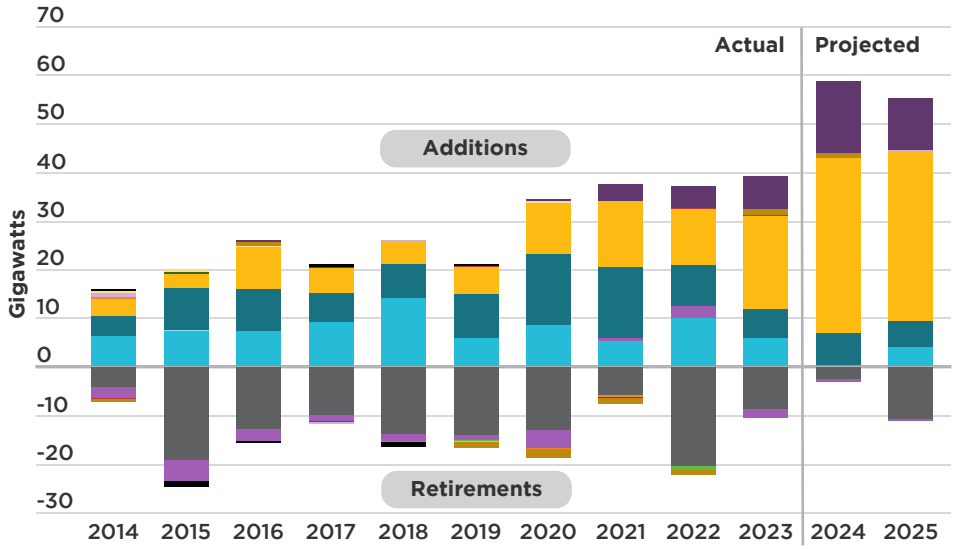
- Figure 1.9 illustrates how different utilities are pursuing different low-emitting resource technologies.
- Among new generation options, solar has leapfrogged other technologies in anticipated capacity build over the next two years (see Figure 1.10).

Figure 1.9: **Examples of Different Electric Utilities Placing Different Bets on Technology**

Contemplating a natural gas-to-hydrogen transition	Conducting several battery storage pilots	Investigating advanced nuclear
Duke Energy	**Dominion Energy**	**Southern Company**
Partnering with Sargent and Lundy and GE Vernova, Duke Energy plans to open nation's first 100% green hydrogen production, storage, and combustion system in Volusia County, Florida by the end of 2024.	The Darbytown Storage Pilot Project consists of two lithium-ion alternatives: the Form Energy 100+ hour storage iron-air batteries to test long-duration storage and Eos Energy Enterprises' zinc-hybrid batteries to test medium-duration storage at a lower cost than Li-ion.	In a collaboration with TerraPower and CORE POWER, Southern Co. has successfully started an integrated effects test (IET) on a molten chloride fast reactor (MCFR); this IET will inform the design, licensing, and operation of an approximately 180-MW MCFR demonstration planned for the early 2030s.

Source: Company reports; ScottMadden research

Figure 1.10: **Annual U.S. Capacity Additions and Retirements by Fuel Type (2014–2025 Projected) (GWs)**



Solar comprises an overwhelming proportion of new power generation capacity being brought online.

Note: De minimis additions and retirements are charted but are not included in the legend. **Sources:** EIA; ScottMadden analysis

IMPLICATIONS

After years of flat electricity demand, utilities must now deal with the enviable problem of significant and potentially rapid load growth. In tandem, they must consider transition and decarbonization goals, resilience and modernization requirements, and, ultimately, customer affordability.

Utilities are considering the nature, level, and timing of infrastructure investment to accommodate demand growth and other priorities. Integrated planning can help optimize those investments.

In addition, utilities must also engage customers, regulators, and other stakeholders to reduce resistance to appropriate cost recovery and capital funding needs. Part of this engagement may include consideration of programs to address affordability and energy burden, particularly for economically vulnerable customers.

Sources:

Economic Research Division, Federal Reserve Bank of St. Louis (FRED), at https://fred.stlouisfed.org; U.S. Energy Information Administration; S&P Global Market Intelligence; Regulatory Research Associates; Edison Electric Institute; Barclays Research; J.P. Morgan; company websites, investor presentations, annual reports, and Form 10-Ks; industry news; ScottMadden analysis

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KEY TAKEAWAYS

FERC and NERC's joint report on Winter Storm Elliott revealed continuing gaps in extreme cold weather preparations of the bulk power system.

Closing gaps that were identified after 2021's Winter Storm Uri is key in improving cold weather operations in both gas and power systems.

Recent weather events in January 2024 showed some improved performance, as thermal generation and strong winds met demand and provided grid support.

FERC and NERC continue to promulgate new cold weather standards, but given timelines for implementation and pending generation retirements, the next few winters may be sources of concern.

Winter System Performance

Winter Storm Elliott is analyzed, while winter 2024 has its moment on the edge.

FERC, NERC Release Joint Report on Winter Storm Elliott

In late December 2022, a bomb cyclone later designated Winter Storm Elliott impacted both the bulk power and natural gas systems in the Eastern Interconnection. At its worst point, December 23-24, there were 90.5 GW of unplanned generator outages (about 13% of winter resources in the interconnection).

- Dry natural gas production dropped by 23% to 54% during the event. This had downstream operational impacts on gas availability and pressure for elevated power generation and retail natural gas demand.
- 1,702 individual generating units, of which 825 units were natural gas-fired generators, experienced 3,565 outages, derates, or failures to start.
- As generator outages mounted, the grid was operating well beyond N-1* planning conditions. To preserve frequency, grid operators in the interconnection shed a total of 5.4 GW of load during the event.

In October 2023, NERC, FERC, and regional reliability authorities released a 167-page joint report, following regional and utility after-action reports issued earlier in 2023. The report contained the following key findings:

- Freezing issues, fuel issues, and mechanical/electrical issues were responsible for 96% of outages, derates, and failures to start.
- The impact of extreme cold weather on mechanical and thermal stress, thermal cycling fatigue, and other effects (such as embrittlement and fuel and lubricant gelling) outstripped freezing and fuel issues as non-performance causes, although all played a role.

A Few Concerning Developments During Elliott

There were some concerning developments mentioned in the FERC/NERC report.

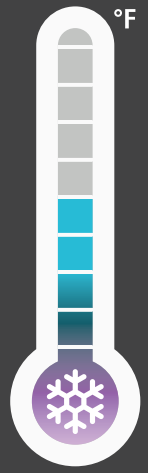
First, a substantial majority of units lost due to freezing issues occurred at temperatures above their documented operating temperature (see Figures 2.1 and 2.2).

Second, natural gas fuel issues—such as low gas pressure due to a drop in regional gas production and pipeline freezing—caused about 20% of lost generation, with 9.5 GW related to transportation or pipeline pressure and 24 GW due to market issues and price restrictions.

- Both firm and interruptible gas were curtailed by force majeure. Failure of gas suppliers to satisfy firm supply commitment and/or pipeline firm curtailments accounted for more generation loss (16.5 GW) than interruptible service interruptions (14 GW).
- In New York City, LNG kept local pipeline pressure adequate after it fell to levels that may have caused a complete gas system outage. Restoring service could have taken months.

Third, 19 GW of black-start-designated units—which can restore the grid after failure—experienced outages, derates, or failures to start, with 23% of those being failures to start, a core capability for such units.

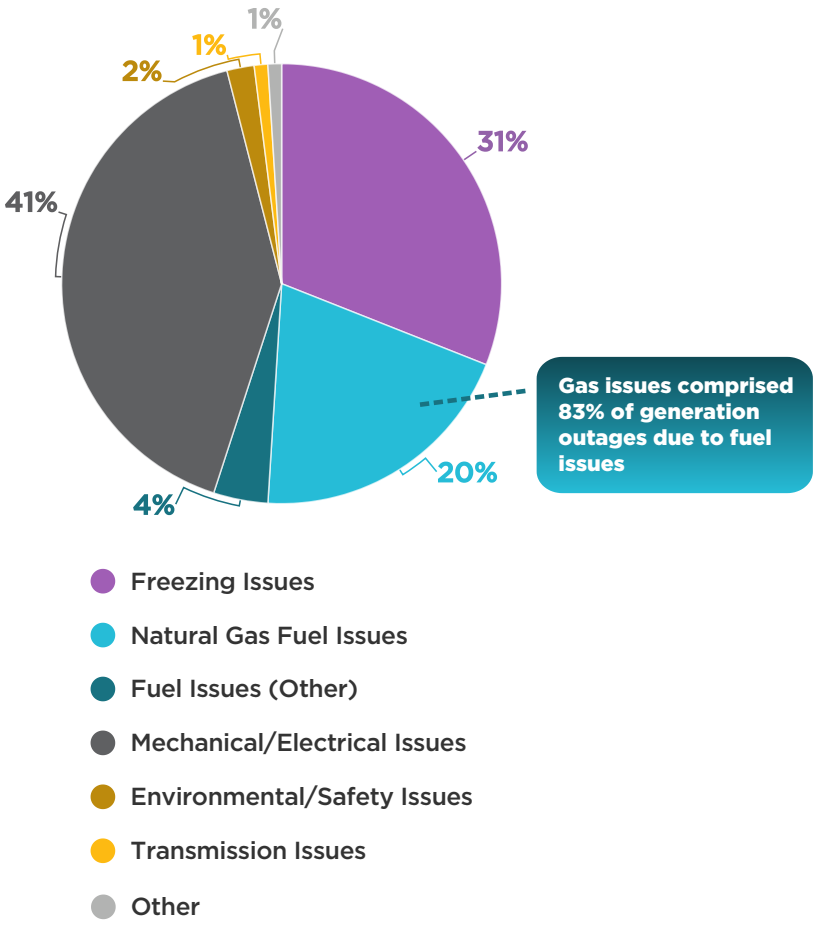
The joint report pointed to prior event analyses and recommendations, particularly for 2021's Winter Storm Uri report, many of which had made limited progress when the Elliott event occurred. For example, frozen transmitters, sensing lines, and other instrumentation—encountered in Uri—accounted for 42% of generation loss (or 46 GW) in Elliott.



The joint report entities pointed several times to the **similarity of issues** experienced during Elliott to those of prior winter events.

In addition to **natural gas production losses** and **mechanical/electrical and fuel issues**, **load forecasts fell short of predicting peak electricity demand** during the coldest periods. One forecast for December 23 was off by 11.6% compared to actual peak load.

Figure 2.1: **Incremental Unplanned Generating Unit MW Outages, Derates, and Failures to Start (Total Event Area by Cause)**



Source: FERC, NERC, and Regional Entity Staff Report on 2022 Winter Storm Elliott, Fig. 7

Figure 2.2: **Unavailable MW Due to Freezing Issues – All Balancing Authorities (December 21-26, 2022)**

Equipment Category	Components and Systems Impacted	Event Count	MW Outaged or Derated**	
Turbine Blades	Icing on blades	**127**	**6,281**	**5.7%**
Instrumentation	Frozen transmitter	**49**	**17,776**	**16.0%**
	Frozen sensing lines	**27**	**9,757**	**8.8%**
	Frozen instrumentation	**58**	**18,824**	**17.0%**
Other Equipment Freezing Problems	Frozen equipment	**27**	**4,388**	**4.0%**
	Frozen valve	**39**	**11,860**	**10.7%**
	Frozen water line	**19**	**6,547**	**5.9%**
	Frozen pipes	**24**	**5,702**	**5.1%**
	Equipment failure	**57**	**8,026**	**7.2%**
	Other freeze-related issue*	**173**	**21,668**	**19.6%**

Overall, units reported 1,030 distinct freezing issue-related unplanned outages, derates, or start-up failures, which, combined, caused 110,962 MW of generation loss at various times during the event.

Notes: *"Other freeze-related issue" includes freeze-related sub-causes external to the generating unit such as frozen coal or ice on transmission lines. **Total=100%

Source: FERC, NERC, and Regional Entity Staff Report on 2022 Winter Storm Elliott, Fig. 75

Same as It Ever Was

The Elliott event had the largest footprint of any examined in a joint FERC-NERC-regional entity inquiry. The joint entities pointed several times to the similarity of issues experienced during Elliott to those of prior winter events.

Some common elements of these extreme cold weather events were natural gas production losses, mechanical/electrical and fuel issues, and load forecasts falling short of predicting peak electricity demand during the coldest periods.

Recommendations: Redoubling Efforts on Cold Weather Reliability

The joint entities recommended 11 actions to improve cold weather reliability for each of generators, natural gas infrastructure, gas-electric coordination, and grid operations.

Several of these recommendations repeat those issued after Winter Storm Uri: in particular, strengthening generators' abilities to maintain extreme cold weather performance. Those recommendations are summarized at Figure 2.3.

Figure 2.3: **Winter Storm Elliott Report Recommendations and Recommended Timing**

	Elliott Recomendations	Timing
Generator	Develop/implement revisions to reliability standards, with robust monitoring by NERC of current standards (Uri recommendation 1) **Near term:** Identify generating units at highest risk and perform cold weather verifications	**Q3 2024 (identify highest risk units by Q4 2023)**
	Perform independent technical review of cold-related mechanical/ electrical outages and identify preventative measures/standards (Uri recommendation 11)	**Initiate by Q1 2024**
	Initiate black-start study modeled after post-Uri ERCOT study to assess readiness of units during cold weather conditions	**Initiate by Q1 2024**
Natural Gas Infrastructure	Promulgate legislation/regulation to establish reliability rules for natural gas infrastructure, addressing cold weather preparedness, situational awareness, and designation of critical loads for priority treatment during load-shedding (Uri recommendations 5, 28)	**Q1 2024**
Gas-Electric Coordination	Consider a one-time report from FERC-jurisdictional entities describing vulnerability to extreme cold weather events and how this is minimized	**Q3 2024**
	Convene gas and power grid operators to identify communication improvements during extreme cold weather events to enhance situational awareness across the gas supply chain	**Q2 2024**
	Initiate independent study of whether additional gas infrastructure is needed to support electric grid reliability and potential cost of such infrastructure	**Initiate by Q1 2024**
Electric Grid Operations	Improve short-term load forecasts for extreme cold weather periods through identifying/sharing sound practices	**Q4 2023**
	Consider new processes, such as multi-day risk assessment processes or advanced or multi-day reliability commitments, to address anticipated capacity shortages or transmission problems during cold weather events	**Q4 2023**
	Conduct joint-regional reliability assessment of grid conditions that occur during extreme cold weather period that can be used in power supply planning	**Q4 2023**
	Conduct a NERC-commissioned study to assess the Eastern Interconnection's state during December 23-24, 2022, focusing on dynamic stability, system inertia, and the risk of triggering and underfrequency load shed event	**Initiate by Q1 2024**

Note: Recommendations contain selected references to Uri joint entity report as referenced in the Elliott report at Appendix E.

Source: Joint Entity Winter Storm Elliott Report and staff presentation

Moving Ahead

Despite halting progress on implementation of recommendations from Uri and prior major winter events, bulk power system players and FERC are pushing along processes that will improve extreme weather preparedness.

A post-Uri analysis of black-start resources in Texas issued in December 2023 studied the causes of black-start resource outages. It issued seven recommendations, focused on the following three themes:

- Black-start system restoration planning and testing
- An assessment of natural gas availability to black-start and next-start resources, as well as improved electric and natural gas coordination
- The prioritization of natural gas supply and transportation to black-start and next-start resources

In mid-February, FERC approved NERC's proposed cold weather standards, which require that each balancing authority have operating processes for "extreme cold weather conditions" and that transmission operators consider impacts of load shedding during emergency conditions on gas infrastructure.

Timing is an issue, however. As Commissioner Clements observed, the cold weather standards will take effect "no sooner than April 1, 2027—three years, and crucially, three winters from today [February 14, 2024]."

Fast Forward One Year

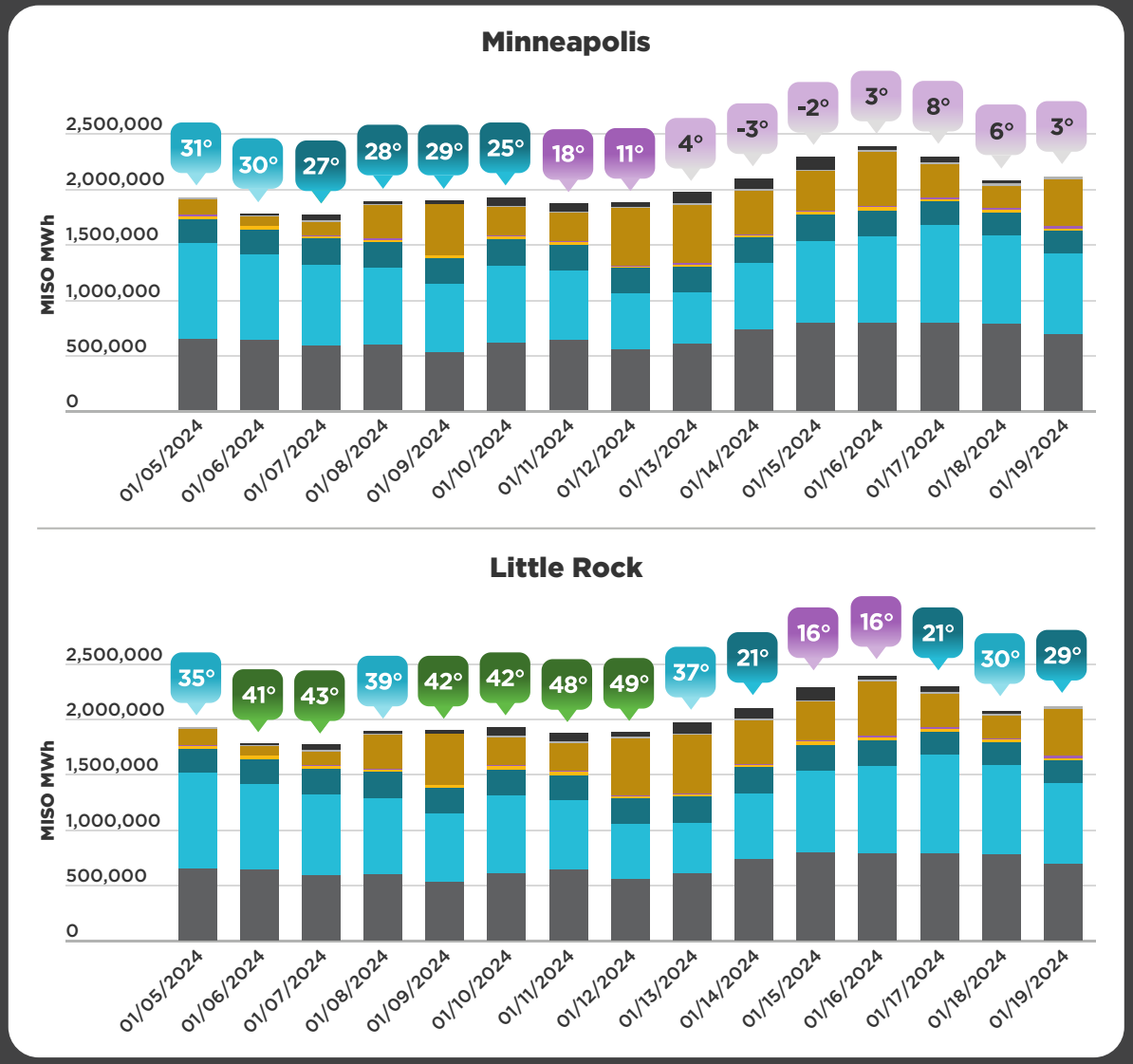
Entering the 2023-24 winter season, NERC's pre-season assessment placed much of the eastern United States and Canada at elevated risk of insufficient power reserves during the winter.

The winter proved to be relatively temperate, except for two significant incursions of Arctic weather, named Winter Storms Gerri and Heather, which occurred approximately January 8-14 and January 13-18, respectively.

Although the storms were not as long and severe as Winter Storm Uri, they did entail significant increases in power demand. One analysis found that Winter Storm Heather set new single-day electricity demand records in SPP and ERCOT. The storm set records for the second-highest electricity demand in the Southeast (after Winter Storm Elliott), the third highest in PJM, and the fourth highest in MISO.

While freezing temperatures affected some thermal units, the grid relied heavily on coal- and gas-fired dispatchable generation and benefited from favorable wind speed conditions, a weather condition that was lacking during the Uri event.

Figure 2.4A: **MISO (Minneapolis and Little Rock) Temperatures (in °F) and Net Generation by Fuel Type and Net Interchange (MWh) (Jan. 5-19, 2024)**



Sources: Weather Underground; EIA Hourly Electric Grid Monitor

Figure 2.4B: **PJM (Pittsburgh) Temperatures (in °F) and Net Generation by Fuel Type and Net Interchange (MWh) (Jan. 5-19, 2024)**

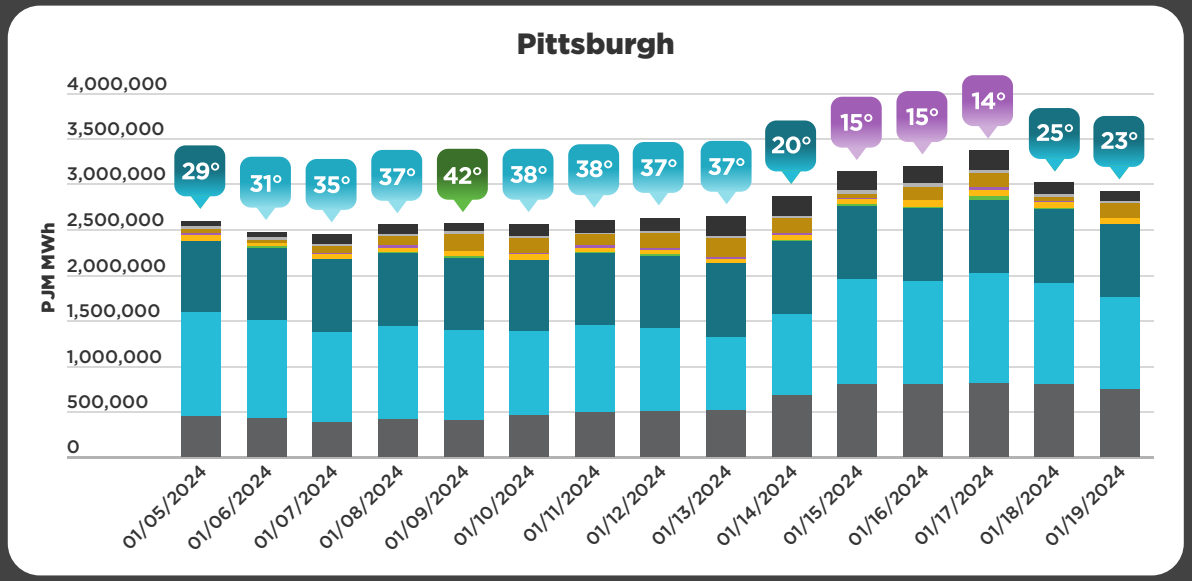
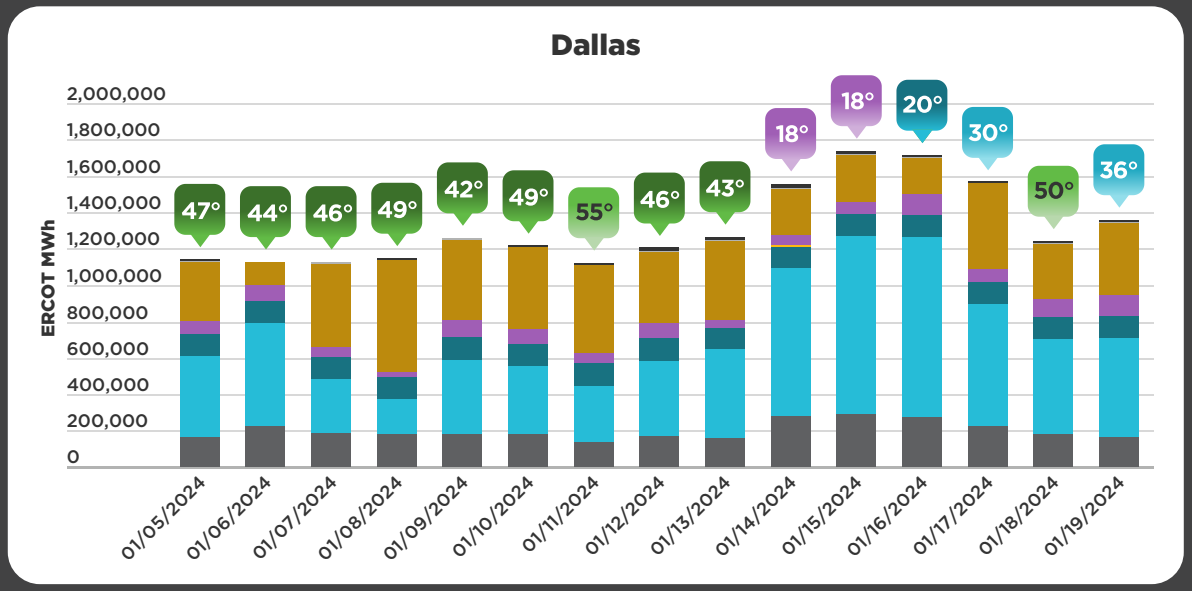
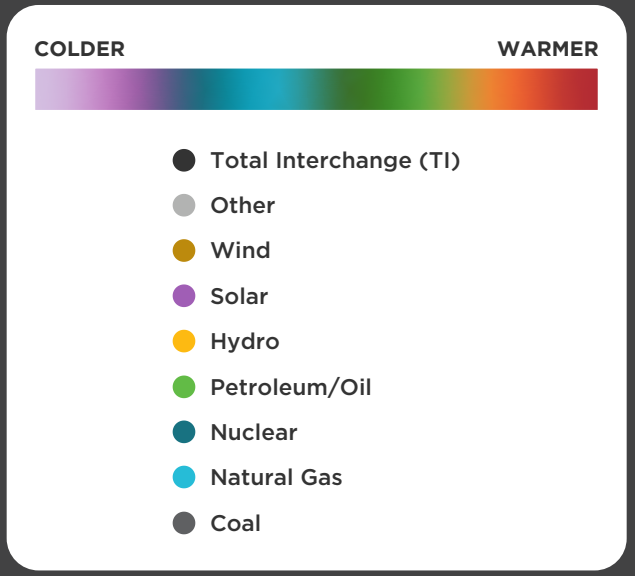


Figure 2.4C: **ERCOT (Dallas) Temperatures (in °F) and Net Generation by Fuel Type and Net Interchange (MWh) (Jan. 5-19, 2024)**





Sources: Weather Underground; EIA Hourly Electric Grid Monitor

Improved Performance, but Caution Ahead

The January 2024 winter storms were an early indicator of whether the industry's remediations to date after Uri are effective. Texas was a case in point.

- While gas production fell by about 8% nationwide, Texas authorities conducted infrastructure inspections to ensure key facilities (processing, pipelines, storage) were properly weatherized to ensure minimal impact to the gas system.
- Forced outages of dispatchable generation were a fraction of that experienced during Uri.
- Energy storage remains a small portion of Texas capability, but it may play a greater role if storage duration can be lengthened.

Midcontinent ISO avoided emergency operations but issued cold weather and conservative operations alerts during Winter Storm Heather, even as its South region hit an all-time winter peak.

- At system peak, unplanned outages totaled 36 GW, of which 17 GW were gas-fired units. This was attributed in part to gas supply availability.
- Wind provided key support, comprising 16% to 20% of the energy mix during the peak period of the storm.

PJM relied upon thermal resources for about 90% of its power, including 41% from gas generators. At its system peak of 134 GW on January 17, it was able to export 8 GW to neighboring regions.

NERC and FERC announced they would review bulk power system performance during the January 2024 storms, the results of which are expected in June 2024.

Commenting on PJM's Ability to Export During **Winter Storm Heather**

> You can't export something if you don't generate it. We know that PJM is going to lose between 30 and 40 GW [of thermal generation] in the next few years.... What NERC is warning us about is the pace of retirements of dispatchable resources is unsustainable.... The numbers just aren't going to add up.
>
> This is not a commentary against some form of resource. It's simply stating what NERC has been telling us over and over—and both MISO and PJM—that if you don't maintain these dispatchable resources until you have an absolutely adequate replacement, we're not going to have the success we've had in the last three or four days.

Mark C. Christie
FERC Commissioner

IMPLICATIONS

System operators and planners will need to focus on weatherization, preparation, inspection, and coordination—on both the power and gas systems—to meet winter demands on bulk power resources. Emergency and transmission operations practices in extreme cold conditions will be a focus of NERC over the next few years.

Some difficult decisions will remain for fossil generators. They have been the main source of energy during extreme weather in the past. While many are slated for retirement, those units are not easily replaced by intermittent resources, particularly solar, because of its non-coincident performance in winter peak conditions. Generation owners may face difficult decisions on investment in weatherization and other winter preparation.

Notes:

*Transmission system planning typically employs N-1 planning criteria (e.g., loss/outage of one system element such as a generator or transmission line) to inform resource adequacy and system transmission capacity.

Sources:

NERC; FERC; Midcontinent ISO; Energy Ventures Analysis/America's Power; Megawatt Daily; S&P Capital IQ; Natural Gas Week; EIA Hourly Electric Grid Monitor; ScottMadden analysis

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ARTICLE

Resource Adequacy: Time for a New Approach

ARTICLE

Utility Evolution Brings About the (Re)Integration of System Planning Processes

ARTICLE

Grid Reliability Is Changing Before Our Eyes

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KEY TAKEAWAYS

New and planned large loads are a key driver behind the sharp increase in peak demand and energy growth forecasts.

Demand from new manufacturing, data centers, and cryptocurrency mining far exceeds the incremental demand from electric vehicles and other beneficial electrification measures.

Federal policies encouraging domestic manufacturing, the emergence of AI, and the ban of cryptocurrency mining in China contribute to the growth.

Stakeholders are responding to large load growth with a variety of actions, ranging from accelerating the deployment of new generation to managing or slowing growth of large loads through public policy mechanisms.

Large Loads

Surging demand and energy needs from new manufacturing, data centers, and cryptocurrency mining present both challenges and opportunities.

Here Come the "Roaring Twenties" for the Electric Industry

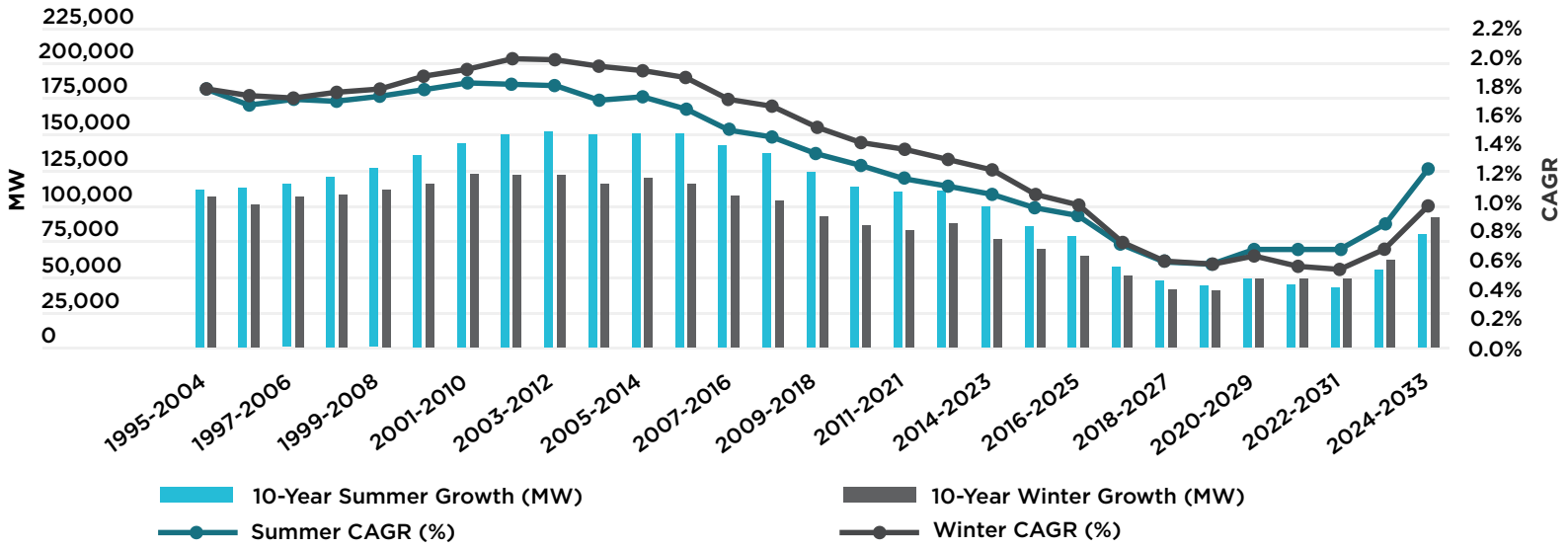
After a decade of slowing, electricity peak demand and energy growth rates in North America are increasing at a pace not seen in decades, if ever.

- NERC forecasts aggregated summer peak demand will rise by 79 GW and aggregated winter peak demand will rise by 91 GW from 2024 to 2033 (see Figure 3.1).
- As for near-term energy demands, recent FERC filings reflect a 158 TWh increase in the energy demand forecasted for 2028 (see Figure 3.2 on next page). PJM recorded the largest forecasted energy increase through 2028 (35.2 TWh). Portland General Electric expects the largest percentage increase (21.2%).

Across numerous markets, a common driver behind the dramatic change in demand and energy forecasts is the rapid expansion and planned addition of large loads. These large loads can be organized into three primary categories: new domestic manufacturing, data centers, or cryptocurrency mining.

Often described as "historic" or "unprecedented," the surge in demand and energy needs is pushing stakeholders to identify solutions and deploy resources with a unique sense of urgency.

Figure 3.1: **Forecasted 10-Year Summer and Winter Peak Growth**



Source: NERC

Figure 3.2: **Planning Areas with Greatest Increase in Projected 2028 Energy Demand**

Planning Area	2022 Forecast (TWh)	2023 Forecast (TWh)	Increase (TWh)	Percent Increase
PJM	823	858	35.2	4.1%
ERCOT	485	516	31.5	6.1%
SPP	297	324	27.0	8.3%
Duke Energy (North & South Carolina)	174	185	11.2	6.0%
Georgia Power	89	98	8.9	9.1%
NYISO	147	154	7.6	4.9%
Arizona Public Service Company	39	47	7.5	16.1%
Portland General Electric	24	30	6.3	21.2%
MISO	690	694	4.1	0.6%
CAISO	228	231	3.6	1.6%
All other planning areas	1,356	1,371	14.7	1.1%
Total	**4,351**	**4,509**	**157.7**	**3.6%**

Source: Grid Strategies

Economic Growth Surges with Boom in Domestic Manufacturing

Efforts to expand domestic manufacturing—a key priority of the Biden administration—were bolstered in August 2022 with the passage of the CHIPS and Science Act and Inflation Reduction Act.

Both laws include significant tax credits for domestic manufacturing—a driving force behind a boom in manufacturing construction spending.

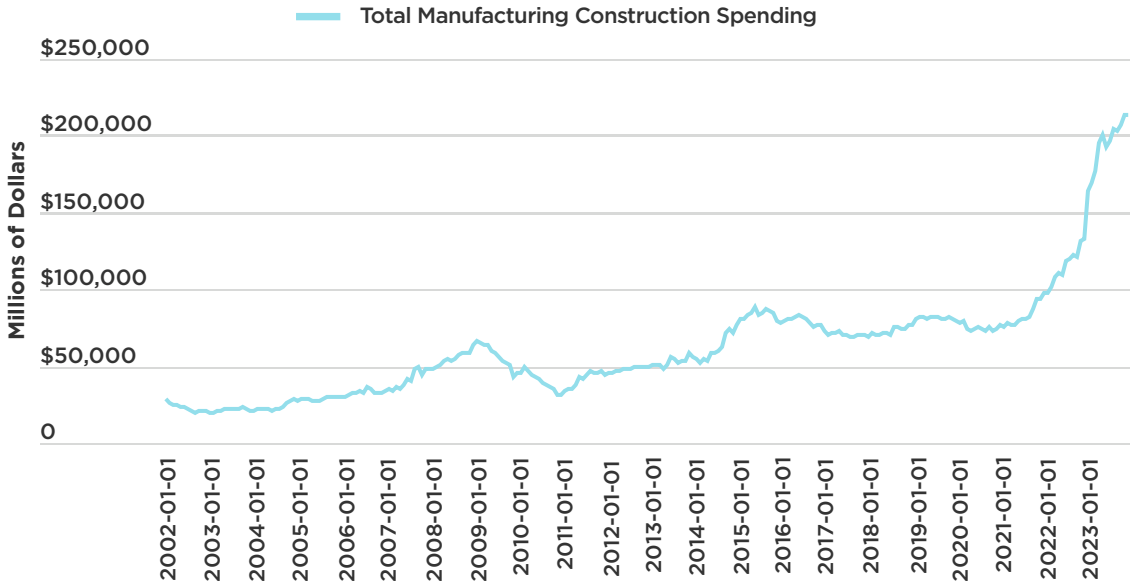
Monthly construction spending on manufacturing has nearly tripled since the end of 2020 (see Figure 3.3). Most notable is the explosive growth in computer, electronic, and electrical manufacturing facilities (see Figure 3.4).

In terms of investment, recent manufacturing announcements by sector include the following:

- Semiconductors and electronics: $235 billion
- Electric vehicles and batteries: $161 billion
- Clean energy manufacturing: $75 billion
- Biomanufacturing and heavy industry: $46 billion

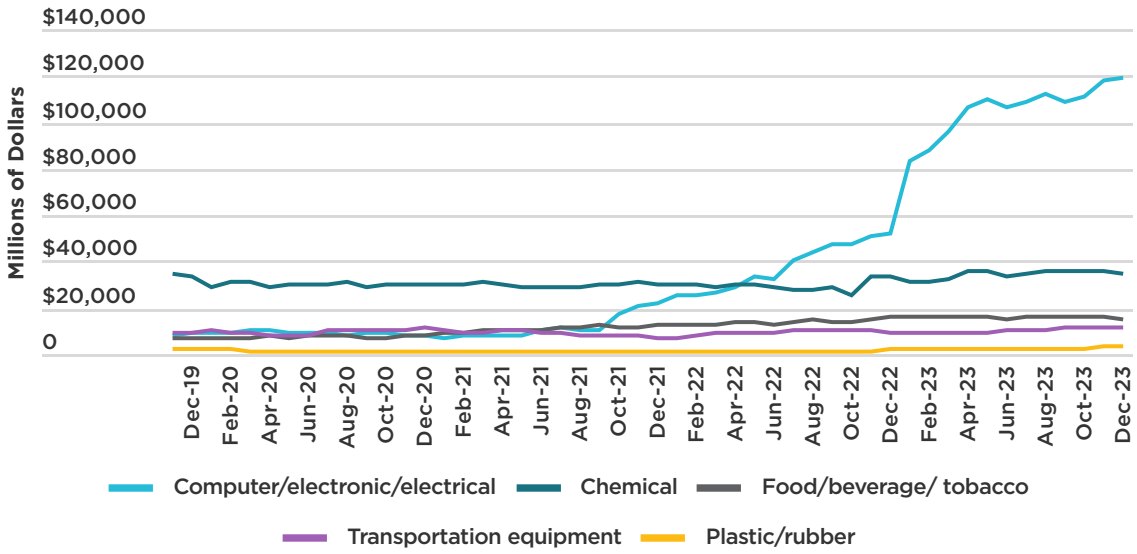
Forecasting unprecedented economic growth—often exceeding historical experience—will remain a challenge for electric utilities and grid planners.

Figure 3.3: **Value of Manufacturing Construction (Jan. 2002-Dec. 2023) (in $ Millions)**



Source: U.S. Census Bureau

Figure 3.4: **Value of Manufacturing Construction by Industry (Jan. 2018-Dec. 2023) (in $ Millions)**



Source: U.S. Census Bureau

Rapidly Expanding Data Center Clusters Can Create Challenges

Electric demand from U.S. data centers is currently 23 GW (see Figure 3.5) and forecast to grow to more than 30 GW by 2030. New data centers and advances in artificial intelligence (AI) are driving the increase in demand (see Figure 3.6).

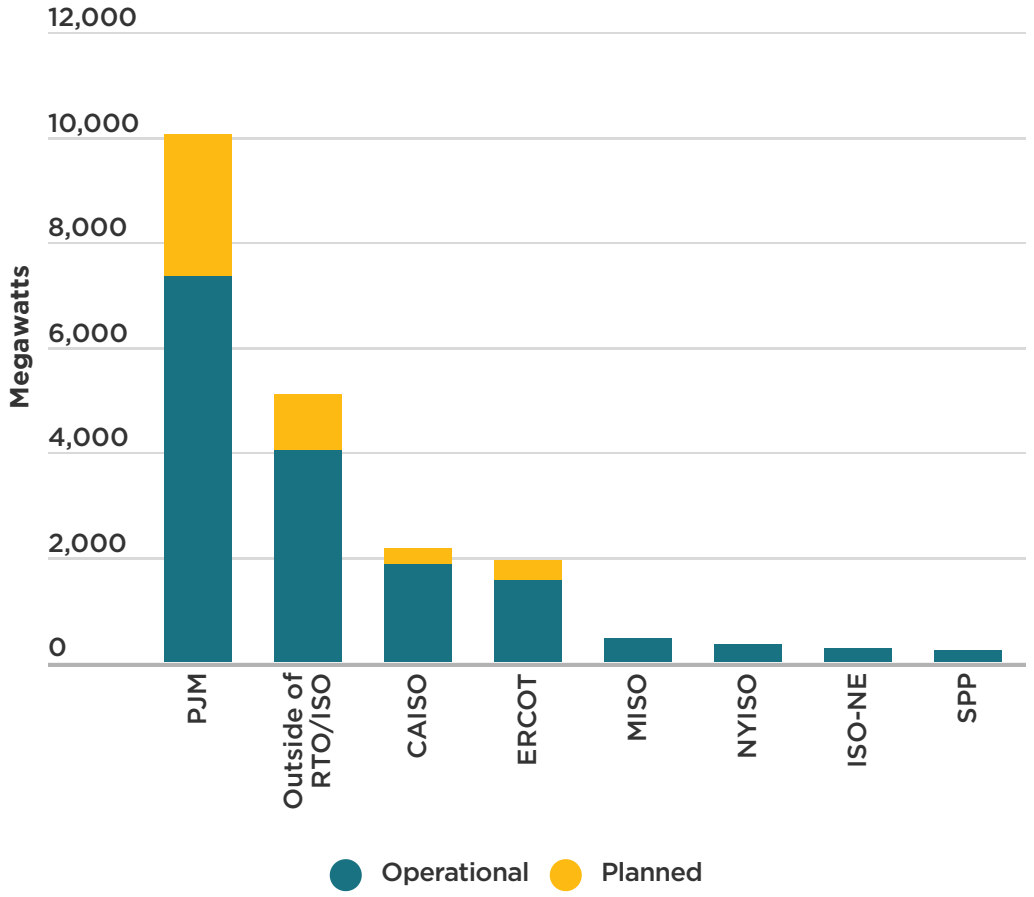
Utilities report that training AI models can consume five to seven times more energy than traditional servers. In addition, inference processes (i.e., making decisions or calculations) can consume two to three times more energy.

In many cases, data centers are clustered in specific regions.

- Dominion Energy serves Loudon County, Virginia, the largest data center market in the world. The utility has connected 81 data centers, totaling 3.5 GW in capacity, to their system since 2019.
- In the Southeast, large load projects in Georgia Power's service territory increased from ~100 MW a year to 2,200 MW in 2022. Data centers account for ~80% of the forecasted growth.
- The Western Electricity Coordinating Council nearly doubled its 10-year load forecast to account for data center growth in the Northwest. Some balancing authorities could see 50% to 200% load growth.

Hyperscale data centers, which provide cloud services, can exceed 100 MW in demand.

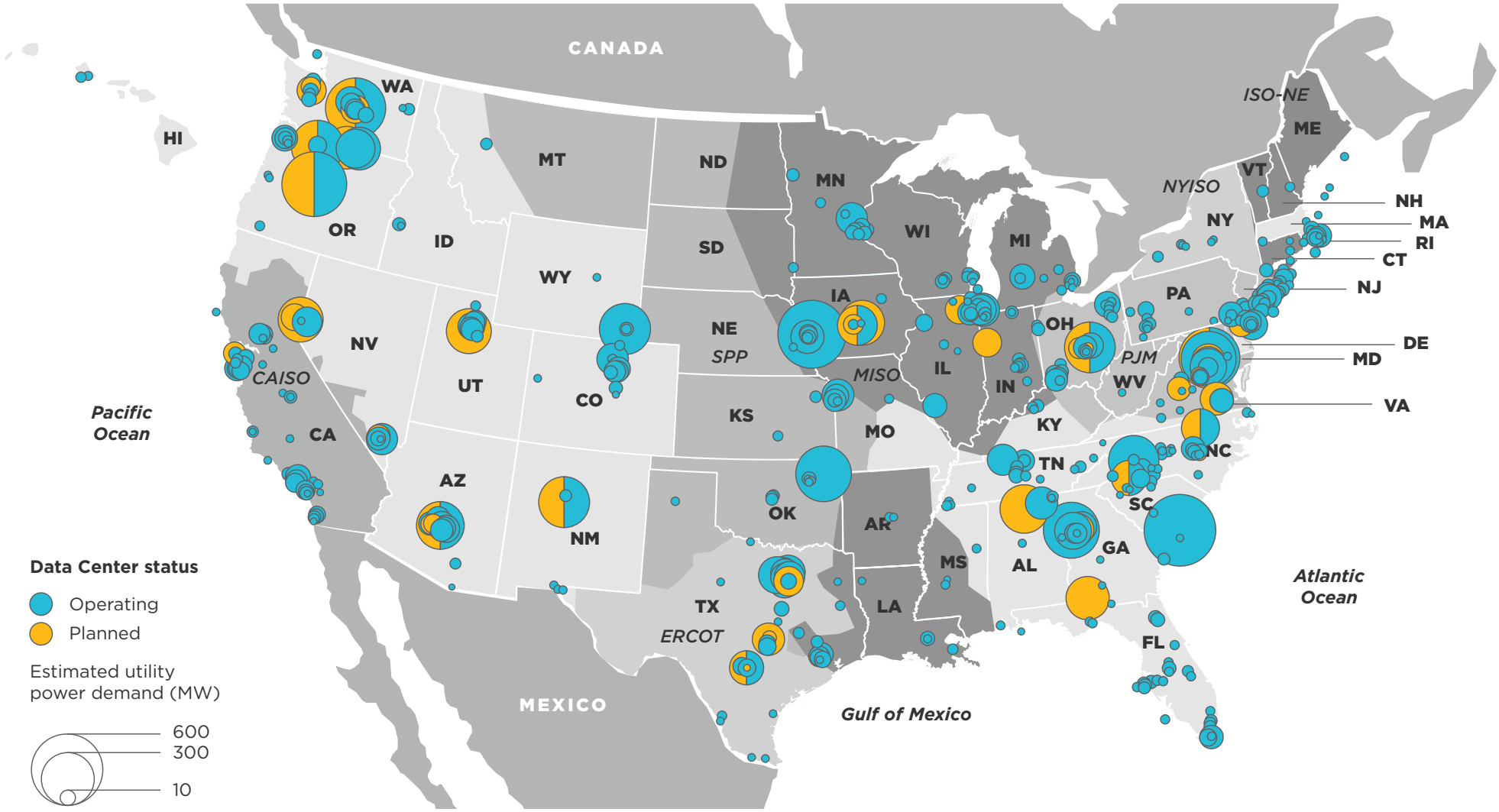
Figure 3.5: **Estimated Electricity Demand from Data Centers in U.S. Power Markets (in MWs)**



Note: Data as of October 12, 2023.

Source: S&P Global Market Intelligence, 451 Research

Figure 3.6: **Operating and Planned Data Centers in the United States**



Sources: S&P Global Market Intelligence; 451 Research; S&P Global Commodity Insights

Cryptocurrency Miners Plug in and Become Flexible Load

Cryptocurrency mining uses specialized computing resources to add blocks to a proof-of-work (PoW) blockchain—a process that validates transactions and awards miners newly minted cryptocurrency.

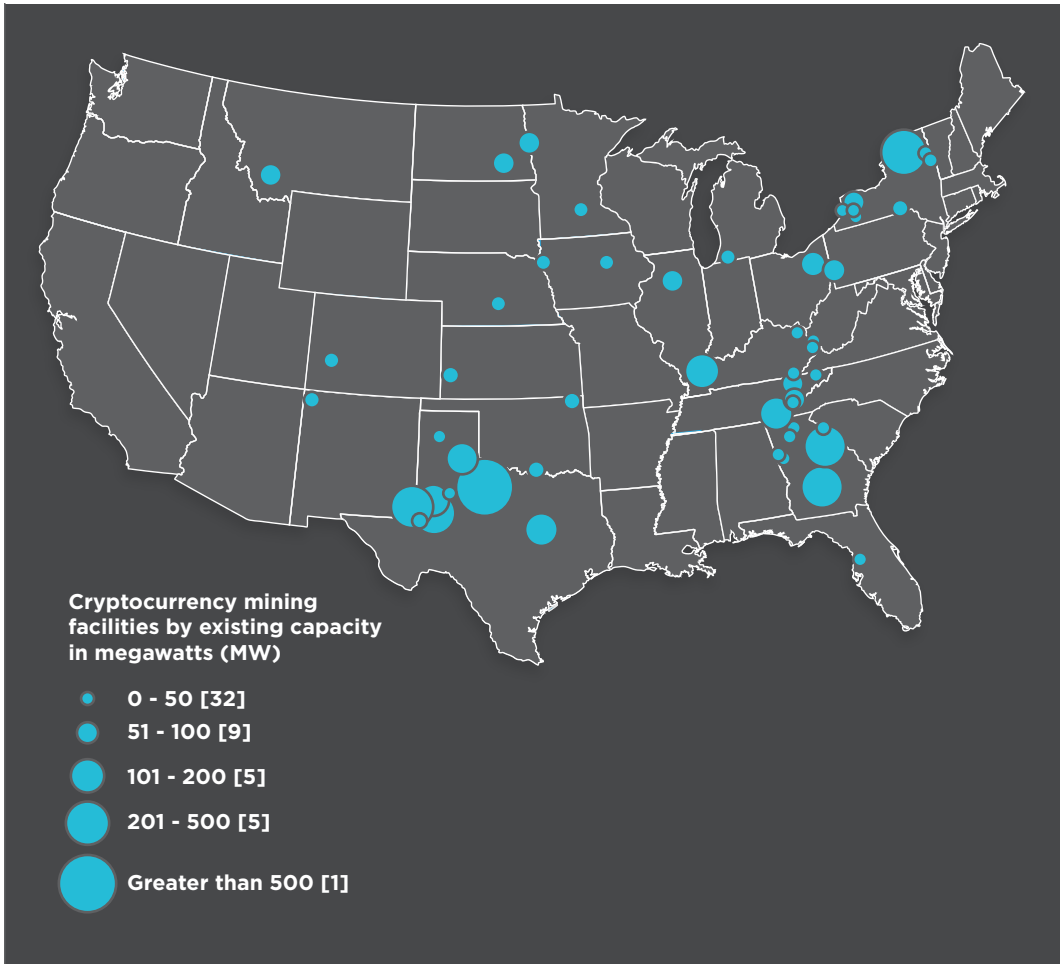
Cryptocurrency mining is increasing in the United States largely due to miners relocating after China banned the practice in 2021.

The Energy Information Administration (EIA) estimates cryptocurrency mining represents 0.6% to 2.3% of annual U.S. electricity consumption. This estimate is based on 131 known facilities, including 52 facilities with known locations (see Figure 3.7).

When selecting a location, cryptocurrency miners may minimize the price paid for electricity by:

- Locating near existing and underutilized power plants
- Directly connecting to a power generating source, avoiding costs associated with connecting to legacy electricity systems
- Locating at sites with very low-cost or stranded energy sources (e.g., natural gas wells with waste methane)

Figure 3.7: **Location of U.S. Cryptocurrency Mining Operations**



Notes: Data as of January 2024. Number in brackets represents the number of facilities.

Source: U.S. Energy Information Administration

Cryptocurrency Miners (Cont.)

Cryptocurrency miners can also serve as flexible loads and provide valuable grid services.

- As a demand response resource, mining operations can offer high availability, low cost, and quick response times. Curtailment can even occur "machine by machine," allowing demand response to the kilowatt.
- Riot, a large cryptocurrency miner in Texas, operates as a flexible load and, as a result, only paid 2.2 cents per kilowatt-hour in 2023. The company earned more than $70 million in power credits and lowered transmission costs by participating in multiple demand response programs and providing ancillary services.

In January 2024, the EIA announced an "emergency" data request from cryptocurrency mining companies. The data request was withdrawn after legal challenges; however, the EIA plans to publish in the Federal Register a new notice of proposed data collection with a 60-day comment period.

Balancing Act: Connecting and Managing Large Loads

Stakeholders are responding to large load growth with a variety of actions, ranging from adding new generation resources to managing the growth of new large loads.

With high load factors, new large loads can increase the efficiency of the electric system. To ensure their development, electric utilities are revising integrated resource plans and seeking rapid resource deployment.

- Arizona Public Service expects to add more than 6,000 MW of solar and wind power, coupled with battery storage, by 2027.
- Following an upward revision to their load forecast, Duke Energy called for additional natural gas combined-cycle capacity and introduction of offshore wind capacity.
- Meanwhile, Georgia Power requested an exception to the traditional RFP process to ensure timely procurement of resources to meet near-term load demands.

In some cases, utilities may consider delaying retirements until new and duty-suitable resources come online. Longer term, with both emissions reduction commitments and the round-the-clock load profile of many large loads, nuclear power might be considered.

Independent power producers view large loads as a growth opportunity.

- NRG Energy noted in an earnings call that they are "one of the largest competitive providers of power to hyperscalers and other data center managers."
- Elsewhere, Vistra Corp. has considered providing behind-the-meter services for data centers at nuclear and gas plants.
- Most recently, Amazon Web Services announced acquisition of a data center adjacent to Talen Energy's Susquehanna nuclear plant, with expected offtake of 480 MW.

Balancing Act: Connecting and Managing Large Loads (Cont.)

States are turning to policy mechanisms to manage growth of large loads.

- New York implemented a two-year moratorium on cryptocurrency PoW operations, and future projects will need an environmental impact statement before being permitted.
- In Georgia, data center operators are exempt from state's sales tax. Lawmakers are considering a suspension of the exemption to manage growth.

Technology advancements may also mitigate demand and energy requirements. Independent power producers view large loads as a growth opportunity.

- In 2023, the Department of Energy announced $40 million in funding for 15 projects to develop high-performance, energy-efficient cooling solutions for data centers.
- Cryptocurrencies can transition to alternative consensus mechanisms. In 2022, Ethereum moved from a PoW model to a "proof-of-stake" model. The change resulted in a 99% decrease in energy consumption.

> **We're going to be net-zero by 2050. We still absolutely believe that. But the demand growth now makes that more complicated.**
>
> **Robert Blue**
> CEO of Dominion Energy

IMPLICATIONS

The emergence of large loads is a challenge that continues to grow in scope and scale across the United States. However, after years of flat growth, this may be a "good news" story for utilities that generate revenues on a volumetric basis.

Grid operators and electric utilities are having to adjust plans in real time in effort to meet these expanding demand and energy needs. Those regions dealing with this growth will need for new generation capacity in both larger quantities and on faster timelines. In addition, it will be critical to encourage, when possible, large loads to flexibly operate to maintain reliability.

Sources:

North American Electric Reliability Corporation; Grid Strategies; Atlantic Council; Axios; Digital Energy Council; EIA; Data Centre Dynamics; Construction Dive; The White House; U.S. Census Bureau; Western Electricity Coordinating Council; S&P Capital IQ Pro; *The Atlanta Journal-Constitution*; Georgia Power Co.; Riot Platforms; Duke Energy Corp.; Arizona Public Service Co.; ScottMadden analysis

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CASE STUDY

Fleet Electrification and Infrastructure Planning

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Natural Gas Sector Developments

Regulatory and policy shifts create new demands on the local gas distribution sector.

KEY TAKEAWAYS

Jurisdictions with decarbonization or net-zero targets continue to scrutinize traditional regulatory models for natural gas distribution utilities.

Proceedings range from "future of gas" investigations to clean heat portfolios.

Utility commissions seek to balance decarbonization with affordability, particularly for low- and middle-income customers.

The key question for utilities and regulators: What are available and desirable options for decarbonization approaches and technologies that will be considered in the near and long term?

Future of Gas Proceedings Continue

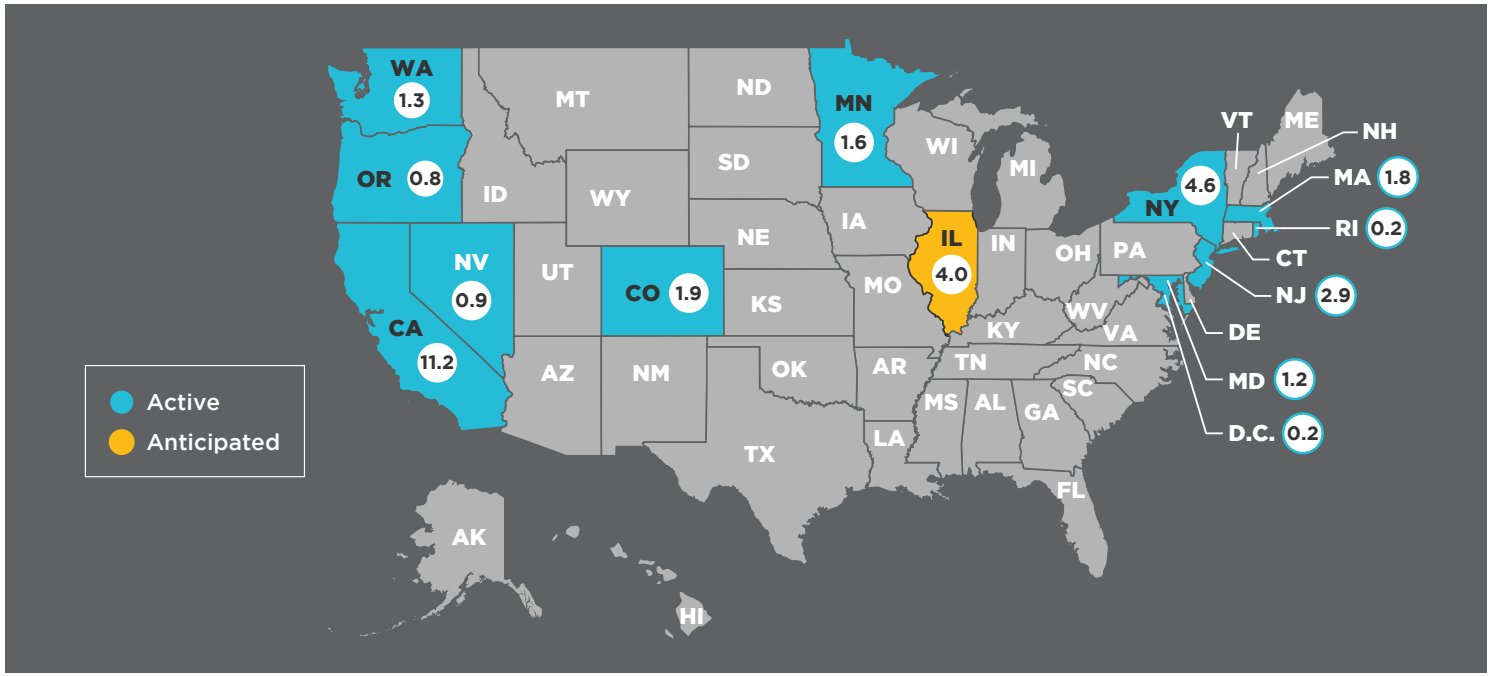
As many jurisdictions progress toward ambitious greenhouse gas reduction goals, some have initiated future of gas proceedings as commission investigations (either self-directed or incited by state legislation) or as utility commissions consider gas rate cases.

Those proceedings are largely a debate over whether and how to reinvest in or expand existing gas systems and what should be the future role of natural gas in a given jurisdiction. An additional focus for these proceedings is the role of electrification, especially in building applications.

Illinois is the latest jurisdiction to initiate a future of gas proceeding. The catalyst was consolidated rate proceedings of North Shore Gas and Peoples Gas, each of which serves the Chicagoland area.

- The Illinois Commerce Commission (ICC) reduced the utilities' rate increase requests by 34% and 25%, respectively.
- However, the ICC noted that proposed gas distribution company capital investment needed to be considered in the context of Illinois' Climate and Equitable Jobs Act, which codifies a goal of economy-wide, 100% clean energy by 2050.
- In a November 2023 order, the ICC directed commission staff to develop a plan for a future of gas proceeding in response to decarbonization proposals and issues raised by parties in the rate case dockets.

Figure 4.1: **Jurisdictions with Future of Gas Proceedings (Active or Anticipated) (as of Dec. 8, 2023)**



Notes: Numbers shown in selected states are 2022 residential customers (in millions) (rounded to nearest 100,000). Total U.S. = 72.5M.

Sources: Building Decarbonization Coalition; EIA

Future of Gas Proceedings Continue (Cont.)

The ICC noted that a rate case is not the appropriate forum for consideration of the future of gas and related decarbonization issues. A broad set of stakeholders, including electric utilities that may be impacted, is required to fully consider the topic.

Formal proceedings were initiated on March 7, 2024, with ICC staff conducting workshops from April through August. (see Figure 4.2).

Figure 4.2: **Illinois Commerce Commission Outline of Issues to Be Addressed at a Future of Gas Proceeding**

Source: ICC Orders 23-0068 and 23-0069 (Consolidated) (Nov. 16, 2023)

Clean Heat Heats Up

In consideration of the role of natural gas as an end-use energy resource, several jurisdictions have considered or are implementing a clean heat standard (CHS). A few examples include the following:

- In Vermont, legislation enacted in May 2023 directed that the utility commission design a potential CHS and to file its recommendations with the Vermont General Assembly by January 15, 2025.
- In November 2023, Massachusetts' Department of Environmental Protection released a draft CHS program framework with an anticipated rollout by 2026. A CHS had been under consideration since Fall 2021.
- In Colorado, state legislation SB 21-264 required gas distribution utilities to file a "Clean Heat Plan" with the PUC by January 2024, demonstrating a 4% and 22% reduction (in GHG emissions) by 2025 and 2030, respectively, from a 2015 baseline (see Figure 4.3).

Figure 4.3: **Overview of Colorado Clean Heat Requirements**

Overview of Colorado's Clean Heat Docket		
Legislative Mandate	▪ Colorado legislation—Senate Bill 21-264—requires gas distribution utilities to file a clean heat plan with the Colorado PUC by Jan. 1, 2024. ▪ Plans must target GHG emissions reductions of 4% by 2025 and by 22% by 2030, from a 2015 baseline.	▪ Plans may include a mix of supply and demand side resources. ▪ Colorado PUC imposed a cost cap of 2.5% of utility's total annual revenue, safe harbor for 2025 only.
Eligible Clean Heat Resources	▪ Additional energy efficiency programs outside of demand-side management (DSM) filing, DSM filing emission reductions count toward target but not the cost cap. ▪ RNG (recovered methane) sourced from inside the State of Colorado must follow the state's accounting protocols, be a qualified feedstock, and is usage capped (which severely limits cost-effectiveness).	▪ Green hydrogen ▪ Beneficial electrification ▪ Leak repair for distribution system not already required by state or federal programs ▪ Any other technology approved by the PUC
Two Portfolios	▪ Colorado PUC sought two clean heat portfolios. ▪ One clean heat portfolio must meet the emissions-reduction targets.	▪ A second portfolio must implement the maximum amount of established clean heat resources within a 2.5% retail cost impact cap.
Some Initial Issues Identified	▪ **Interpretation of targets:** A percentage below a past-year baseline does not acknowledge system growth. ▪ **Limits on RNG:** If in-state RNG is limited, larger providers (buyers) may be at an advantage.	▪ **Electrification:** Gas customers may effectively subsidize customers switching to electric heat service, as costs are spread over fewer remaining customers; electric utility funding may be needed. ▪ **Efficiency "wall":** On a dollar-per-ton basis, efficiency may be the most cost-effective resource in many cases, but customer preference may limit significant additional uptake.

Sources: Colorado Public Utilities Commission; ScottMadden analysis

Clean Heat Heats Up (Cont.)

A CHS is a performance standard, akin to a renewable portfolio standard, requiring heat providers—notably gas utilities and heating oil and propane providers and possibly electricity suppliers—to deliver a gradually increasing percentage of zero or low-emissions heating services to customers.

- These increasing annual requirements are typically pegged to greenhouse gas goals.
- Potential clean heat choices are jurisdiction specific but can include weatherization, electric heat pumps, and low-emissions heating solutions (biodiesel, RNG, district energy, solar thermal, or advanced wood heat).
- Obligated parties can deliver cleaner fuels, help convert heat systems, or purchase credits from others.

Other states are investigating building decarbonization proposals, including CHS.

- Maryland, for example, is instituting a zero-emissions heating equipment standard (ZEHES) as well as a CHS as part of the state's Climate Pollution Reduction Plan rolled out in December 2023. ZEHES would not require early replacement of equipment but will mandate conversion to zero-emissions technologies at the end of useful life of installed equipment.
- Maryland's Department of the Environment will initiate a rulemaking to propose a draft regulation by the end of 2024 and adopt a final regulation by the end of 2025.

Massachusetts Issues Final Order in Its Future of Gas Proceeding

Massachusetts initiated its future of gas proceeding (D.P.U. 20-80) in 2020, after its Department of Public Utilities (DPU) opened an investigation of the role of gas in achieving the state's goal of economy-wide net-zero greenhouse gas emissions by 2050.

The proceeding focused on eight potential decarbonization "pathways" and regulatory design recommendations for the DPU to consider in its policies and structures governing local gas distribution companies operating in Massachusetts.

In early December 2023, the DPU issued its final order in that docket. In that order, it stated "beyond gas" regulatory principles. While the traditional notions of the regulatory compact continue to apply, the DPU stated that Massachusetts' net-zero objective required that "a different lens will be applied to gas infrastructure investments going forward." In particular:

- Examining more closely whether gas infrastructure investments are "in the public interest"
- Moving beyond "business as usual" in gas system planning, whether involving proposed expansion of service or safety investments
- Examining non-pipeline alternatives (broadly defined) as a condition of recovering gas pipeline and main investments

Massachusetts Issues Final Order in Its Future of Gas Proceeding (Cont.)

The D.P.U. 20-80 order made specific findings on natural gas regulatory design going forward in key areas such as heating technologies, renewable natural gas, pilots and innovation, embedded gas infrastructure and cost recovery, customer affordability, and transition planning. A summary of those findings and conclusions are shown in the table at Figure 4.4.

The order leaves as many questions as answers, many of which will have to be considered as Massachusetts' local gas distribution companies (LDCs) prepare their climate compliance plans, which are due on or before April 1, 2025. For example:

- How do LDCs navigate needed repairs for reliability, safety, and leak protection under a "beyond gas" construct?
- How do LDCs and regulators balance affordability and adequate cost recovery for mandated transition activity such as non-pipes alternatives and early migration of customers from the gas system as well as impacts on remaining customers (including income-qualified customers)?
- How will non-combination LDCs coordinate planning with electric utilities?
- How will LDCs preserve options amidst uncertain cost, technology, and policy developments?

Figure 4.4: **Summary of Regulatory Design Findings in MA D.P.U. 20-80**

	Key Conclusions	
Support customer adoption and conversion to electrified/ decarbonized heating technologies	▪ No use of exit fees or transfers to offset increased EE budgets ▪ No ratepayer funding of marketing geared toward promotion of new gas service ▪ If investment to serve a new gas customer does not pass an internal rate-of-return test, may require customer to pay to make up deficit	▪ Replace current per-customer rate decoupling mechanism with a total revenue or revenue cap decoupling mechanism ▪ For hybrid heating, rate design should not encourage gas as primary heating fuel
Blend renewable gas supply into gas-resource portfolios	▪ Inappropriate to use RNG in a gas resource portfolio ▪ No socialization of costs—system upgrades or commodity—under an RNG program; participants pay	▪ May consider RNG or hydrogen for hard-to-electrify applications
Pilot and deploy innovative electrification and decarbonized technologies	▪ Hybrid heating seen as short-term solution, not feasible to maintain gas system solely for backup heating ▪ Geothermal, hydrogen, and RNG pilots supported but cost-effectiveness screening is required	▪ Significant research needed before hydrogen can be injected into LDC distribution systems ▪ LDCs must work with relevant electric distribution companies for targeted electrification studies
Manage gas-embedded infrastructure investments and cost recovery	▪ Pre-approval of investments not currently appropriate ▪ For future cost recovery proposals, LDCs must demonstrate NPA* nonviability or cost prohibitive	▪ LDCs directed to conduct review to forecast size of stranded investments, cost recovery, shareholder risk, affordability, and equity
Evaluate and enable customer affordability	▪ Develop framework to identify, quantify transition costs as gas customers leave system ▪ Develop additional policies and incentives for low-income electrification	▪ Incentives for weatherization and heat pump conversions to reduce energy consumption and bill impacts
Develop LDC transition plans and chart future progress	▪ LDCs must file individual Climate Compliance Plans every five years; first plan due on or before April 1, 2025	▪ DPU will amend existing incentives in performance-based regulation framework

Note: *Non-gas pipes alternatives
Source: Massachusetts DPU Order, D.P.U. 20-80-B (Dec. 2023)

Proposed New York State Budget Suggests Building Decarbonization

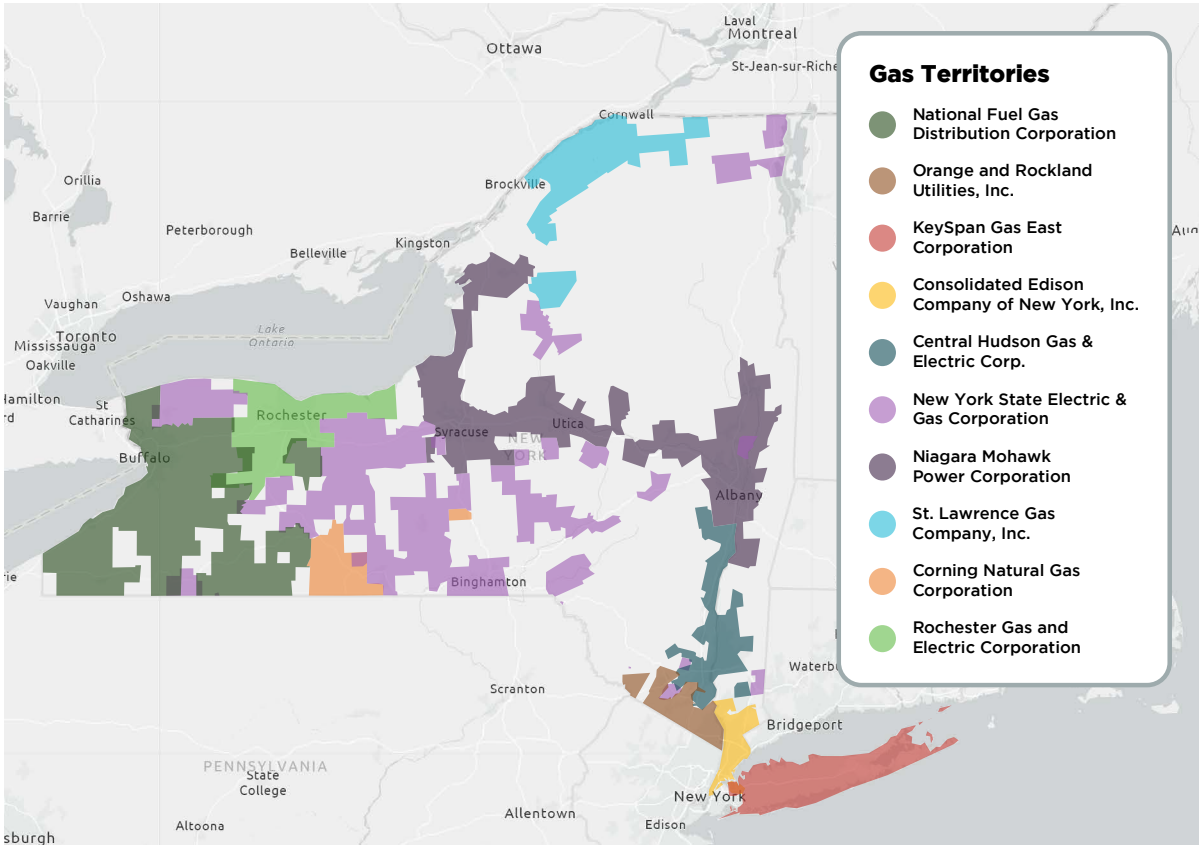
In February 2023, the New York State Senate introduced the NY Home Energy Affordable Transition Act (HEAT Act). That act sought to, among other things:

- Remove a residential customer's legal entitlement to utility gas services.
- Remove the 100-foot rule, by which, for new gas customers, utilities pay for connection if those customers reside within 100 feet of an existing gas main.
- Regulate for the continued provision of gas service to existing residential customers unless such service is discontinued under a PUC-approved program that ensures customers have access to safe, reliable, and "clean" substitutes to gas prior to cessation of service.
- Cap energy bills for customers at 6% of their household income.

This legislation was passed by the State Senate but did not pass committee in the State Assembly.

New York Governor Kathy Hochul released her fiscal year 2025 budget in early January 2024. In that budget, Gov. Hochul reprises some key provisions of the HEAT Act in new proposed legislation: the Affordable Gas Transition Act (AGTA).

Figure 4.5: **New York Gas Local Distribution Companies and Territories**



Source: S&P Capital IQ Pro

> It continues to be my belief that we should use our extensive, storm-resistant natural gas system and offer a dual-heating option that combines renewable energy with natural gas when temperatures dip below freezing.
>
> **Donna DeCarolis**
> President, National Fuel Gas Distribution Corp.

Tapping the Brakes on Proposed Natural Gas Bans

In 2019, the city of Berkeley, California, enacted an ordinance prohibiting natural gas infrastructure in newly constructed buildings. The ordinance spurred dozens of other cities to do the same. As of January 2024, 147 municipalities have established zero-emissions building ordinances for new construction.

Gas industry, appliance, and large user organizations (e.g., restaurants) challenged the Berkeley ban. After a district court dismissed their action, a three-judge panel of the federal Ninth Circuit Court of Appeals agreed to hear the case.

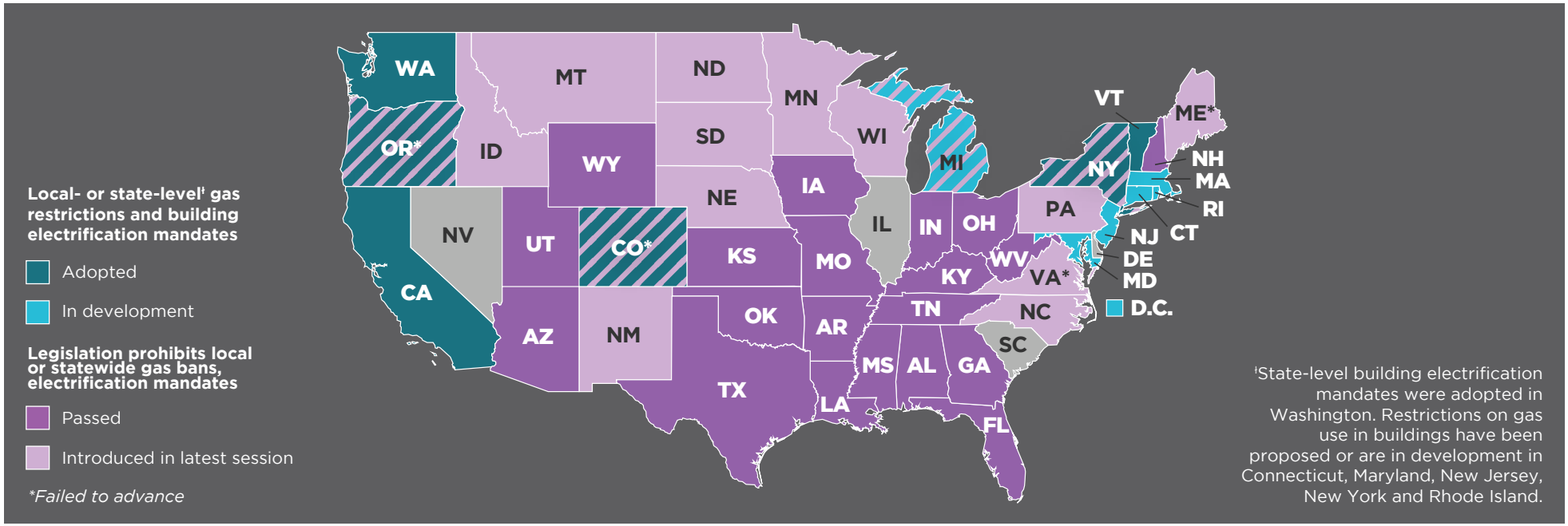
In April 2023, the court found that the federal government preempted Berkeley's ability to effectively ban gas appliances. Congress enacted the Energy Policy and Conservation Act, under which the Department of Energy establishes appliance efficiency standards and expressly preempts state and local regulations concerning "energy use" of gas appliances.

One analysis by law firm Akin Gump summarized the court's rationale: "The city's ban on natural gas hookups for new construction constituted a regulation of the 'energy use' of the covered products. By hiding 'energy use' regulations in building codes, the city effectively was doing indirectly what Congress prohibited them from doing directly."

An appeal for an en banc (i.e., all judges) hearing was declined on January 2, 2024. The ruling is applicable only in states in the Ninth Circuit footprint. Some municipalities have suspended enforcement of similar ordinances while the case evolves and appeals continue.

Some analysts note that states and municipalities may seek other alternatives to limit natural gas uses, noting that the court was careful to clarify that states can continue to regulate natural gas distribution under the federal Natural Gas Act.

Figure 4.6: **Gas Bans and Ban Prohibitions (as of June 26, 2023)**



Source: S&P Capital IQ Pro

IMPLICATIONS

Gas utilities in jurisdictions with aggressive decarbonization goals should engage policymakers and regulators as they consider potential pathways to a lower-emissions future. Being proactive with options and education, as well as influencing policy prescriptions, can smooth any transition sought by regulators and stakeholders.

Customer uptake and acceptance is also a significant factor. Government mandates and restrictions can cause serious customer pushback, so a gradual approach in jurisdictions that have demonstrated customer interest is key to programs effectiveness.

For decarbonization solutions such as clean heat, utilities should draw lessons from vehicle electrification efforts. In those cases, balance, patience, and well-executed transition activities are critical for success.

Sources:

Acadia Center; Vermont Public Utility Comm'n; *Daily Hampshire Gazette*; Massachusetts Dept. of Public Utilities; Colorado Public Utilities Comm'n; Illinois Commerce Comm'n; Regulatory Assistance Project; Maryland Dept. of the Environment; Building Decarbonization Coalition; New York State Assembly; S&P Capital IQ; Fox News; National Fuel Gas Co.; *California Restaurant Association v. City of Berkeley*, No. 21-16278 (Apr. 17, 2023); American Public Gas Ass'n; Air-Conditioning, Heating, and Refrigeration Institute; *Reason*; Akin; industry news; ScottMadden analysis

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ARTICLE

How States Are Tackling Clean Heat and What It Means for Utilities

ARTICLE

Gas Local Distribution Company Peer Analytics

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Workforce Development

Utilities seek to attract and retain talent in a competitive labor environment with integrated workforce planning and development.

KEY TAKEAWAYS

A survey conducted for the Center for Energy Workforce Development shows the energy industry workforce has stabilized, with Millennials representing the largest portion of the workforce.

Most workers have less than 10 years of service, suggesting that many aging workers have been replaced by younger workers.

Reskilling and retraining may be needed to fill the growing number of emerging technology jobs being created by the energy transition.

Both non-retirement and total attrition have significantly increased; however, it remains unclear if this is a new normal or transitory post-COVID adjustment. Retention efforts will be critical for utilities.

An integrated workforce planning and development program can provide a competitive advantage and address workforce challenges.

Workforce Challenges Persist Throughout the U.S. Economy

Despite the end of pandemic restrictions, attracting and retaining talent remains a persistent challenge for many companies.

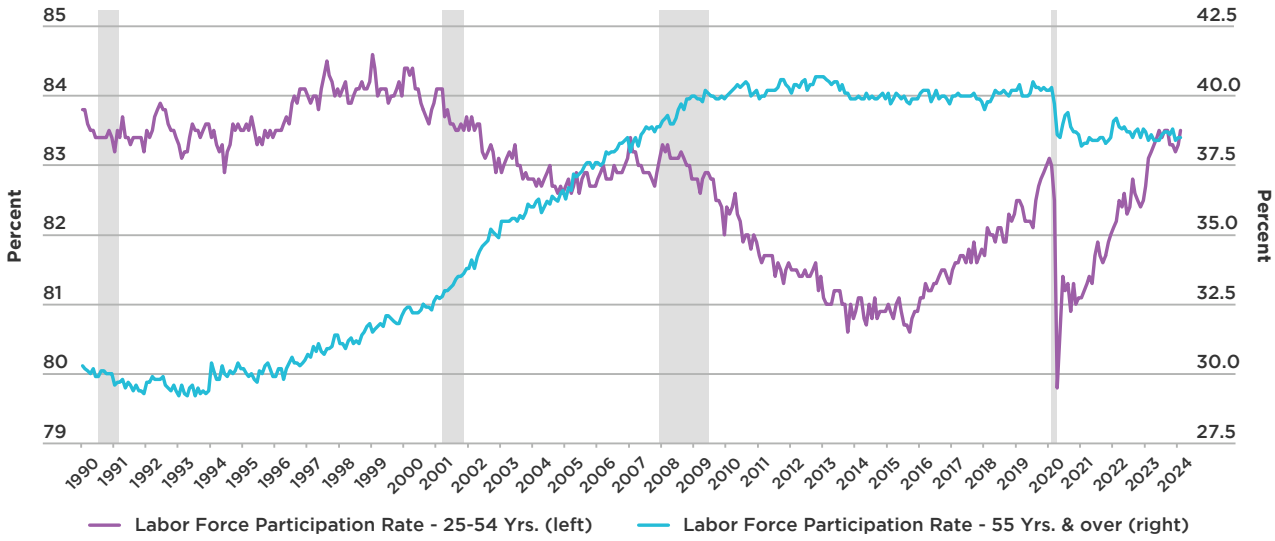
Notable workforce trends include:

- Labor force participation of prime-age workers (25 to 54 years old) is approaching highs not seen since the early 2000s.
- The participation of older workers (55 years old and above) has not recovered to pre-pandemic levels, a trend likely driven by the retirement of Boomers (born between 1946 and 1964).
- The ratio of job openings to hires—a proxy for the average time needed to fill a position—remains near historic highs despite recent declines.

To understand specific challenges facing the energy sector, ScottMadden facilitated the Center for Energy Workforce Development's (CEWD) biennial energy workforce study, which provided insights on specific challenges facing the energy sector from data collected from 40 electric and natural gas utilities and energy companies.

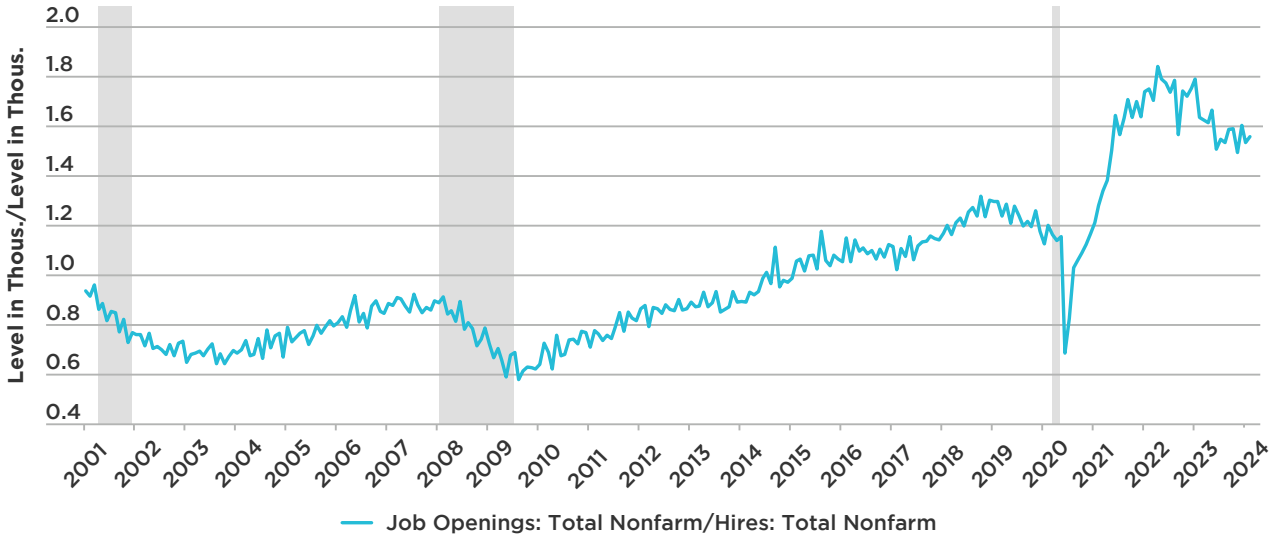
Key findings from the CEWD survey, which was completed in 2023, are presented on the following pages. In addition, we outline an approach to integrated workforce planning and development.

Figure 5.1: **U.S. Labor Force Participation by Age Group Seasonally Adjusted (1990-2024 YTD)**



Note: Shaded areas indicate U.S. recessions. **Sources:** U.S. Bureau of Labor Statistics; ScottMadden analysis

Figure 5.2: **Ratio of U.S. Job Openings to Hires (Nonfarm, Seasonally Adjusted) (2001-2024 YTD)**



Note: Shaded areas indicate U.S. recessions. **Sources:** U.S. Bureau of Labor Statistics; ScottMadden analysis

Aging Workforce Concerns Replaced by Need to Train Younger Workers

Concerns over an aging workforce have been replaced with a new challenge focused on developing a younger workforce.

When viewed by generations, Millennials (born between 1981 and 1995) now represent the largest percentage of employees in the energy industry, exceeding both Generation X (born between 1966 and 1980) and Boomers. Also notable, more than 50% of workers have fewer than 10 years of service. The data suggest that many aging workers with lengthy experience have been replaced by newer workers.

In response, the energy industry will need to redirect some of its focus from recruitment to training, mentorship, and other programs to develop its younger, less experienced workforce.

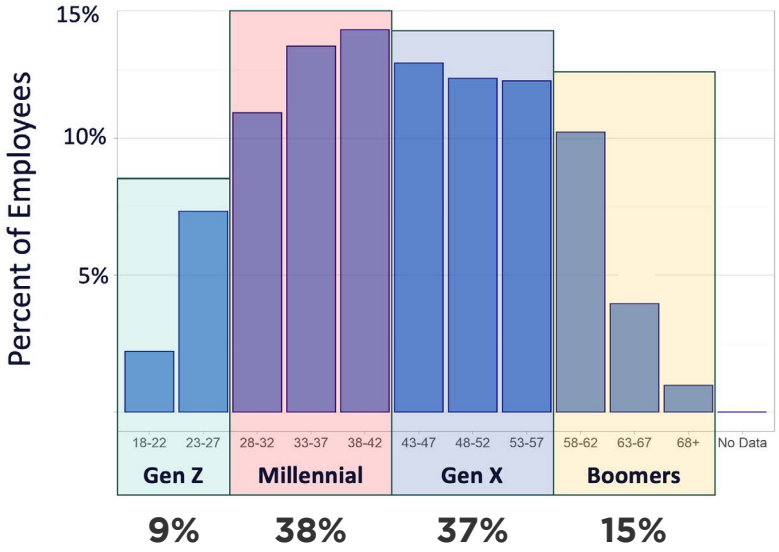
Few Emerging Technology Jobs, but Category Shows Significant Growth

While still a small portion of the overall utility workforce, emerging technology jobs approximately quadrupled between 2021 and 2023. The survey defined emerging technology jobs as data scientists, as well as solar, wind, storage, and EV engineers and technicians.

A significant number of emerging technology jobs are held by mid- to late-career individuals, suggesting these positions are being filled by both younger workers and experienced individuals moving into these roles.

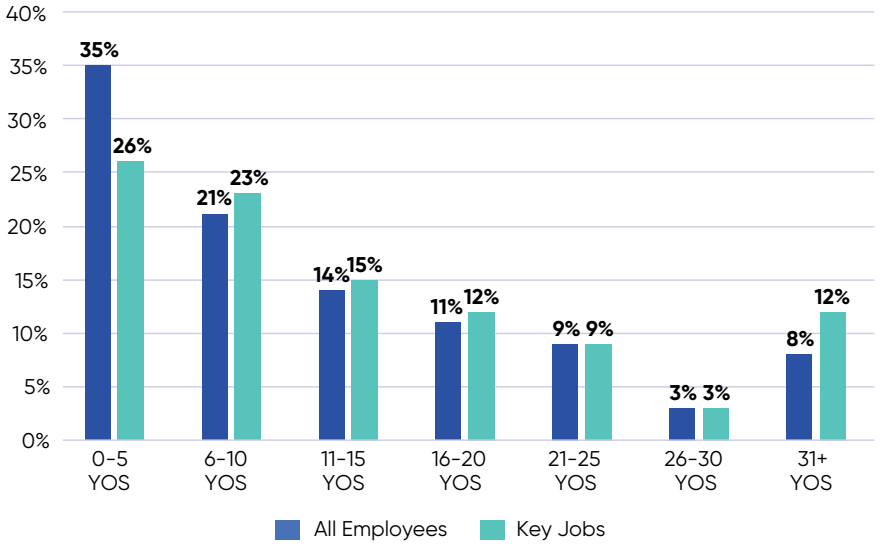
Consequently, the energy transition will require careful management of workforce changes and a focus on programs to retrain and reskill displaced workers to perform new energy jobs.

Figure 5.3: **Percent of All Utility Employees by Age Group (Surveyed Utilities)**



Source: Center for Energy Workforce Development

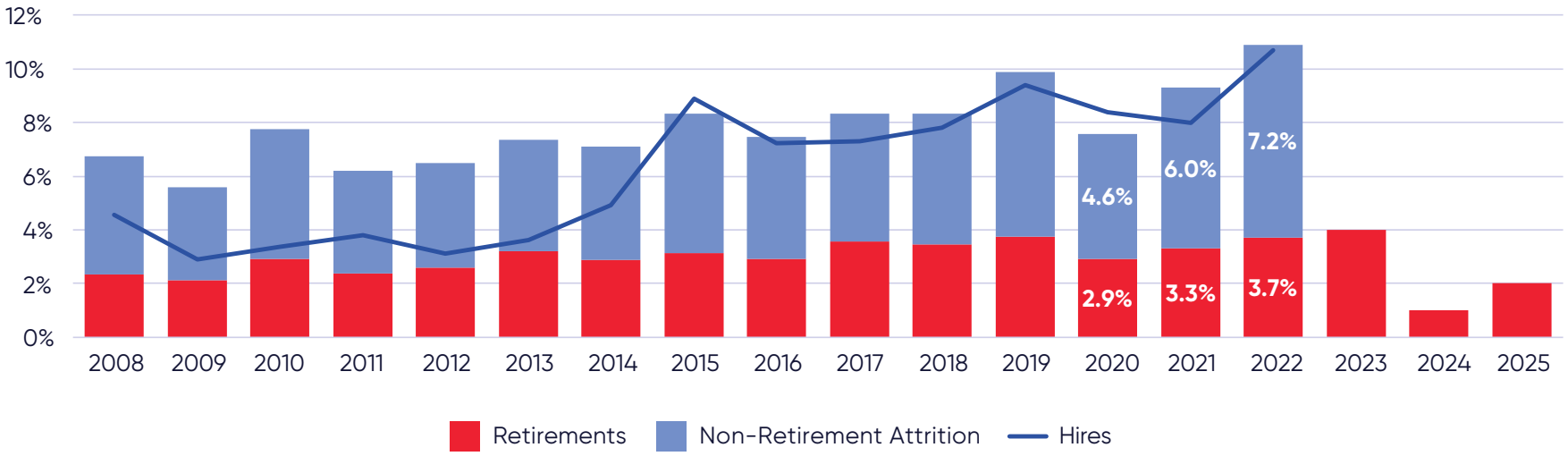
Figure 5.4: **Percent of Utility Employees by Years of Service (Surveyed Utilities)**



Notes: YOS means years of service. "Key Jobs" are primarily line operating positions and exclude administrative and support organization positions.

Source: Center for Energy Workforce Development

Figure 5.5: **Total Attrition and Hires for U.S. Utilities as a % of Total Workforce (2008 to 2022) (Surveyed Utilities)**



Source: Center for Energy Workforce Development

Attrition Spikes Post-COVID, but Long-Term Trend Remains Unclear

Both non-retirement and total attrition have significantly increased in the last two years. In 2022, these metrics hit the highest level since the CEWD survey began in 2008.

It is unclear if the elevated attrition reflects a new normal post-COVID or some natural adjustment after a period of very low turnover during the height of the pandemic.

If elevated attrition persists, the energy industry will need to increase focus on retention efforts and programs to encourage workers to build long-term careers in energy. This may include placing a greater emphasis on employee health and wellness.

Companies Report Relatively High Adoption of Diversity, Equity, and Inclusion (DE&I) Practices

The survey asked participants to report on the adoption of 13 different DE&I practices. Response options ranged from "currently in place" to "no plans to implement."

Survey results show favorable adoption of DE&I practices with 9 of 13 practices being adopted by 75% or more of the participants. Adoption was generally higher among larger companies, those with nuclear, and those with a dedicated DE&I leader.

The most adopted practice (87% of participants) was having DE&I strategies and goals within the company. The least adopted practice (27% of participants) was DE&I training for board members.

Tackling the Talent Challenge with Integrated Workforce Planning and Development

In response to recent workforce challenges, many companies have launched workforce planning and development strategies and initiatives.

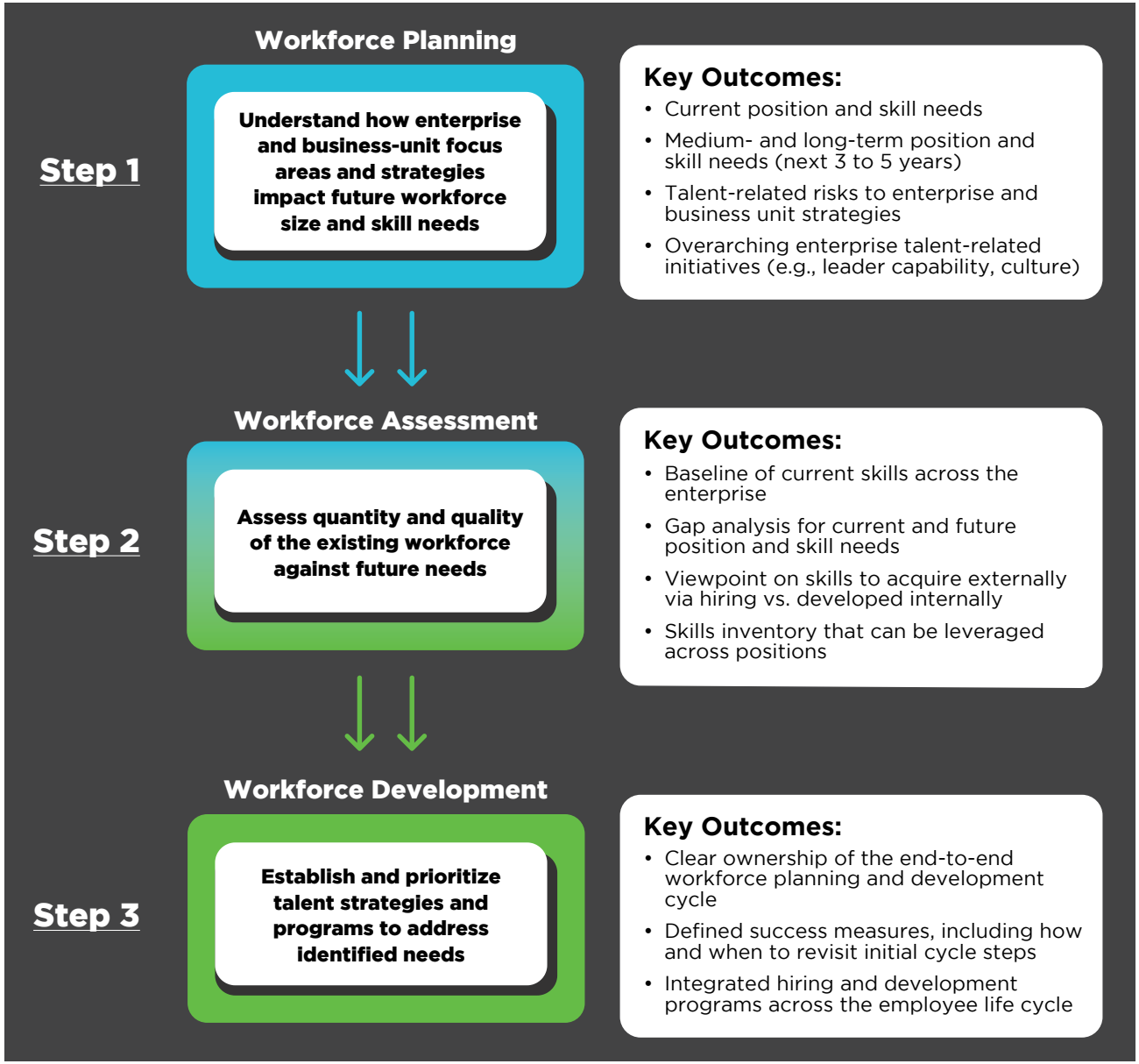
However, these programs are often developed in silos, which leads to misaligned business and people strategies, a disjointed employee experience, and lackluster returns on investment.

A better approach is to implement an end-to-end workforce planning and development program. An integrated approach allows a company to establish a foundation from which multiple talent strategies can be developed, including:

- Anticipating and planning for changes in workforce sizes and skill needs
- Enhancing leadership capabilities and functional expertise
- Managing the workforce and retaining top talent

Implementing a successful integrated framework includes three steps—workforce planning, workforce assessment, and workforce development (see Figure 5.6).

Figure 5.6: **Integrated Workforce Planning and Development**



Source: ScottMadden

IMPLICATIONS

The energy industry faces new workforce development challenges. Concerns about an aging workforce have been replaced with a need to enhance the skills of younger workforce and develop talent in emerging technologies.

In addition, some degree of flexibility may be needed to attract and retain talent. For example:

- Recruiting talent from new sources (e.g., community partnerships, expanded geographical focus)
- Adjusting minimum requirements for certain positions (e.g., experience, education)
- Enhancing health and wellness offerings (e.g., onsite childcare, wellness funds)

Regardless of the specific approach, an integrated workforce planning and development program can provide a strong foundation that supports a robust collection of talent strategies.

Notes:

Generational birth year ranges are estimates. There are several formulations depending upon the demographer and institution studying intergenerational characteristics. Survey results shown at Figures 5.3, 5.4, and 5.5 are based upon a survey of 41 U.S. electric and natural gas utilities.

Sources:

Center for Energy Workforce Development, 2023 Energy Workforce Survey Results (2023), executive summary available at https://cewd.org/wp-content/uploads/2023/01/CEWD-2023-Workforce-Report-Executive-Summary_2023-FINAL-1.pdf; U.S. Bureau of Labor Statistics; The Conference Board; U.S. Chamber of Commerce

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Talent Struggles: The Importance of Workforce Planning

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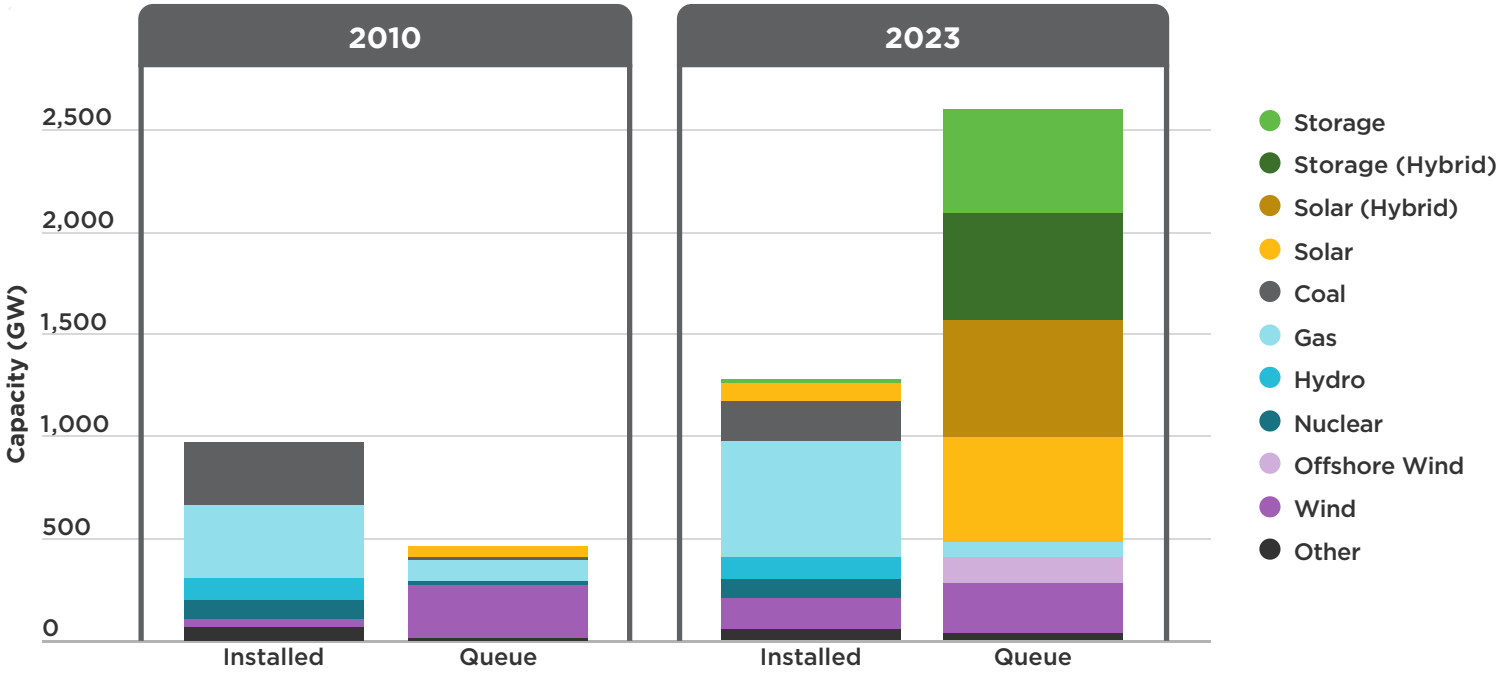
The Interconnection Queue to Installed Capacity Ratio Has Dramatically Increased Since 2010

95% of the resources currently in the interconnection queue are zero-carbon resources with nearly 1,500 GW of generator capacity and 1,000 GW of storage capacity.

Historically, only ~20% of interconnection requests, comprising 14% of planned capacity for interconnection, made from 2000 through 2018 reached commercial operations by the end of 2023.

Figure 6.1: **Entire U.S. Installed Generation Capacity vs. Active Projects in Interconnection Queue**



Source: Lawrence Berkeley National Laboratory, Queued Up: 2024 Edition

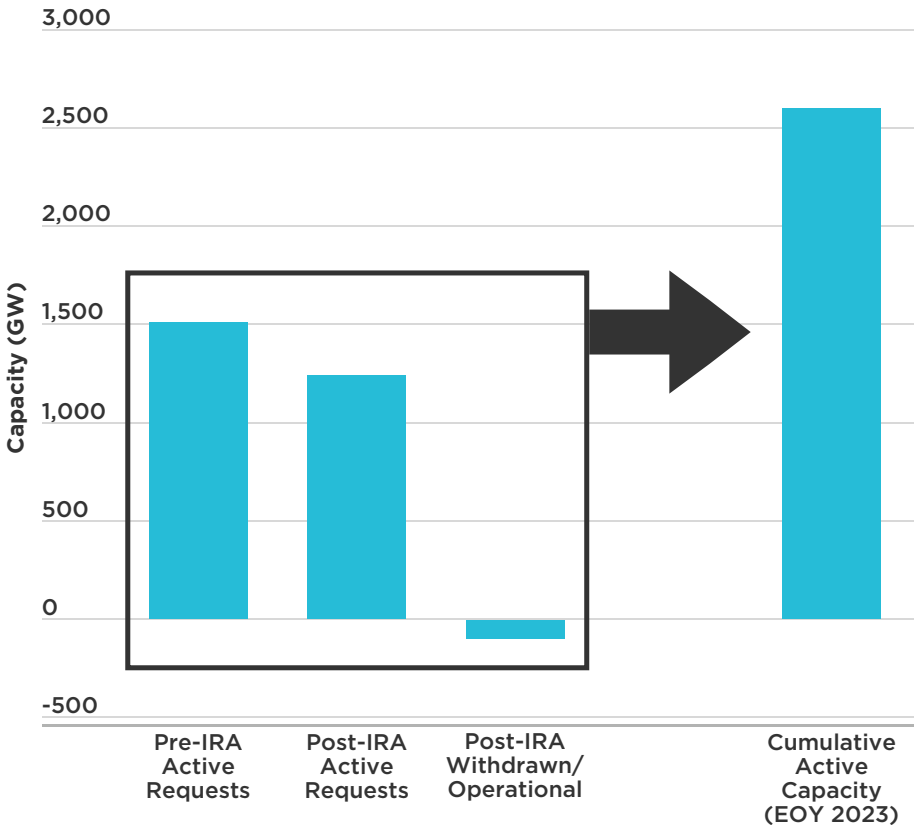
Provisions Contained in the Inflation Reduction Act (IRA) Supercharged Clean Energy Development in the Interconnection Queue

With a phase out no earlier than 2032, the new Clean Energy Investment Tax Credit (ITC) and Clean Energy Production Tax Credit (PTC) provide entities with the security of long-term planning.

The new credits, which become effective in 2025, will be technology neutral and include eligiblity for standalone storage and new nuclear assets.

Further, there are adder provisions related to wage and apprenticeship requirements, domestic content, energy and low-income communities, and low-income project requirements that can raise the maximum ITC from 6% to 70% and the PTC from .50¢/kWh to 3.20¢/kWh.

Figure 6.2: **Interconnection Queue Activity Pre- and Post-IRA**



Source: Lawrence Berkeley National Laboratory, Queued Up: 2024 Edition

GLOSSARY

AI
artificial intelligence

Ass'n
Association

B
billion

Bcfe
billions of cubic feet equivalent

CAGR
compound annual growth rate

CAISO
California ISO

capex
capital expenditure(s)

CEWD
Center for Energy Workforce Development

CHS
clean heat standard

Comm'n
Commission

DE&I
diversity, equity & inclusion

DPU
department of public utilities

EEI
Edison Electric Institute

EIA
U.S. Energy Information Administration

ERCOT
Electric Reliability Council of Texas

EV
electric vehicle

FERC
Federal Energy Regulatory Commission

GHG
greenhouse gas

GW
gigawatt

GWh
gigawatt-hour

ICC
Illinois Commerce Commission

IIJA
Infrastructure Investment and Jobs Act

IOU
investor-owned utility

IRA
Inflation Reduction Act of 2022

ISO
independent system operator

kWh
kilowatt-hour

LDC
local gas distribution company

LNG
liquefied natural gas

M or mil.
million

MISO
Midcontinent Independent System Operator

MMBtu

million British thermal units

MW

megawatt

MWh

megawatt-hour

N-1

a standard transmission planning criteria that studies impact of the loss/outage of one system element (such as a generator or transmission line) to inform resource adequacy and transmission capacity needs

NERC

North American Electric Reliability Corporation

NYISO

New York ISO

PJM

PJM Interconnection LLC

PoW

proof of work

PSC

public service commission

PUC

public utility commission

RFP

request for proposal

RNG

renewable natural gas

ROE

return on equity

RTO

regional transmission organization

SPP

Southwest Power Pool

T&D

transmission and distribution

ZEHES

zero emissions heating equipment standard

ENERGY PRACTICE
ScottMadden Knows Energy

About ScottMadden
We know energy from the ground up. Since 1983, we have served as energy consultants for hundreds of utilities, large and small, including all of the top 20. We focus on Transmission & Distribution, the Grid Edge, Generation, Energy Markets, Rates & Regulation, Enterprise Sustainability, and Corporate Services. Our broad, deep utility expertise is not theoretical—it is experience based. We have helped our clients develop and implement strategies, improve critical operations, reorganize departments and entire companies, and implement myriad initiatives.

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