

A Framework for Streamlining Large Load Interconnection

An Assessment of Current Practices and
Emerging Strategies for Fair and Efficient
Load Interconnection Processes

September 2025

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Acronyms and Abbreviations

AI	artificial intelligence
CHILL	Conditional High Impact Large Loads
ERCOT	Electric Reliability Council of Texas
GW	gigawatt(s)
HILLGA	High Impact Large Load Generation Assessment
i2X	Interconnection Innovation e-Xchange
ISO	Independent System Operators
kV	kilovolts
LEL	large electric load(s)
LLIS	Large Load Interconnection Study
MISO	Midcontinent Independent System Operator
MW	megawatt(s)
NERC	North American Electric Reliability Corporation
PJM	PJM Interconnection, LLC
POI	point of interconnection
PUC	public utility commission
RTO	Regional Transmission Operators
SAIFI	system average interruption frequency index
SPP	Southwest Power Pool
WECC	Western Electricity Coordinating Council

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1.0 Introduction

Proposals to connect large electric loads (LELs), particularly data centers, to the grid are increasing rapidly nationwide, with load growth from data centers specifically having tripled over the last decade (Shehabi et al. 2024). This growth has created growing uncertainty for regulators, developers, and utilities. These uncertainties are exacerbated by the lack of a standardized approach to managing load interconnection queues (Quint, Thomas, et al. 2025; Clements and Freed 2025).

Data centers themselves are not new, but the notable recent increase in the number and total capacity of data centers connected to the grid in the United States has skyrocketed largely due to the rise of artificial intelligence (AI). Research has shown that overall energy use from data centers remained relatively stable until 2017, because the then-steady increase in data center deployment was largely offset by efficiency gains from technological improvements. By approximately 2018, coincident with the advent of dedicated AI servers, data center load growth began to accelerate much faster than efficiency improvements. Although exact forecasts vary depending on future technological advancements and power requirements, among other factors, current projections estimate that data centers will account for between 6.7 and 12 percent of total U.S. electricity consumption by 2028, up from 4.4 percent in 2023 and only 1.9% in 2018 (Shehabi et al. 2024).

Consistent with these projections, utilities across the country are seeing a rapid uptick in LEL interconnection requests. Unlike generator interconnection requests, the location of a data center is not tied to the customers it serves or the location of fuels or resources. Data centers serve their customers via Internet connection and can therefore be located anywhere with reliable internet speeds and electricity access. Outside the development and construction period, data centers require little ongoing workforce to maintain operations, further increasing their locational freedom. In addition to data centers, the “large load” category can include advanced manufacturing hubs, EV charging stations, and hydrogen electrolysis facilities, among others (NERC Large Loads Task Force 2025).

The interconnection of LELs presents distinct challenges and opportunities for transmission operators, utilities, and Independent System Operators (ISOs). This complex process requires rigorous planning, transparency, and reform due to the unique operational characteristics and rapid growth of these loads. Unlike generation interconnection, which focuses on deliverability and system-level impacts, large load interconnections prioritize site-level reliability, ramping characteristics, and operational redundancy.

The definition of what constitutes a “large” load varies, and this report does not propose a firm definition of LELs by size. LELs may range from a relatively small distribution-connected data center with a load of 5 MW to a “hyperscale” load of 500 MW or more (Quint, Thomas, et al. 2025). The Southwest Power Pool (SPP), for example, defines any load greater than or equal to 10 megawatts (MW) of peak demand as a “large load” if its point of interconnection (POI) is 69 kV or below, or 50 MW if its POI voltage is greater than 69 kV (SPP 2025). The Electric Reliability Council of Texas (ERCOT) applies large load requirements to loads 20 MW or greater, with additional considerations for loads 75 MW or greater. Oregon state legislation establishing a new rate class for large loads sets a threshold of 20 MW or greater, while Texas legislation creating interconnection and reporting requirements applies to loads with peak demand of 75 MW or more. Rather than establishing a size threshold, the North American Electric Reliability Corporation (NERC)’s Large Loads Task Force defines large loads as “any

commercial or industrial individual load facility or aggregation of load facilities at a single site behind one or more point(s) of interconnection that can pose reliability risks to the [bulk power system] BPS due to its demand, operational characteristics, or other factors (NERC Large Loads Task Force 2025).”

This report focuses on current perceptions, challenges, and processes related to interconnection of LELs to the grid; while these loads include several types of entities, the primary focus of this work is on data centers, the largest current driver of this growth. It begins by summarizing relevant context related to load growth in the United States, including key stakeholder perceptions as data center deployment drive historic load growth nationwide. It then reviews the current landscape of large load interconnection processes and challenges and then proposes a framework of potential strategies intended to support a more consistent, streamlined, and fair approach to load interconnection. This framework is adapted from solutions proposed or adopted to address similar challenges faced in generator interconnection queues as well as notable reforms currently being proposed or enacted for large loads that could be more widely adopted.

2.0 Load Growth in Context: Key Perspectives and Considerations for Data Center Deployment

While the LEL category can include several different types of entities, data centers make up most of the current and projected large load growth in the United States. As a result, this section focuses on considerations relevant to the siting and interconnection of data centers, in particular.

Data center developers consider a wide range of factors when deciding where to apply to site a data center and ultimately connect it to the grid. This section first maps some of these factors in order to visualize the geography of data center deployment in the United States to date. It then offers a review of current perspectives from stakeholders, including developers, utilities, regulators, and other ratepayers, in order to illustrate priorities, challenges, and emerging ideas related to LEL growth and its impact on the grid.

2.1 Mapping factors shaping data center siting decisions

In the high-speed tech world, one of the most important factors for data center siting is typically how quickly a project can be constructed and interconnected to the grid. Time spent waiting on permitting or grid upgrades is an economic loss for a data center (Quint, Thomas, et al. 2025). This urgency to operate, combined with their locational freedom, are among the reasons why data center developers may submit multiple interconnection requests across utilities and states (Ramadan and Brownstone 2024; Quint, Thomas, et al. 2025).

As electricity demand is the largest operational cost of a data center, the lower the price of electricity, the higher its profit margin (Datacenters.Com 2024a; EPRI 2024). Likewise, any disruption in electricity access is an economic loss, therefore the more reliable the grid system, the more secure the investment. Lastly, fast and reliable internet access is critical to data center operation (Ptašinskaitė-Mačiulė, n.d.; Omnitron Systems, n.d.; Flexential, n.d.). Figure 1 visualizes the variation in data center favorability according to these factors across the U.S., overlaid with current locations of data centers.

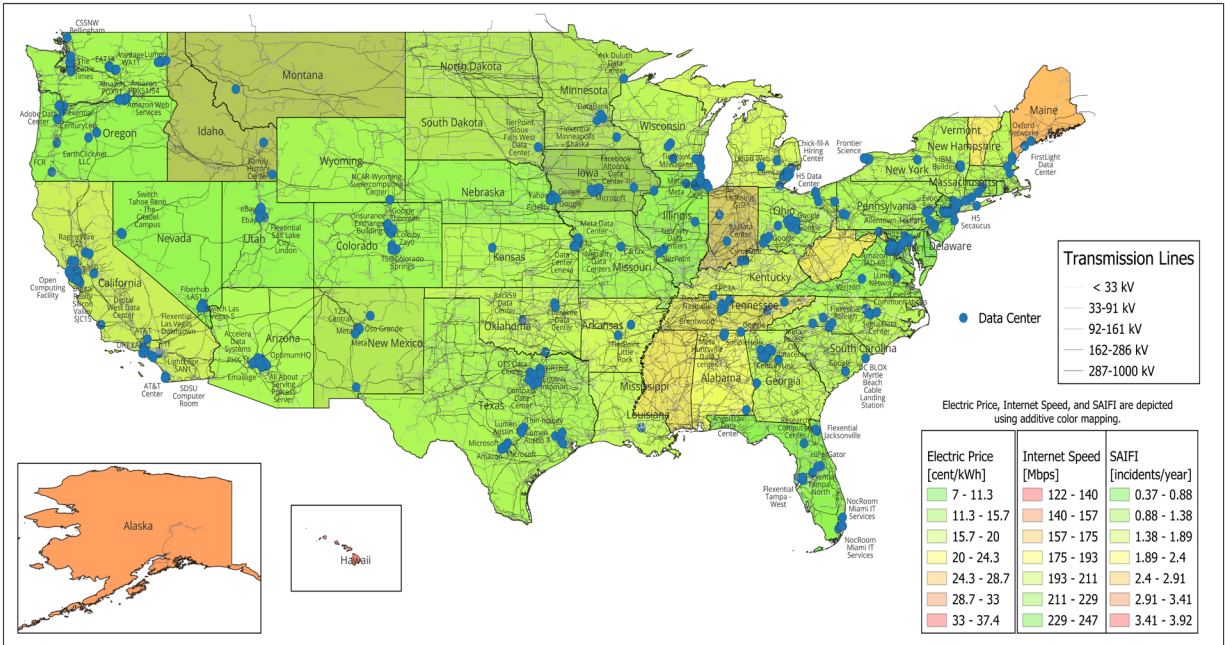


Figure 1. Data center favorability and current data center locations across the U.S.¹

The more favorable a location for a data center, i.e., the lower its electricity price, higher its internet speeds, and lower its system average interruption frequency index (SAIFI), the more green it is depicted in the above map. States that have higher electric prices, slower internet speeds, or lower grid reliability appear more yellow or orange on this map.

It should be emphasized that, while indicative of some characteristics important to developers, these mapped factors are not comprehensive: while there appear to be no data centers in the most red states like Hawai'i and Alaska, there are a handful of locations in states that are less than favorable based on these factors, including Maine, Idaho, Montana, and Indiana, indicating that other factors not included on this map may be of comparable importance, such as the availability and price of land and state tax burdens (Anderson et al.).

Figure 2 zooms in on “Data Center Alley,” a term coined to refer to the area around northern Virginia and Washington, DC. This region is known for its highly skilled workforce, fiber internet access, low-cost electricity, and very few weather events that would threaten grid reliability, and as a result has the highest nationwide concentration of data centers by far (Datacenters.Com 2024b; Paullin 2024).

¹ Visualization created using QGIS 3.40.1 by PNNL. Electric Price corresponds to the average of the commercial and industrial sectors' average electricity price in each state, as of June 2025 (U.S. Energy Information Administration 2025). Internet speeds are state averages as of 2025 (Wheelwright 2025). Grid reliability is reported as SAIFI, or times per year with major events in 2023 (U.S. Energy Information Administration 2024). SAIFI was selected among other reliability metrics as any interruption in electricity access represents a financial loss for a data center. Data center locations were reported in the IM3 Open Source Data Center Atlas, derived from the crowd-sourced database OpenStreetMap (Mongird et al. 2025).

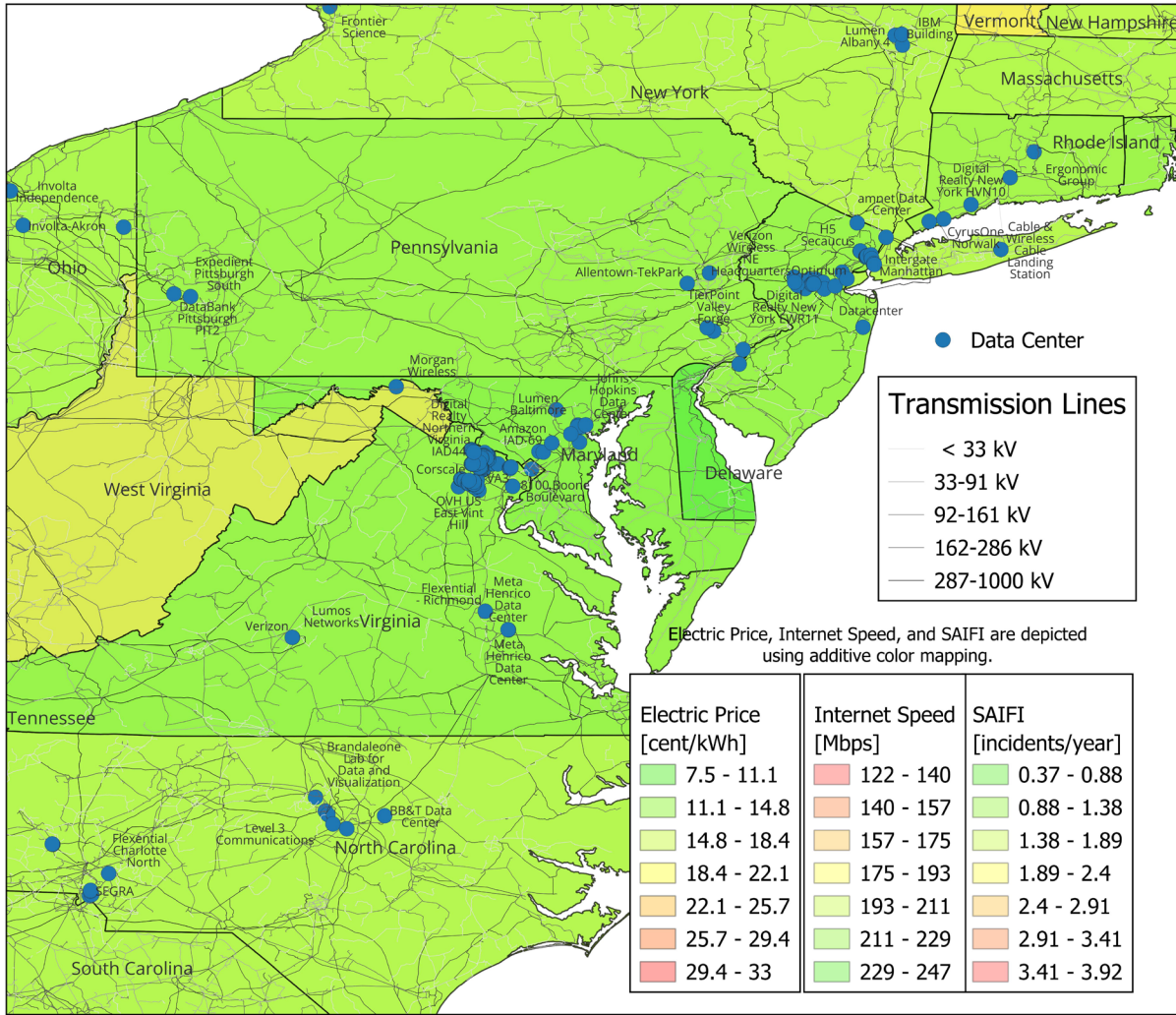


Figure 2. “Data Center Alley” Data Center Favorability and Location Map

2.2 Stakeholder perceptions on large loads

The spike in LEL growth has been accompanied by a surge in “speculative” interconnection requests by developers, where applications are submitted for information-seeking purposes and may not represent a viable project. Partially driven by this phenomenon, estimates for how actual data center growth will compare to projections varies significantly, with some analysts estimating that there are as many as ten times the number of interconnection requests as there are data centers that will ultimately be constructed (Martucci 2025; Giacobone 2025; Paccou and Wijnhoven 2025).

Understanding key incentives and considerations by important stakeholders is a necessary step toward adopting interconnection reforms that streamline deployment and reduce incentives to use the interconnection processes themselves for information-seeking purposes. Examples include the incentives that drive developers to submit speculative interconnection applications and utility challenges accurately forecasting LEL growth. The stakeholder viewpoints discussed

in this section include those of data center developers, electric utilities, regulators, and the non-data center customers that may be impacted by LEL growth.

2.2.1 Data center developers

Data center developers contend with the present realities surrounding a mismatch between their own timelines versus those of the electric utility industry. One veteran data center developer recently told a reporter that a few years ago that his “ompany could get access to electricity almost anywhere in the country within a year” (Giacobone 2025). That is changing. That same developer described selling facilities to customers seeking data center space two or three years in advance of completion, while timelines for completing required upgrades and interconnecting new facilities to the grid may be five to seven years or more. To mitigate the mismatched timeline risk, developers submit interconnection requests in multiple areas in an attempt to identify the area where they will be able to build soonest (Brunette 2025; Clements and Freed 2025; Quint, Thomas, et al. 2025; Giacobone 2025).

In this sense, speculation is driven by rational incentives for developers. To an extent, speculative requests are based on a perspective that the system is becoming more and more constrained and the perceived need for speed in getting projects online (Clements and Freed 2025). Multiple applications allow for reasonable assurance that they can site their plant and move forward, whereas submitting only one application might expose the developer to substantial risk if they encounter significant interconnection, permitting, or regulatory delays. Absent non-refundable deposits or other mechanisms to penalize speculation in the interconnection process, developers experience few penalties for submitting these requests.

2.2.2 Utility perspective

For the first time in over a decade, many electric utilities are in the position of seeing rapid load growth after years of demand remaining largely flat (Riu et al. 2024). While the realities of current load growth is placing pressure on utilities, this growth also has the potential to increase utility revenues as a result of the mechanisms of the investor-owned utility business model, where profit is earned via recovery on the cost of new infrastructure (Homer and Shipley 2025; Associated Press 2025). However, utilities also face risks: under-forecasting demand can lead to reliability and resource adequacy challenges, while over-forecasting the demand and building facilities that ultimately are not needed may expose utilities to stranded assets and high costs, including the risk of regulators disallowing cost recovery for some investments (Tsuchida et al. 2024). A recent survey by the Electric Power Research Institute (EPRI) shows that there is no consensus among the respondents on how to handle data center service requests in load forecasts. Of 24 respondents, 10 utilities include the full requested capacity, 8 include a derated capacity based on specific factors, and 6 exclude requests from forecasts. The same survey shows nearly half of utilities expect data centers to represent over 10 percent of total load in five years, while about a quarter of utilities expect it to represent over 20 percent of total load (Larson and Wilson 2024).

Meanwhile, electric utilities and grid operators are increasingly concerned about the impact of large data center loads on the system. There have been incidents in Virginia where momentary power quality issues on the grid caused data centers to switch from taking power off the grid to taking power from backup power systems. Because of the size of these data center loads, these shifts briefly left the grid in a power imbalance, where the generation that had previously served the data centers was still injecting power into the grid even though the load had disappeared.

These imbalances threaten grid reliability and risk leading to outages and other challenges (NERC 2025a; Quint, Thomas, et al. 2025).

Another source of potential concern for grid operators is the complexity and potential grid impacts from the increasing incidence of large data centers constructing their own, behind-the-meter generation co-located with load. While some data center operators have contended that effectively and intentionally islanded on-site generators should have no grid impacts, utilities and regional grid operators point to issues related to contingencies (Levitt and Shparber 2025; NERC Large Loads Task Force 2025). For example, if the power source trips offline for a data center powered primarily by on-site generation, will the data center—and its generator—need assistance from the power grid to continue operations and have generation come back online? Furthermore, there are additional considerations if a third-party power supplier to a data center wants to participate in markets and export power to the grid. As of the time of writing, there is a Federal Energy Regulatory Commission (FERC) proceeding to investigate issues related to the Open Access Transmission Tariff that governs interconnection to the power grid, intended to address these and other issues related to generation being co-located with data centers (FERC 2025).

2.2.3 Regulators and non-data center utility customers

The perspectives of utility regulators and other ratepayers related to data centers are frequently similar and, as a result, are discussed together here. A primary concern raised by both groups is the question of fair and efficient allocation of the costs associated with building the infrastructure needed to accommodate growth driven by LELs. In addition to financial costs, some ratepayers have raised questions related to property values, noise, or pollution from nearby construction of data centers and their associated infrastructure—concerns similar to those commonly raised about other energy infrastructure, transmission lines, or other large developments (Eisenson et al. 2024; Murphy 2025).

Questions abound related to the trade-off between revenues and governmental spending on capital investments such as high-speed fiber optic networks. While much of this is beyond the scope of this report, the question of whether the work being performed by utilities to expand the electric grid to accommodate data centers will ultimately be subsidized by other ratepayers such as residential or commercial consumers is core to the load growth conversation. For example, Dominion Energy's load growth forecasts in their 2024 Integrated Resource Plan call for the construction of approximately 10 additional GW of new energy capacity by 2039 to serve data centers alone (Dominion Energy 2024). ERCOT has approximately 56 GW of load in its queue (NERC 2024). Residents have expressed concerns about the impacts of this level of growth (Murphy 2025).

In addition to system upgrade costs associated with the new generation and transmission infrastructure needed to serve load, LEL growth has also delayed retirement of older power plants in some states in order to maintain resource adequacy. Keeping these generally more expensive plants operational can drive up average costs, putting pressure on rates (Goldsmith and Byrum 2025; Dunlap 2025).

Regulators in some states have thus begun to take steps intended to insure that that the costs of grid expansion to facilitate such new loads will not lead to disproportionate impacts onto small consumers, with actions including establishing distinct rate classes with cost allocation guidance for large loads meeting certain criteria (SEPA 2025).

3.0 Large Load Interconnection Approaches and Challenges: Current Landscape

Interconnecting new generation or storage to the grid, whether for utility-scale projects interconnecting to the transmission system or smaller projects interconnecting to the distribution system, generally requires developers to submit an application to participate in a standardized process, where projects go through defined study processes as part of an interconnection queue. As part of this queue, generators or storage are studied for their potential impacts on grid reliability and whether new transmission or distribution lines, substations, or other infrastructure may be required to bring that capacity online.

Load interconnections, on the other hand, have not generally been managed as part of a standardized queue process in most cases (Frick 2025). However, as deployment of LELs continues to accelerate, straining both the grid's ability to accommodate them and utilities' ability to efficiently process applications, some grid operators have begun to adopt standardized interconnection processes. In some cases, these new LEL queues are managed similarly to existing generation queues.

This section reviews the current landscape of interconnection processes for large loads across the United States, including how utilities and RTOs/ISOs are responding to these and other emergent challenges.

3.1 Queue management and study approaches

ERCOT, an emerging hotspot for data center load growth, has seen a rapid influx of large load interconnection requests. In June 2025, the RTO has projected 156 GW of large loads in its interconnection queue by 2030 (ERCOT 2025a). Utilities in the Western Electricity Coordinating Council (WECC) region report similar challenges, where legacy serial queue systems result in lengthy approval times. Furthermore, many projects in this region have failed to materialize due to prolonged waiting times and lack of timely communication from utilities, and few utilities have adopted clear processes to mitigate these issues (Quint, Zhao, et al. 2025).

ERCOT has taken steps to address delays by establishing a large load interconnection process, with its proposal to establish a formal Large Load Interconnection Study (LLIS) process approved by its board in April 2025. The LLIS approach establishes a definition of large loads as having an aggregate peak demand of 75 MW or more, establishes study fees for each interconnection request, and includes study processes similar to those used in generation queues, among other requirements (ERCOT 2025b; EPE 2025). As of summer 2025, ERCOT is discussing additional mechanisms for queue reforms, allowing various large load projects—such as cryptocurrency mining and energy-intensive manufacturing—to proceed under coordinated cost and reliability frameworks (ERCOT 2025c).

SPP, which expects large load requests to double over the next decade, proposed a standardized interconnection process for large loads in 2025. The proposal includes 90-day targets for most load interconnections and offers distinct tracks for standalone large loads, LELs with co-located generation, and LELs willing to curtail power usage in exchange for quicker interconnection (SPP 2025). This process was approved by SPP's board in September 2025 (Walton 2025). Portland General Electric (PGE) in Oregon, a non-RTO state, has similarly adopted a large load study process for all loads greater than 1 MW in capacity, outlining application requirements, study processes, deposits and fees, and expected timelines (PGE,

n.d.). While this is far from an exhaustive list of grid operators that have adopted publicly available descriptions of their LEL interconnection process, their recent emergence indicates trends toward standardizing queues as load growth continues to increase.

Of final note, FERC Order No. 2023 introduced cluster studies as a viable solution for generator interconnection queues, enabling utilities to group multiple interconnection requests into a single study. This approach reduces the repetitive efforts of serial queue processes while offering consistent timelines for groups of applicants studied in each cluster, creating precedent for adaptation for large loads as processes continue to evolve (Quint, Thomas, et al. 2025).

3.2 Speculative applications

As noted throughout this report, speculative applications—interconnection requests submitted without a clear commitment to financial readiness or site control—are a leading cause of inefficiency in the interconnection process. Speculation, often incentivized by a lack of information about interconnection costs and timelines, is similarly common in generation queues (Baldwin et al. 2025; Gorman et al. 2024). Many utilities treat speculative inquiries as formal applications, investing time and resources in feasibility studies for projects that may never be realized (Quint, Zhao, et al. 2025). This phenomenon inflates queue sizes and creates delays for legitimate projects with stricter development timelines. Withdrawal rates then exacerbate delays in queue systems as they prevent reliable progress for legitimate applicants. For instance, many speculative interconnection requests drop out post-study, leaving utilities to reassess reliability frameworks unnecessarily. This creates further delays for other projects in the queue.

Utilities in the WECC region, like many others nationwide, have seen significant impacts of speculative applications. A substantial portion of LEL interconnection requests never proceed to energization (Quint, Zhao, et al. 2025). ERCOT has attempted to address speculative filings by requiring refundable fees and deposits tied to specific milestones, including site control and financial guarantees. This has included the adoption of refundable study deposits of \$14,000 for any proposed load projects over 75 MW in capacity. This is the same amount ERCOT requires as an initial interconnection fee for proposed generators with a capacity of 10 MW or greater (ERCOT 2025). Similarly, the Midwest ISO (MISO) has proposed reforms to its Business Practice Manuals (BPMs), introducing upfront commitments for new speculative load applications to ensure credible proposals before allocating resources to conduct studies. While these reforms are still under discussion, they underscore the need for utilities to delineate between viable and non-viable applicants (Peters 2025).

Also in Texas, the state has taken legislative action via SB6, passed in 2025, which directs the state public utility commission (PUC) to establish additional standards around large load interconnection for ERCOT, including requirements that large load customers must demonstrate site control for their proposed location; pay study fees of at least \$100,000; and disclose whether they are “pursuing a substantially similar request for electric service” in the state (EPRI 2025).

3.3 Transparency and data considerations

A lack of transparency poses critical challenges to interconnecting LELs without compromising grid stability. Utilities often lack visibility into the operational characteristics of large load facilities, such as ramp rates, power electronic settings, and redundancy requirements. Without detailed load data, utilities face increased forecasting errors, creating risks for reliability

planning. For example, North American Electric Reliability Corporation (NERC) has highlighted deficiencies in dynamic load modeling across multiple ISOs, urging utilities to standardize data collection protocols for large loads in order to support load interconnection studies (NERC 2025b).

Some utilities are addressing these shortcomings by mandating detailed technical documentation from developers during the interconnection request process. Eversource, another utility that has begun to adopt a more standardized process for large load interconnection, requires applications to include descriptions of the proposed load's operational characteristics, reliability preferences, and ramping behavior to complete feasibility studies (Eversource 2025). ERCOT has introduced similar requirements, with the intention of enabling utilities to model loads more accurately during the study phase (ERCOT 2025b). These reforms can improve forecasting capabilities and reliability outcomes while reducing uncertainty for applicants.

3.4 Flexibility for large loads

Data centers have often been assumed to require firm interconnection service and operate at 100 percent of maximum electricity draw at all times, including during system-wide peaks (Norris et al. 2025; Riu et al. 2024). As a result, data center proposals often trigger utilities to forecast a need for significant system upgrades, which are time-intensive and costly. As understanding of data centers' computational needs has evolved, however, flexible interconnection frameworks for large loads are becoming an increasingly prevalent alternative as utilities adapt to both the grid demands and unique power needs of these loads. Flexible interconnection, where loads are asked to curtail power usage under certain conditions to alleviate system stress during peak demand, can reduce delays in deploying LELs by mitigating some of the need to construct additional grid infrastructure that would otherwise be required to accommodate them (Norris et al. 2025). This type of flexibility is already common for residential and non-residential utility customers nationwide in the form of demand response programs, but participation rates are generally low (Stenclik and Hostetter 2025).

Evolving understanding of data center grid needs, particularly AI data centers, has indicated more opportunities for curtailment without negatively impacting service or core operations (Norris et al. 2025). Meanwhile, flexible interconnection for generation is common internationally, and is similarly increasingly under discussion for generator interconnection in the United States for the same reasons: even minimal curtailment can defer the need for system upgrades, dramatically reducing costs and interconnection timelines in many cases (Baldwin et al. 2025).

SPP's Conditional High Impact Large Loads (CHILL) service, one of three LEL interconnection pathways approved in September 2025, is an innovative pathway enabling flexible interconnection of LELs in the United States. CHILL offers LEL customers the potential to interconnect more quickly than customers pursuing firm interconnection, in exchange for agreeing to temporary curtailment during energy emergencies or periods of high system stress, enabling faster access to grid resources without compromising long-term grid reliability (SPP 2025). In Oregon, PGE has explored flexible tariff structures tied to real-time monitoring, incentivizing distributed load transfers and cooperative response during congestion periods.

In general, utilities leveraging flexibility de-emphasize fixed infrastructure investments and focus on operational enhancements that accommodate voltage sensitivity and redundancy needs.

3.5 Co-location of generation and load

One challenge to LEL interconnection and deployment is the possibility of delays due to mismatched timelines between the construction schedules of large load facilities and the utility infrastructure required to serve them. Data centers, for example, are designed and built in six to twelve months, whereas the transmission projects needed to accommodate their electricity demand typically take five to ten years. This results in bottlenecks, as utilities struggle to meet the demands of developers seeking rapid site energization.

One approach taken by many developers to avoid this particular source of delay is to co-locate on-site generation with their proposed large load. Building generation, or in some cases siting a proposed LEL next to an existing generator, reduces the urgent need to build out new infrastructure to serve that load via standard utility planning and procurement practices. Proposing LEL projects that include co-located generation can also reduce the strain placed on the reliability of the grid by surging load growth. Having developers procure their own generation can also address some cost allocation challenges. Finally, on-site generation and/or energy storage can offer localized reliability benefits and, depending on their configuration, can act as a source of emergency backup power in the case of grid disruptions (Levitt et al. 2025). It should be noted that in almost all cases, LELs with on-site generation are not designed to operate in isolation and must still interconnect both load and generator to the grid, meaning that process and cost allocation questions remain for these projects.

Generation and load are typically addressed via two separate utility processes, but some models are emerging for new innovative pathways to accommodate co-located generation and load. SPP, for example, has adopted a load interconnection track called “High Impact Large Load Generation Assessment” (HILLGA), where large loads and “supporting generation” are evaluated in parallel in order to enable more efficient interconnection of both while minimizing impacts to the grid (SPP 2025). Finally, PJM issued guidance for co-located load and generation in 2024, outlining requirements for metering, market participation, system sizing, and operational characteristics (PJM 2024). However, this guidance was rescinded by FERC as discriminatory in 2025, and updated guidance is forthcoming (FERC 2025).

3.6 Cost allocation and tariff design

Fair cost allocation for large loads is an increasingly contentious issue, with utilities and developers frequently disagreeing over which ratepayers should bear responsibility for system upgrades required to accommodate large loads, as reflected in stakeholder perceptions, summarized in Section 2.2. Several utilities have adopted tariff structures that clarify cost allocation requirements for large loads, with the intention to insulate non-LEL ratepayers from subsidizing system upgrades that would not be required without LEL deployment (Satchwell et al. 2025; SEPA 2025).

Other cost allocation approaches have also been adopted or proposed. PGE, notably, has proposed a reduction in the system upgrade costs allocated to large load customers, citing the system benefits of customers with “flat, stable demand.” This proposal, actively under review by the Oregon PUC, also considers whether LELs should be required to adopt time-varying rates. This approach is intended to minimize upfront costs while incentivizing optimized load behavior (Oregon Public Utility Commission, n.d.). In Texas, ERCOT has implemented refundable deposits as another mechanism designed to ensure that developers contribute to system costs without penalizing speculative or canceled projects (EPE 2025; ERCOT 2025b). These efforts

are intended to support cost transparency and streamline interconnection for economically viable projects. Additional cost allocation policies and considerations are discussed in more depth in a forthcoming companion report (Anderson et al.).

4.0 A Framework to Develop Load Interconnection Strategies

The fundamental considerations around interconnecting load to the grid are distinct from the process of interconnecting generation in several ways. These differences are largely due to distinct characteristics of LELs as compared to generation or storage technologies but also because, at a fundamental level, utilities have a core obligation to serve load. Nevertheless, the processes of interconnection, including queue management, study processes, and cost allocation, among other considerations, share core elements and approaches. Lessons learned from efforts to standardize and reform generator interconnection processes can therefore be used to inform approaches to load interconnection.

Generator interconnection processes for both transmission-scale and distributed projects have faced many of the same challenges currently impacting load interconnection queues, including queues backlogged by significant growth, speculative interconnection applications, challenges in fair allocation of interconnection costs, and inefficient and varying process approaches between utilities and regions (Baldwin et al. 2025; Gorman et al. 2024). Many reforms have been proposed to address these challenges, and recent years have seen rapid evolution in generator interconnection processes nationwide. The adoption of FERC Order 2023 is one notable example among many such efforts. A number of these reforms have the potential to be adapted for load interconnection queues to enable faster, fairer, and simpler interconnection of LELs. Ideally, adoption of some actions proposed to address the challenges that face generator interconnection queues could also help LEL queues sidestep some of these challenges entirely.

This proposed framework for LEL interconnection process reform thus draws heavily from generator interconnection reforms. Two resources are of particular note, the roadmaps for transmission-level and distributed energy resource interconnection process reforms published by the Department of Energy's Interconnection Innovation e-Xchange (i2X) Initiative (Baldwin et al. 2025; Gorman et al. 2024). This section builds upon the review of challenges included in Section 3.0 of this report by proposing a framework of strategies to address them.

The strategies proposed here each align with one or more process improvement goals:

1. Standardize the large load interconnection process and increase process transparency,
2. Reduce speculative large load interconnection requests,
3. Maintain grid reliability through large load interconnection processes,
4. Ensure fair allocation of system upgrade costs required to accommodate large loads.

4.1 Proposed Goals and Strategies

Goal #1: Standardize the Large Load Interconnection Process and Increase Process Transparency

Generators seeking to interconnect to the electric grid generally enter a queue and participate in a relatively standardized study process. For large load customers, however, utilities have tended to evaluate interconnection applications individually, lacking a standardized interconnection process or queue (Quint, Zhao, et al. 2025). As the number of large load

interconnection requests continues to grow, however, utilities are struggling to keep up using current practices.

The two strategies in this section describe:

1. How the large load interconnection process could be standardized by leveraging best practices across utilities and RTOs as well as from generator interconnection reforms.
2. How to increase process transparency through greater data sharing of relevant grid and queue data while balancing grid security and business concerns of LEL applicants.

Goal 1, Strategy 1	Develop standardized queue processes across utilities and RTOs/ISOs, adopting relevant best practices from generator interconnection queue reforms.
Description	<p>Utilities and RTOs can create more efficient and fairer large load interconnection procedures by standardizing the interconnection process for LELs instead of processing applications on a case-by-case basis.</p> <p>By sharing and replicating LEL interconnection best practices across utilities and RTOs, the process can further become more uniform across utilities and regions, reducing friction for developers. In adopting standardized queuing processes, utilities and RTOs may consider using generator interconnection queues as a model, reviewing both established practices and emerging reforms. Among the latter may include the adoption of cluster studies, beginning in areas with high data center and LEL deployment, and implementing process automation where applicable.</p>
Notable models or references	<p>See adoption of standardized queues, including timeline targets, application requirements, study tracks, and deposit fees by ERCOT and SPP as discussed in Section 3.1. The i2X Initiative’s DER Roadmap Solution 4.11 recommends that utilities “Develop evidence-based interconnection best practices that promote safety and reliability while allowing for local or regional differences” (Baldwin et al. 2025). Clements and Freed (2025) recommend “standard process and queuing” for large loads via “clear, repeatable process.”</p>
Goal 1, Strategy 2	Improve process transparency by sharing relevant grid and queue data while balancing grid security and business concerns.
Description	<p>In many cases, there is limited information available regarding which LEL projects are in the queue, their queue position, who they belong to, where they are located, how large they are, and how they are progressing (Clements and Freed 2025).</p> <p>Greater transparency around interconnection queues can enable utilities to iterate upon and improve their interconnection processes using real queue data and information, as has been the case with transparency reforms for generator interconnection queues (Baldwin et al. 2025; Gorman et al. 2024). This level of transparency may also reduce incentives for developers to submit speculative interconnection requests as a way to seek information by providing some of that information up front. Critically, however, the benefits of transparency must also be balanced with grid security and LEL developers’ business sensitivity concerns, as well as with the effort required to collect and publish information.</p>

Notable models or references

The i2X Initiative’s DER Roadmap Solution 1.1 suggests utilities “establish guidelines for collecting and sharing grid data that consider trade-offs between value created, effort required, and data security and accessibility concerns,” with a similar proposal for larger generators outlined in Solution 1.1 of the accompanying Transmission Interconnection Roadmap (Baldwin et al. 2025; Gorman et al. 2024). In addition, ERCOT publishes aggregate information about LEL queue capacity, including total capacity approved and under study, by month and year, but does not release more detailed public data about project characteristics (ERCOT 2025a).

Goal #2: Reduce Speculative Large Load Interconnection Requests

Speculative applications are prevalent in large load interconnection queues since these processes often lack barriers to entry. For instance, large load customers face minimal financial commitments and lack project maturity requirements regarding site control or technological readiness (Quint, Thomas, et al. 2025)

The two strategies in this section detail how speculative load requests can be discouraged or mitigated:

1. Establishing clear technical requirements for load interconnection applications, raising the barrier to entry for beginning a study process.
2. Further discouraging speculation by establishing clear commercial readiness requirements and requiring financial commitments at different phases of the interconnection queue process.

Goal 2, Strategy 1

Establish clear and standardized technical requirements that large load customers must provide on interconnection applications.

Description

Data centers often withhold operational details to maintain a competitive edge; however, utilities must have detailed performance specifications (ride-through capabilities, power quality characteristics, load composition, etc.) to be able to properly assess and mitigate reliability risks and conduct interconnection studies. As it stands, utilities dedicate significant time and resources to identifying and obtaining missing data from LEL applicants (Quint, Thomas, et al. 2025).

Transparency around technical requirements for LEL interconnection, including requirements for co-located generation can help disincentivize speculation by providing proactive information. It will also enable more efficient study of LEL’s potential grid impacts by freeing up utility staff and resources.

Notable models or references

Some utilities or RTOs have established clear technical application requirements as part of their intake process for LEL interconnection, as discussed in Section 3.3. Eversource requires LEL developers to provide operational characteristics, reliability preferences, and ramping behavior to complete feasibility studies. ERCOT has similar requirements, allowing utilities to model loads more accurately during the interconnection study phase. See also i2X DER Roadmap Solution 1.3, “Standardize and clarify the technical data that developers of large

DER systems must provide on interconnection applications to facilitate interconnection studies” and accompanying Transmission Roadmap Solutions 1.1, 1.2, and 1.3, all of which describe pathways and considerations to enhance transparency without compromising security concerns. See also Clements and Freed (2025)’s recommendation to provide transparency about projects in the interconnection queue and some anonymized characteristics in order to support utilities and end users to evaluate project viability.

Goal 2, Strategy 2 **Establish and enforce process requirements that discourage speculation, including commercial readiness requirements and financial commitments.**

Description

Commercial readiness requirements, such as proof of site control, require developers to demonstrate their capability and the viability of the proposed projects entering the queue (Clements and Freed 2025). Financial commitments, such as study deposits or withdrawal penalties that are linked to a project’s progression through the queue, create barriers to entry and reduce developers’ incentives to use interconnection applications to elicit information.

LEL developers are generally less sensitive to price than generation developers, which may limit the effectiveness of financial requirements in disincentivizing speculative requests, or indicate that higher fees may be necessary to discourage speculation (FTI 2024). It may be more effective to pair higher deposits with commercial readiness requirements such as proof of site control.

Notable models or references

As discussed in Section 3.2, Texas has taken steps to implement financial requirements to discourage speculation via legislation and ERCOT policy. SB6 (2025) directs the state public utility commission (PUC) to establish standards around large load interconnection, including requirements that large load customers must demonstrate site control for their proposed location; pay study fees of at least \$100,000; and, of particular note, explicitly disclose whether they are “pursuing a substantially similar request for electric service” in Texas. These requirements come in addition to ERCOT’s study deposit requirement (paid toward study fees) of \$14,000, adopted in 2025. See also i2X DER Roadmap Solution 2.1, which explores options for implementing and enforcing “more stringent commercial readiness requirements, financial commitments, withdrawal penalties, and time limits that balance effectiveness, equity and open access principles.” See also Clements and Freed’s (2025) recommendation to reduce speculation by ensuring that fees for interconnection studies “should be commensurate with the cost of that interconnection and project size.”

Goal #3: Maintain Grid Reliability through Large Load Interconnection Processes

Increasing LEL interconnection requests on the grid have strained available generation and transmission capacity and threatened grid reliability as utilities struggle to maintain resource adequacy in the face of explosive growth. While technical requirements to maintain grid stability are discussed in other publications and are largely outside of the scope of this report, there are opportunities via the interconnection process to enable and incentivize alternative LEL interconnection pathways that reduce these loads' risk to grid reliability either by flexing load during peak demand, interconnecting with self-supplied generation that can meet a LEL's energy demand, or both.

The two strategies in this section explore these options:

1. Distinct interconnection pathways for LEL customers that plan to co-locate generation with load, including clarity on application requirements and defined parallel study processes and timelines.
2. Options and incentives for flexible interconnection or demand response participation requirements for LELs, where customers agree to temporarily curtail some use of grid power during periods of acute need.

Goal 3, Strategy 1

Develop and standardize distinct interconnection pathways for large loads that plan to co-locate with self-supplied generation.

Description

Generator interconnection and load interconnection have historically been treated as separate utility processes, and co-located LEL and generation are currently evaluated using an ad-hoc process in most cases. Utilities and RTOs can enable more efficient coordination between load and generator interconnection processes by adopting parallel studies that allow load and associated generation to be evaluated together. This can facilitate a faster interconnection timeline for the overall project, reduce system upgrade requirements, and enable load flexibility.

Establishing clear interconnection requirements for co-located LELs and generation may involve developing distinct interconnection application pathways for these projects, separate from processes for standalone generation or load. Distinct interconnection pathways for co-located projects can incentivize developers to propose LELs in combination with generation to reduce grid pressure.

As recommended in Goal 2, Strategy 1, clear technical requirements for applications can not only help safeguard against speculative applications but also support utilities in evaluating the unique characteristics of grid-interconnected loads whose power needs are supplied partially, mostly, or entirely via on-site generation. For co-located projects, these requirements should clearly describe whether the proposed load will be served exclusively by its on-site generation without or with minimal use of the grid, or if onsite generation will be primarily used as a source of backup power or a tool to enable load flexibility (NERC Large Loads Task Force 2025). Clarity on other characteristics, including metering requirements and market participation rules, should also be included in development of these pathways, although such requirements should be adopted in alignment with upcoming guidance from FERC (FERC 2025).

Notable models or references	SPP conducts parallel studies for co-located facilities through its CHILL service pathways, establishing a clear and distinct interconnection track for LELs that wish to self-supply generation. See also relevant lessons from i2X DER Roadmap Solution 2.8, which outlines pathways to coordinate between load and generator interconnection in the context of new building construction that includes integrated DER as part of building plans, including offering standardized pathways for parallel load and generation evaluation for projects at a smaller scale.
Goal 3, Strategy 2	Develop and standardize pathways for flexible interconnection of eligible large loads.
Description	<p>Under a flexible interconnection agreement, LELs can enter an agreement to curtail under specified terms, generally when utilities need to reduce strain on the grid during peak stress periods. Many LELs are able to temporally flex their loads, maintain spatial flexibility across multiple data centers, or leverage on-site generation as a source of backup power to ensure continuity of operations despite grid curtailment (Norris et al. 2025). This flexibility could allow more LELs to interconnect with shorter lead times and lower system upgrade costs.</p> <p>Utilities and RTOs/ISOs can therefore enable more efficient interconnection of LELs by offering flexible interconnection agreements as an option for applicants and may consider incentivizing flexible options. Offering a faster interconnection study timeline for LEL developers willing to agree to curtailment under defined conditions may be one way to encourage participation in flexible interconnection pathways.</p> <p>As with flexible interconnection for generation, utilities should also consider whether flexible interconnection should be offered on a permanent basis or whether some or all flexibly interconnected loads may have an option to transition to a firm interconnection agreement, where curtailment would no longer be required.</p>
Notable models or references	SPP’s CHILL service, also described in Section 3.4, enables faster access to grid resources without compromising long-term reliability, allowing large loads to interconnect within 90 days, contingent upon the requirement for curtailment during energy emergencies. CHILL is a notable example of flexible interconnection being offered as a distinct pathway for load customers, and of a grid operator incentivizing flexibility by offering accelerated interconnection timelines. See also i2X DER Roadmap Solution 3.9, which recommends allowing flexible interconnection as a way to mitigate system upgrade costs assigned by interconnection studies. Norris et al (2025) outline detailed considerations for enabling flexible interconnection and operation of AI data centers and other large loads.

Goal #4: Ensure Fair Allocation of System Upgrade Costs Required to Accommodate Large Loads

Interconnecting LELs frequently results in system upgrade costs in the form of additional generation and/or transmission infrastructure needed to accommodate new LELs without threatening resource adequacy. Without careful attention to cost allocation principles, some of these costs have the potential to be passed on to residential customers and other ratepayers. To avoid undue cost shifts, costs associated with system upgrades that would not be required without a new LEL can be allocated using beneficiary-pays cost allocation principles, where costs are assigned proportionally to the customers who benefit from those upgrades.

The strategy in this section describes some considerations that may be used to develop cost allocation methodologies that fairly balance the costs assigned to LEL developers against those distributed across other ratepayers.

Goal 4, Strategy 1	Allocate costs of system upgrades fairly using beneficiary-pays cost allocation principles.
Description	<p>Some utilities, regulators, and legislatures have taken steps toward beneficiary-pays cost allocation for large loads by creating specific rate classes for LELs. Others are pursuing other ratemaking actions that take steps to define which costs should be paid by LEL developers and which costs should be socialized among other ratepayers as part of a utility's general rate base.</p> <p>The “but for” principle has commonly been applied to cost allocation for new generation, where developers of a project are responsible for costs for any upgrades that would not be required “but for” that new project. This approach has been criticized as unfair by some developers and other stakeholders, who argue that the cost-causer pays methodology developed in response to this framework unduly burdens one developer with costs for upgrades that will benefit other future generation projects. For load customers, upgrades required to accommodate load growth and maintain resource adequacy in a general sense are typically socialized among ratepayer classes in ways that are roughly proportional to their system use (NARUC, n.d.). LEL growth has the potential to challenge these existing cost allocation principles, as utilities and regulators are increasingly adopting approaches that assign more direct costs to specific load customers in ways that parallel the cost-causer-pays approach used for generation interconnection.</p> <p>Finally, regardless of the specific methodology used, transparency in cost allocation methodology for system upgrade costs is critical to ensure fair interconnection processes for all load types.</p>
Notable models or references	<p>Several utilities have adopted distinct tariff schedules for large loads that are intended to ensure fair allocation of the costs required to integrate LELs without unfairly burdening other ratepayers, as described in Section 3.6; see Smart Electric Power Alliance's database (SEPA 2025) and Satchwell et al. 2025. See also i2x DER Roadmap Solution 3.1, which proposes options to reform the “cost-causer-pays” model such that the cost of interconnection-triggered upgrades is fairly distributed among those that benefit from the upgraded feeder circuit; similarly fair cost allocation for LELs may result in different approaches to achieve the same beneficiary-pays principles.</p>

5.0 Conclusions

The recent and ongoing increase in load growth in the United States, driven primarily by data centers built to support the emergence of computationally intensive AI, is straining the electric grid and putting pressure on utilities and regional grid operators to find ways to efficiently interconnect these loads while balancing concerns related to cost allocation and grid reliability. The process of interconnecting a large load to the grid has historically not followed a standardized process for most utilities, rather a case-by-case approach which is increasingly found to be insufficient.

The combination of massive load growth and the lack of consistent interconnection processes has led to a rise in speculative interconnection applications for data centers, compounding delays and challenges and adding uncertainty to utilities' ability to accurately forecast load growth and the generation required to accommodate it. Developers face economic incentives to find locations that meet data centers' requirements for reliable power and internet service while minimizing delays in interconnection, permitting, and construction. And while utilities, which exist to serve load, stand to see revenue increases from the new construction required to accommodate that load, they must also take steps to ensure that interconnection of data centers and other LELs does not threaten grid reliability for all customers.

Some utilities and RTOs/ISOs have begun to adopt formal queue processes modeled after generator interconnection queues, with standardized application requirements and study processes. SPP and ERCOT, while not alone, stand as notable examples. Overall, there are many relevant parallels between the steps required to study new generation or storage and those required to interconnect new large loads. As a result, many processes—including recent reforms—used or proposed for generation interconnection queues may be adapted to enable more efficient, fair, and straightforward interconnection of these loads.

This report proposed a brief framework for streamlining load interconnection that draws from generator processes as well as from pioneering load interconnection processes, emergent proposals, and an understanding of the drivers and incentives that have created challenges in LEL interconnection and deployment. The goals of a streamlined and consistent LEL interconnection process include standardized and transparent processes, reduction in speculative load requests, maintenance of grid reliability, and reasonably fair allocation of system upgrade costs. Implementation of these strategies will require more detailed consideration of load growth forecasts, regulatory contexts, grid constraints, and other factors and may vary—perhaps widely—across utilities and regions.

While LEL growth may be driving a transformative period for the United States electric grid, this is not the first and likely far from the last period of such rapid change. By adopting a framework to enable more efficient and streamlined interconnection of LELs, utilities, regulators, and industry can position themselves to better weather not only this notable moment, but future transformations as well.

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