

Large Load Considerations— Small to Medium-sized Entities

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Background

“An increasing number of large commercial and industrial loads are rapidly connecting to the bulk power system (BPS). Emerging large loads, such as data centers (including cryptocurrency and artificial intelligence), hydrogen fuel plants, and others, present unique challenges in forecasting and planning for increased demand.”

Source: [NERC RSTC Large Load Task Force FAQ document](#)

Background: Seeking a Stakeholder Willing to Share

- Experiences connecting and serving large loads
- Discussing challenges and lessons learned—interconnection process
- Operations and Planning ... and Planning ... and Planning
- Information of Interest for Small to Medium-sized Entities
- Reliability Challenges and Opportunities

Background: Large Loads

We asked Google Gemini:

**“How much power is consumed per day
in the U.S. in AI searches?”**

Background: Partial Results of Query



Several factors make it difficult to provide a precise daily figure:

- The energy use per AI query depends heavily on the model's size, the type of response (text, image, video), and the efficiency of the data center.
- Tech companies are not required to release verified emissions or energy use data, so most current figures are estimates from researchers.
- AI is a fast-moving field, and efficiency improvements in hardware and software could alter consumption trends.
- The energy strain is concentrated in certain regions with high data center density, like Virginia and Texas, which creates regional grid challenges. 

As energy demands for AI increase, so should company...

Jul 14, 2025 — While a lack of access to this kind of data has made...

B Brookings 



Energy demand from AI – Energy and AI – Analysis – IEA

Energy demand from AI * What is a data centre? Artificial intelligence (AI...

IEA – International Energy Agency 



ChatGPT is an energy guzzler. These things you're doing are...

Aug 26, 2025 — AI emits more than search ... It takes a massive amount ...

The Washington Post 



US data center electricity demand could double by 2030,...

May 30, 2024 — Under the scenarios, U.S. data center power consumption...

Utility Dive 



How much energy does ChatGPT use? Less than these other dail...

Aug 26, 2025 — These numbers are not definitive: AI research firms have...



Background: Partial Results of Query

◆ AI Overview

Determining the precise amount of power consumed *daily* for AI searches in the US is extremely difficult due to the lack of transparent, standardized data from companies and rapid shifts in AI technology. However, based on recent estimates, the energy consumed by all AI activities—including searches—is becoming a significant driver of overall data center electricity demand. [🔗](#)

The following provides context on the energy demand driven by AI in the US:

- **Data center consumption:** In 2023, data centers used about 4.4% of all US electricity, or 176 terawatt-hours (TWh) for the year. This is roughly 482.2 gigawatt-hours (GWh) daily.
- **AI's share of data center energy:** AI is a primary driver of the increase in data center energy use. Some reports suggest that AI could account for over half of all data center power consumption by 2028. In 2023, high-performance AI servers used over 40 TWh of energy, more than tripling since 2017.
- **Energy per query:** A single AI query using a large language model like ChatGPT can use significantly more electricity than a traditional search engine request. One recent figure suggests that an average text response from Google's AI tool, Gemini, used 0.24 watt-hours (Wh). [🔗](#)

DOE Releases New Report Evaluating Increase in Electricity ...

Dec 20, 2024 — The report finds that data centers consumed about 4.4% of total U.S....

 Department of Energy (.gov) ⋮



As energy demands for AI increase, so should company transparency

Jul 14, 2025 — While a lack of access to this kind of data has made calculating the electrici...

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AI boom triggers electricity surges

Sep 11, 2025 — the United States and...

 YouTube · The National Desk ⋮



Show all

Background: Partial Results of Query

AI's daily energy use is rapidly growing. Forecasts suggest a substantial increase in the coming years:

- **Doubling demand:** The International Energy Agency (IEA) projects US data center electricity consumption to increase by 130% by 2030.
- **Share of US electricity:** The Department of Energy (DOE) estimates that US data centers could account for as much as 12% of the country's electricity consumption by 2028, largely driven by the demands of AI.
- **Equivalents:** By 2028, the electricity used by AI data centers could be equivalent to the annual energy consumption of as much as 22% of all US households.



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Department of Energy (.gov)

AI boom triggers electricity surges
Sep 11, 2025 — the United...
YouTube · The National Desk

AI is Driving Up Electricity Demand —Will You Pay the Price?
Jun 25, 2025 — AI is driving up electricity demand—will you pay the...
EnergySage

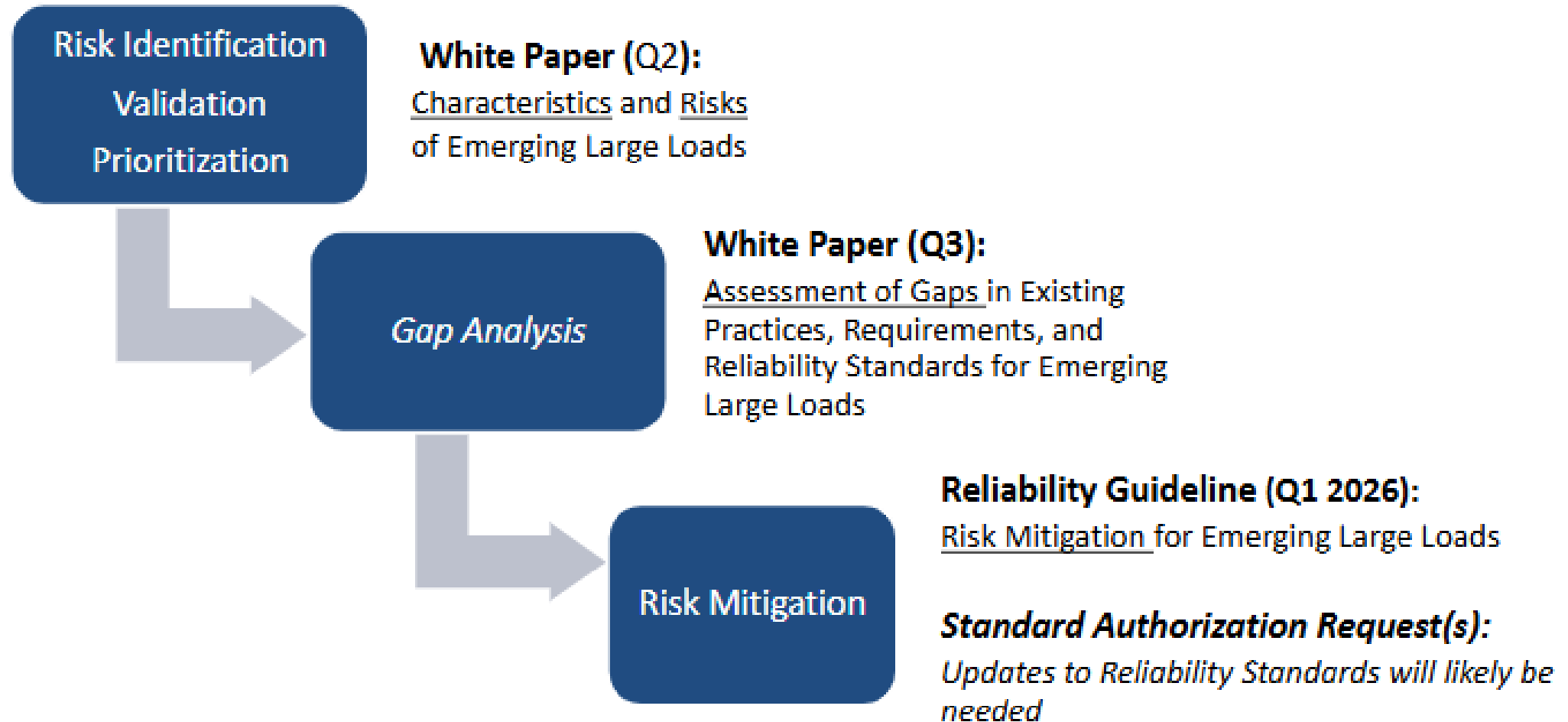
The U.S. and China drive data center power consumption
Sep 16, 2025 — Power consumption from data centers in the U.S. is set to...
Cipher News

AI Boom to Fuel Surge in Data Center Energy Needs, IEA Says
Apr 10, 2025 — IEA (International Energy Agency) projects data centers'...
The Wall Street Journal

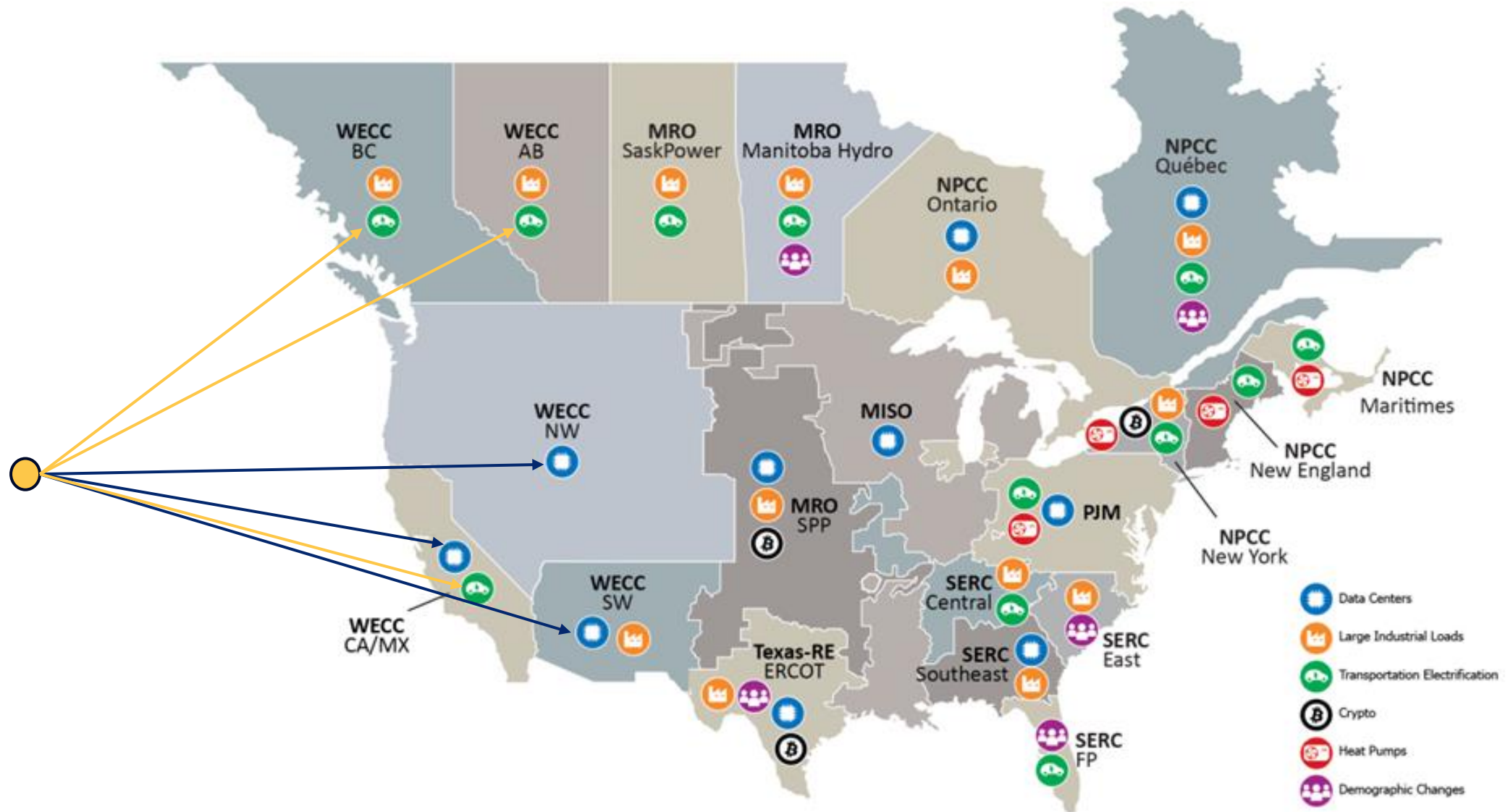
Large Loads: Representative Activity Timeline

- July 10, 2024: [E.I. Incident; Large Load Losses, 1500 MW “behind the meter”](#)
- August 2024: [NERC RSTC forms Large Load Task Force \(LLTF\)](#)
- December 2024: [NERC 2024 Long Term Reliability Assessment](#)
- November 2024: [FERC Technical Conference Docket No. AD24-11-000](#)
- April 2025: A-4 FERC Open Meeting: [NERC Presentation](#)
- July 2025, Webinar: [Characteristics and Risks of Emerging Large Loads](#)
- July 2025: White Paper: [Characteristics and Risks of Emerging Large Loads](#)
- August 2025: [Large Load Integration Panel, Quarterly Technical Session](#)
- September 9, 2025: [Level 2 NERC Alert, responses due January 28, 2026](#)
- October 6, 2025: [NERC Large Loads Action Plan Q3 Update](#)
- October 20, 2025: [Load Modeling Working Group Workshop \(online, free\)](#)

Large Load Task Force Framework 2025



Background: NERC 2024 LTRA—Demand Drivers



Notes: Data Center & Transportation Electrification
Today's Presenter will be focusing on their experience with **Data Center Loads**

Takeaway: EPRI 2024 Report / Executive Summary

“EPRI highlights three essential strategies to support rapid data center expansion:

1. Data center efficiency improvements and increased flexibility.
2. Close coordination between data center developers and electric companies regarding data center power needs, timing, and flexibility, as well as electric supplies and delivery constraints.
3. Better modeling tools to plan the 5–10+ year grid investments needed to anticipate and accommodate data center growth without negatively impacting other customers and to identify strategies for maintaining grid reliability with these large, novel demands.”

[Page 2 of public report](#)



How is a Large Load defined or going to be defined?



Large Load Integration: Insights from a Large Utility for Small to Medium-sized Entities

October 15, 2025

Shawn Wagner, NV Energy

Insights from a Large Utility for Small to Medium-Sized Entities

Primary Objective: Share NV Energy's experiences with integrating large, complex loads, particularly data centers, to help small to medium-sized entities understand the process, challenges, and best practices.

Key Discussion Points:

- **Understanding the "New" Large Load:** New 24/7/365 demands from data centers, with their rapid growth and high density, are forcing NV Energy to re-evaluate traditional planning. The utility is now using accelerated planning to better prepare.
- **The Interconnection Journey:** The "Timeline Mismatch" between a customer's desired energization date and the utility's multi-year construction schedule for transmission and substations is a major challenge. We've found that early and transparent collaboration with customers is crucial to managing this disparity.
- **Transmission & Reliability:** Serving large loads depends heavily on high-voltage transmission (100 kV and above), which can present unique challenges for grid stability. We leverage the work of the NERC Large Loads Task Force and collaborate with regional partners like WECC to ensure grid reliability across the Western Interconnection.

Mission



“To be the best and easiest utility to work with in the State of Nevada, while delivering a modern, resilient, sustainable and prudent system that provides operational excellence for our customers”

- ① Best customer service
- ② Best people — best safety environment
- ③ Great stewards of the environment
- ④ Respected by our regulators
- ⑤ Most efficient and effective operator
- ⑥ Achieve our financial commitments and efficiently reinvest in our assets

OUR **CORE** PRINCIPLES



Strengths



- **Proactive Planning:** NV Energy's **Integrated Resource Plan (IRP)** has seen projected demand skyrocket from 2.5 GW to 4.3 GW, with current contracts totaling 5 GW to meet a massive influx of 15 GW in new load requests over the next five years.
- **Renewable Energy Resources:** With **80 GW** of proposed generation in the interconnection queue, Nevada has abundant solar, wind, and geothermal resources, allowing NV Energy to meet large customers' sustainability goals. Many of these projects, however, require extensive network upgrades.
- **Established Processes:** NV Energy's Open Access Transmission Tariff, defined by FERC standards, provides a well-defined framework for connecting large loads. For example, large generator interconnections are defined as **20 MW** or greater, and NV Energy serves as its own **Balancing Authority and System Operator**.
- **Infrastructure Investment:** NV Energy is actively expanding its transmission system, including the Greenlink Nevada project. Regulators have been receptive to depreciating these assets over **70 or more years** to mitigate rate shock for customers.

Weaknesses



- **Forecasting Inaccuracy:** Despite detailed planning, the utility receives speculative or inaccurate load forecasts from large customers, such as data centers. This lack of reliable data can lead to over-investment or under-investment in infrastructure, as current data center load is estimated at **300 MW**.
- **Mismatched Timelines:** Utilities face a significant challenge because their multi-year infrastructure projects (with lead times and sourcing often exceeding **four** years) do not align with the much faster development schedules of data centers, creating a mismatch between electricity supply and demand.
- **Aging Infrastructure:** Parts of NV Energy's grid are aging, posing reliability risks. The high-level of uptime required by data centers is difficult to meet without significant upgrades. The national average age of substations, **is over 50 years old**, well past typical design life of 25–30 years.
- **Cost and Ratepayer Risk:** Financing large, specialized infrastructure for a small number of customers can lead to a risk of shifting costs to general ratepayers. This financial exposure, which can involve projects in the **tens of millions of dollars**, can create regulatory challenges and public opposition.

Opportunity



- **Clean Energy Partnerships:** NV Energy has partnered with large-load customers to develop new, dedicated renewable generation, often through special tariffs like the **Clean Transition Tariff**. This unique approach, developed with companies like Google, aligns a customer's clean energy goals with the utility's long-term planning, and avoids shifting costs to other ratepayers.
- **Demand Response & DER Integration:** The utility is developing advanced demand response programs to work with customers to manage energy use during peak times. Additionally, we continue to evaluate **new tariffs and programs** to integrate large customer's distributed energy resources (DERs), such as on-site solar and battery storage, into the broader grid.
- **Economic Development:** The successful attraction and integration of large customers like data centers drives significant economic growth for Nevada, **creating jobs and increasing tax revenue**. This provides a clear, shared benefit for the state.
- **Next-Generation Conservation:** The data center industry is continually innovating to improve efficiency. Research from academic sources like Lawrence Berkeley National Laboratory and NREL shows a shift toward **more advanced and sustainable cooling technologies**, such as immersion cooling and thermosyphon systems, that can dramatically reduce energy and water consumption.

Threats



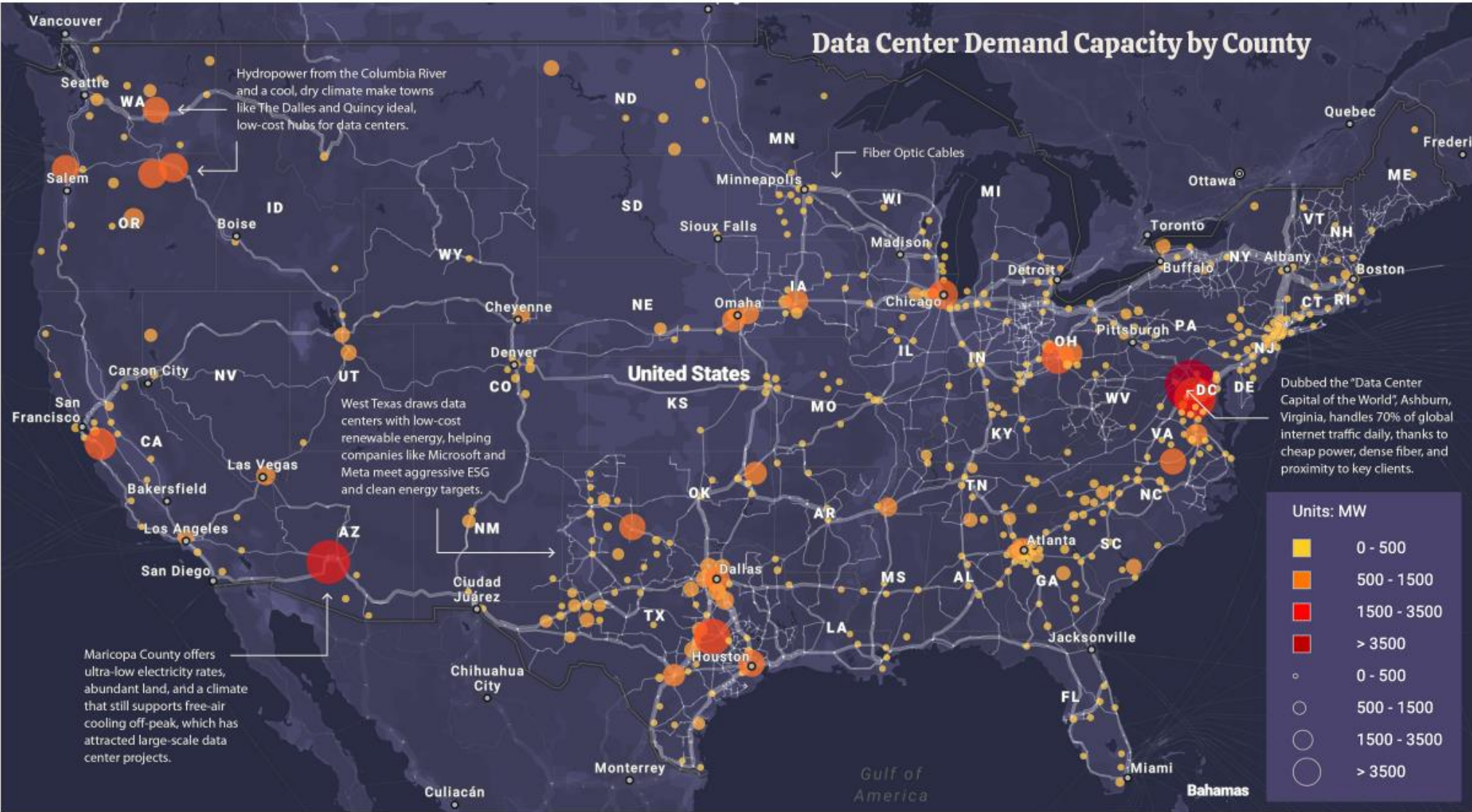
- **Unplanned Load Growth:** The rapid proliferation of new data centers and other high-load industries can outpace the utility's ability to plan and build infrastructure, risking **grid reliability and potential blackouts**. This includes the challenge of managing a change in load forecasting velocity, as data center growth outpaces traditional planning cycles.
- **Competition and Bypass:** Large customers may opt to build their own on-site generation (referred to as "**colocation**") or seek to bypass the utility entirely if interconnection costs are too high or project timelines are too slow. This could lead to a loss of revenue, **limit the ability of the utility to serve other network customers**, and investment for the utility.
- **Regulatory Scrutiny:** Regulators closely monitor how utilities handle large-load integration. If we are perceived as unfairly passing costs to ratepayers or failing to meet demand, we could face regulatory penalties or mandates that impact our business model. **Contractual obligations for load profiles** are a key tool for us and regulators to hold customers accountable for their energy use, preventing unexpected load fluctuations.
- **Environmental Concerns:** Meeting a massive new load, especially in a state with ambitious renewable energy goals, might require **more fossil fuel-based** "peaker plants" to ensure reliability. This can threaten progress toward the state's climate targets and lead to public backlash.



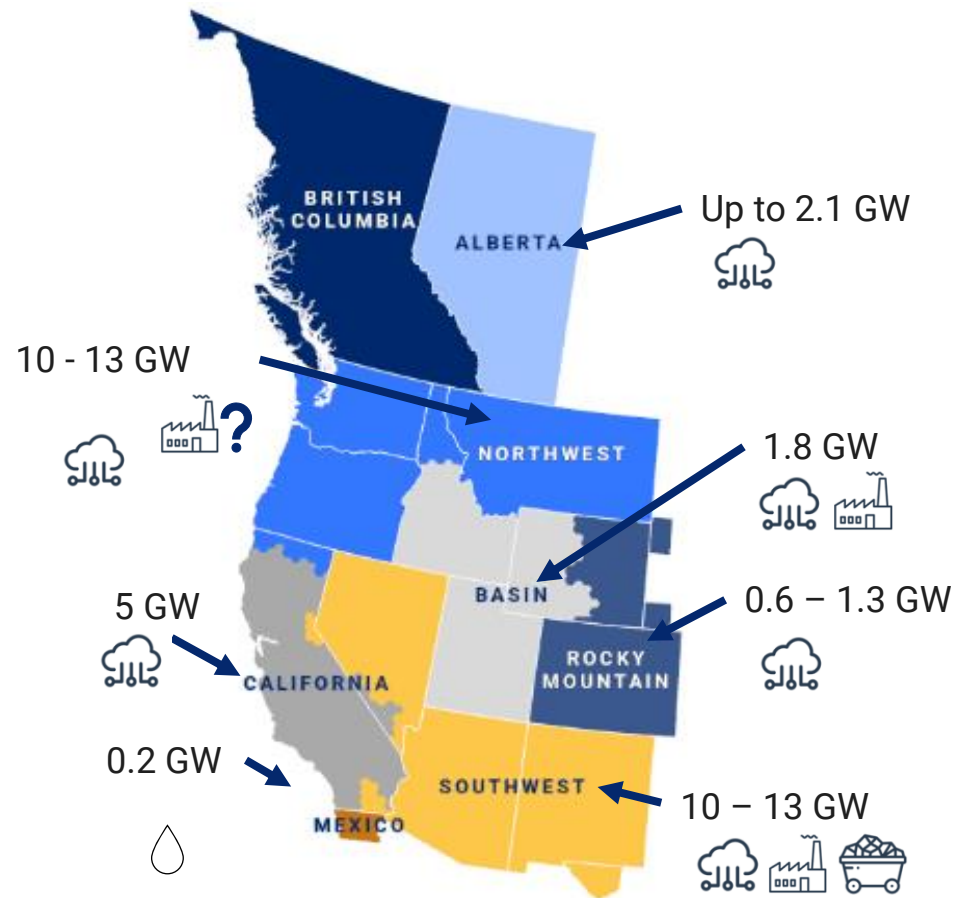
Large Loads—Additional Perspectives

Enoch Davies, WECC

Large Loads Across the U.S.



Large Load Additions by Region of the Western Interconnection



2022–2035 Western Interconnection Large Load Growth

- 2022 = 7 GW
- 2024 = 8 GW
- 2027 = 14 to 18 GW
- 2030 = 21 to 29 GW
- 2035 = 27 to 37 GW
- Interconnection Queue (2024) = 45 GW



Potential AI Training



Periodically fluctuating load potentially peaking every few seconds with a magnitude of up to several hundred megawatts (MW)

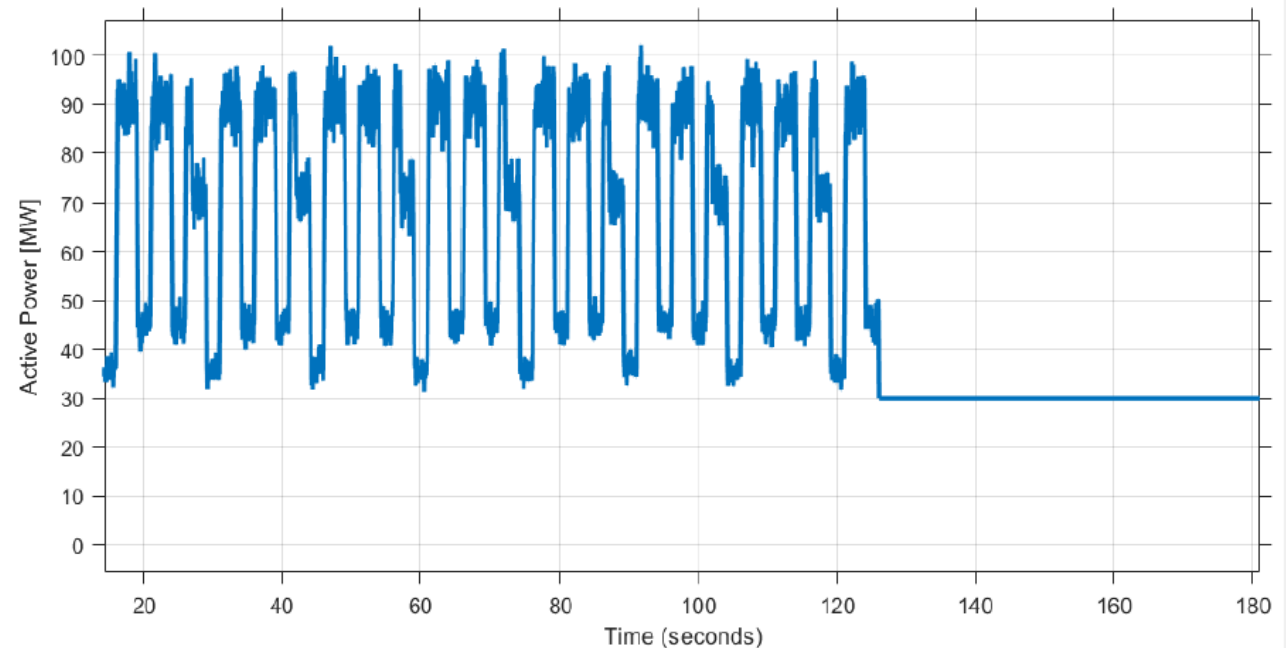


Negative Impact on the grid:

- Effects on nearby generators
- Potential for forced oscillations
- Risk of grid instability
- Voltage sags or flicker, especially in weak grids

2025-03-20

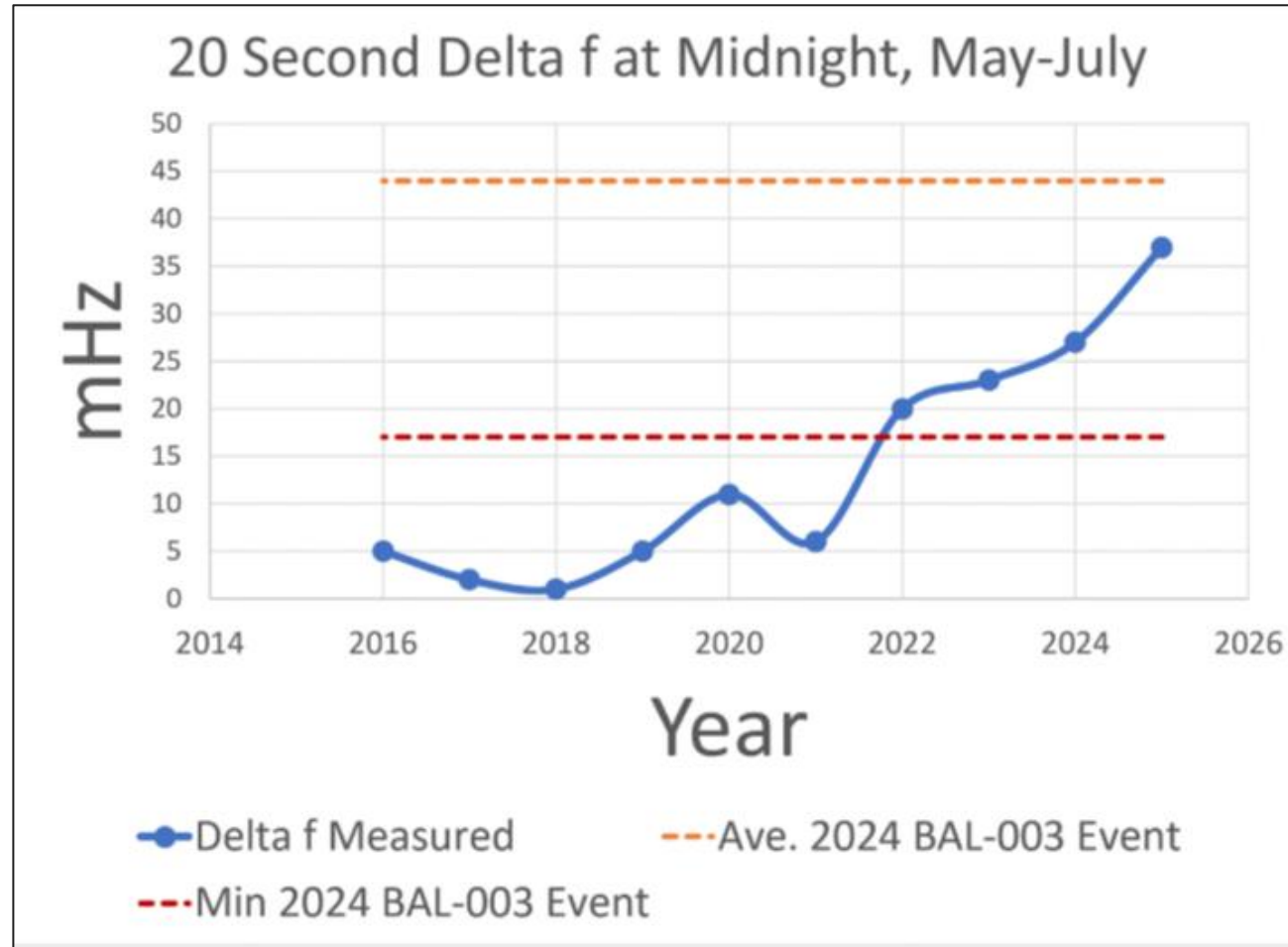
AI-training datacenter load pattern



This is a fictitious load pattern based on Pratyush Patel, Esha Choukse, Chaojie Zhang, Íñigo Goiri, Brijesh Warriar, Nithish Mahalingam, and Ricardo Bianchini. [Characterizing power management opportunities for llms in the cloud. 2024.](#)

Sergey Kynev | SE GT 2
unrestricted © Siemens Energy, 2025

Changing Grid: Time of Use vs. Internet of Things?



Source: WECC RPPA



Selected Q&A Panel Discussion

Panelist Questions and Answers

- What is the most significant difference between integrating traditional industrial loads and today's hyperscale data centers?
- The Planning Phase: How can small to medium-sized entities best prepare for the interconnection process and what information is critical for the utility to receive early on?
- Physical Infrastructure: What are the most common unique transmission requirements or challenges we've encountered, and what steps are we taking to address them?
- Reliability & Resilience: From a WECC perspective, how are large loads affecting the broader grid, and what measures are being implemented to ensure regional reliability?



Audience Q&A



WECC



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