Geography of Data Center Deployment in the U.S.

An Energy Horizons Special Report

September 10, 2025

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Disclaimers

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The OL25-NEMS model used in this analysis is OnLocation's modified version of the U.S. Energy Information Administration's National Energy Modeling System (EIA NEMS). The OL25-NEMS model and results presented here do not represent the views of EIA. OL25-NEMS is based on the EIA Annual Energy Outlook (AEO) 2025 and includes the same market and technology assumptions unless otherwise noted. For more information about EIA NEMS, visit https://www.eia.gov/outlooks/aeo/.

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Introduction and Report Highlights

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Who We Are

KeyLogic

Mid-tier firm offering deep domain expertise in our country's most critical undertakings within the energy, federal civilian, and defense sectors

Innovative Integration

Large-scale data management, advanced analytics, enterprise transformation, science & technology advisory services, R&D management, and systems engineering

Thought Leaders in Emerging Technologies

Technology readiness scale with experience modeling and assessing a range of energy-relevant technologies at low-technology-readiness levels

Critical Materials Expertise

Material and resource analysis, including life-cycle analyses, across the critical materials supply chain in support of energy production, generation, and storage technologies

OnLocation

Specialized division of KeyLogic with more than four decades of experience developing and applying innovative energy system and economic models to address key energy and environmental challenges

Assess Role of New Energy Technologies

Evaluate system and economic impacts of new and emerging energy technologies such as electric vehicles, battery storage, biofuels, hydrogen, and carbon capture & storage

Explore Alternative Energy Futures

Design "what-if" scenarios and alternative energy futures for use in uncertainty analyses including alternative energy prices, technology costs, and data center demand projections

Inform Energy & Environmental Policy

Perform economic impact assessments of new or proposed energy and environmental regulations and policies such as the OBBBA, Presidential Executive Orders, and state/local policies

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Motivation for Report

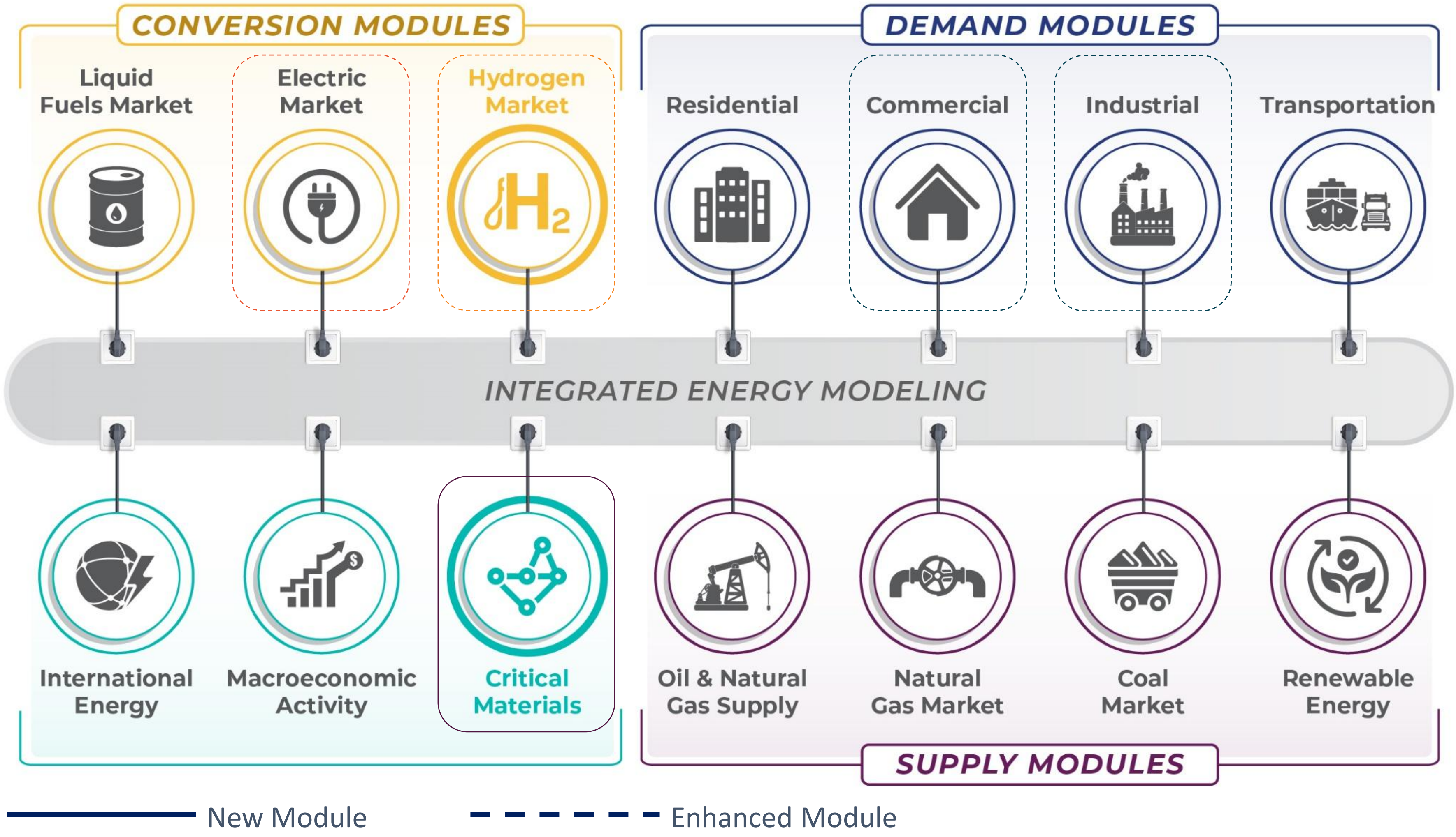
Evaluate key driving forces in the U.S. energy system, focusing on the unprecedented growth in AI data center electricity demand and critical factors used by developers to locate new centers

Analyze implications of critical factors to determine the most favorable regions for future data center growth

Provide insights into the evolving power grid response to AI data center growth, regional deployment, and Administration policy changes

Perform updated and timely scenario analysis using OnLocation's revised version of the National Energy Modeling System (OL25-NEMS)

OnLocation's Customized Version of the National Energy Modeling System (OL25-NEMS)



Development & Application of Energy System Models

- Analyzing Impacts of Demand Growth
- Assessing New Energy Technologies
- Informing Cost-effective Approaches and Policies

Customization & Analyses

- Regional Data Centers
- Updated Policies
- Advanced Technologies
- Critical Materials

Note: The official version of NEMS is developed and maintained by the Energy Information Administration (EIA), U.S. DOE

Data Center Report Highlights

Data center energy demand growth continues to be a driving force in the U.S. and will require new investments in electric generation and transmission.

Regional decision factors will drive the geography of data center deployment, especially for hyperscale centers. Priority factors include Power Availability and Affordability, Favorable Policy and Business Environment, Infrastructure Readiness, Workforce Accessibility, and Environmental Resilience.

The future electricity generation mix will depend on regulations and policies that influence capacity investments and utilization of energy sources as well as the regions chosen for new data centers.

Multiple energy sources will be essential for meeting the growing energy demand for data centers, including conventional fossil fuels, conventional & advanced nuclear power, renewables, and battery storage.

Cryptocurrency operations and other large loads, which have different determining factors for location and operating characteristics, require further study to develop a comprehensive view of future power sector requirements.

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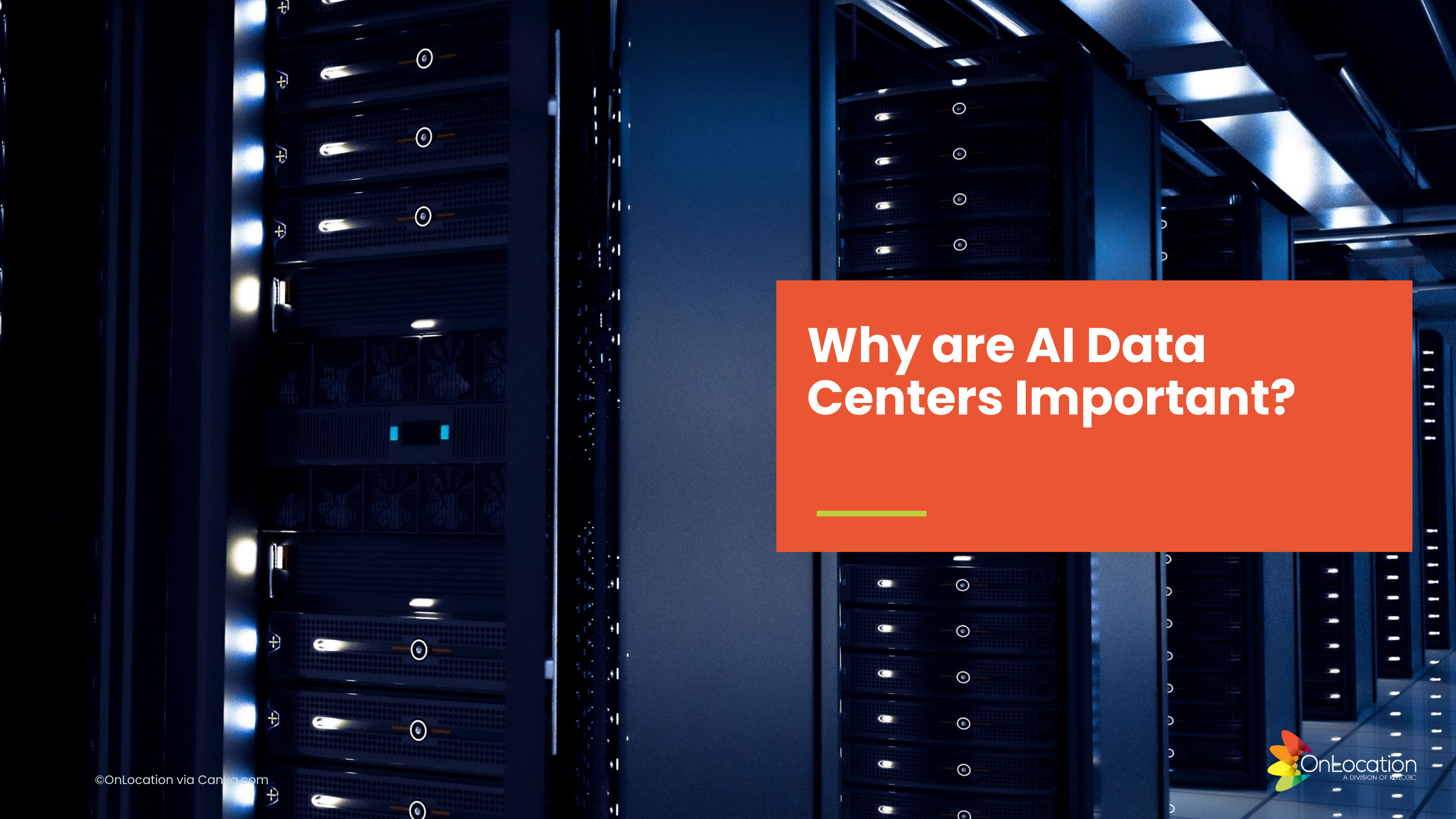

Why are AI Data Centers Important?

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Why are AI data centers important?

Data centers provide businesses, governments, and homes with vast amounts of data storage and computing power:

- eCommerce, telecommunications, video streaming services, stock trading, medical imaging, online gaming, research studies, and many other applications.

Data center power demand accounts for more than 4% of total U.S. electricity consumption in 2023[1] and is projected to grow significantly in the next few decades.

Digital transformation is driving increasing data center energy demand for:

- Cloud computing, artificial intelligence (AI) training and user applications, digital services, and cryptocurrency mining operations.

The fastest growing markets in recent years are the use of data centers for AI models and applications and by cloud service providers such as Amazon, Google, and Microsoft.

What are the main data center types?

Primary Data Center Types:

- **Small-scale:** Includes server rooms and edge data centers. Serves localized operations such as small businesses, facilities, or individual customers. [2, 3]
- **Large-scale:** Serves extensive operations such as cloud computing, training models, and processing large datasets often for multiple businesses, governmental agencies, or entire industries. [3, 4, 5]
  - **Enterprise data centers:** 20-30% of the U.S. data center load
  - **Hyperscale and multiple host data centers:** 60-70% of the U.S. data center load

Type	Size	% Bldg Load	Capacity
Small-scale	<10,000 sq. ft.	10%	500kW – 5MW
Large-scale	>10,000 sq. ft.	90%	>40MW

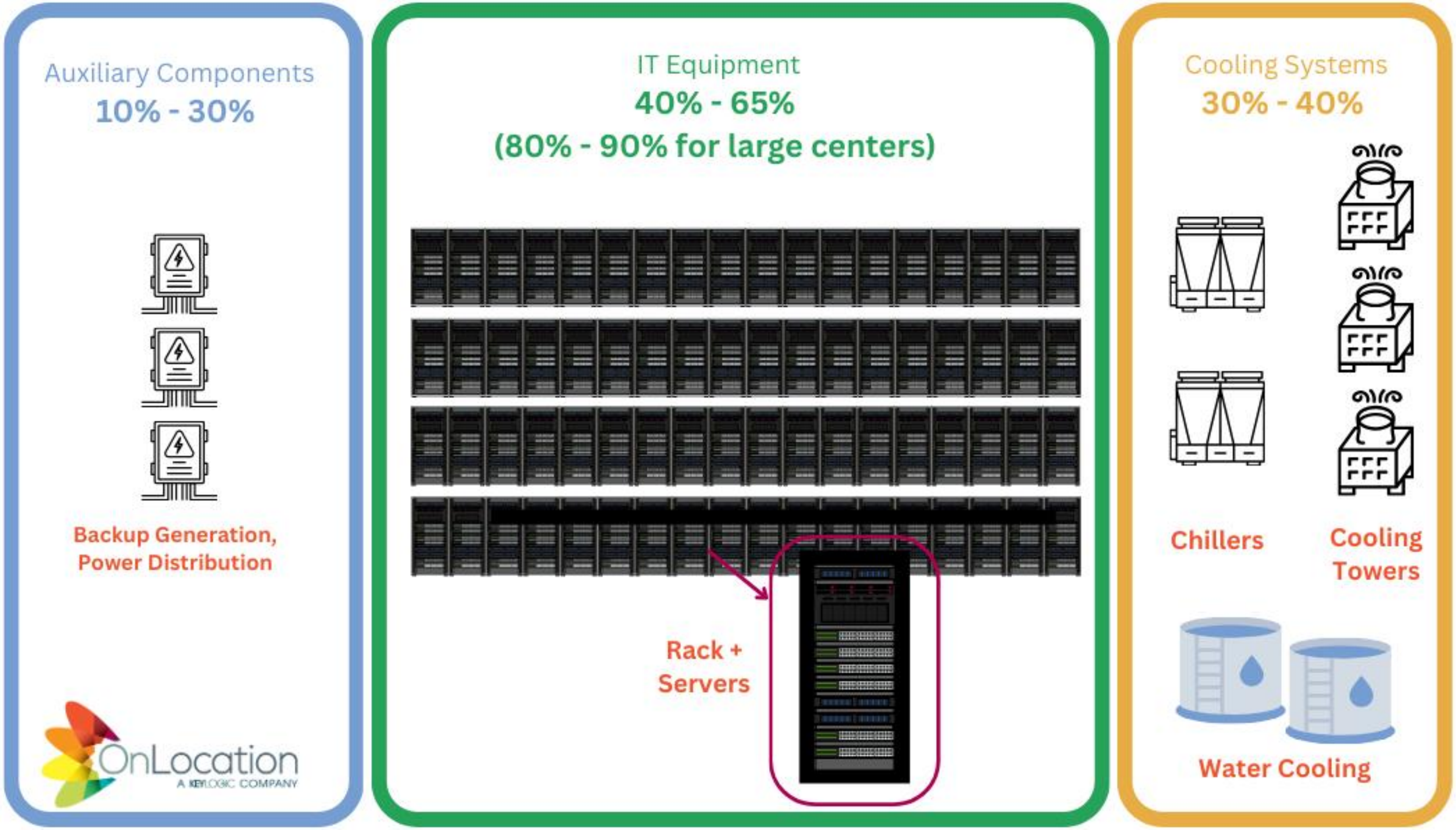
Types of Large-Scale Data Centers: [3, 4, 5]

- **Enterprise data centers** are controlled by one organization for the purpose of storing important IT infrastructure and other elements necessary for processing, storing, and managing the organization's data and applications.
- **Multiple host data centers** are facilities that provide server hosting and hardware services for multiple businesses that share infrastructure.
- **Hyperscale data centers (>100,000 Sq. Ft.)** support and service major cloud providers such as Amazon, Google, and Microsoft and can quickly expand to accommodate extensive computing and storage requirements.

Our analysis focuses on hyperscale data centers

How is electricity consumption distributed across various components of a data center?

The electricity use within a data center is mainly driven by three key areas and their consumption range can differ by data center size: [3, 6, 7]



% of Data Center Total Energy Consumption

Evolving Policy Landscape

For this analysis, we focus on select policies and regulations that will have the most significant impact on the energy system and data center development in the future. These include:

- **Congressional legislation:** The **One Big Beautiful Bill Act (OBBBA)** enacted in July 2025 significantly altered the energy policies and technology incentives of the Inflation Reduction Act (IRA) of 2022, especially for renewable energy, while providing additional support for new development of fossil fuels.
- **Presidential Executive Orders:** Several regulations aimed at reducing greenhouse gas emissions in the power and transportation sectors are expected to be repealed or substantially modified.
- **State & local policies:** Many states and cities offer tax exemptions, streamlined permitting, and other business-friendly incentives to attract new AI data centers.

What Makes a Region Attractive to AI Data Center Developers?

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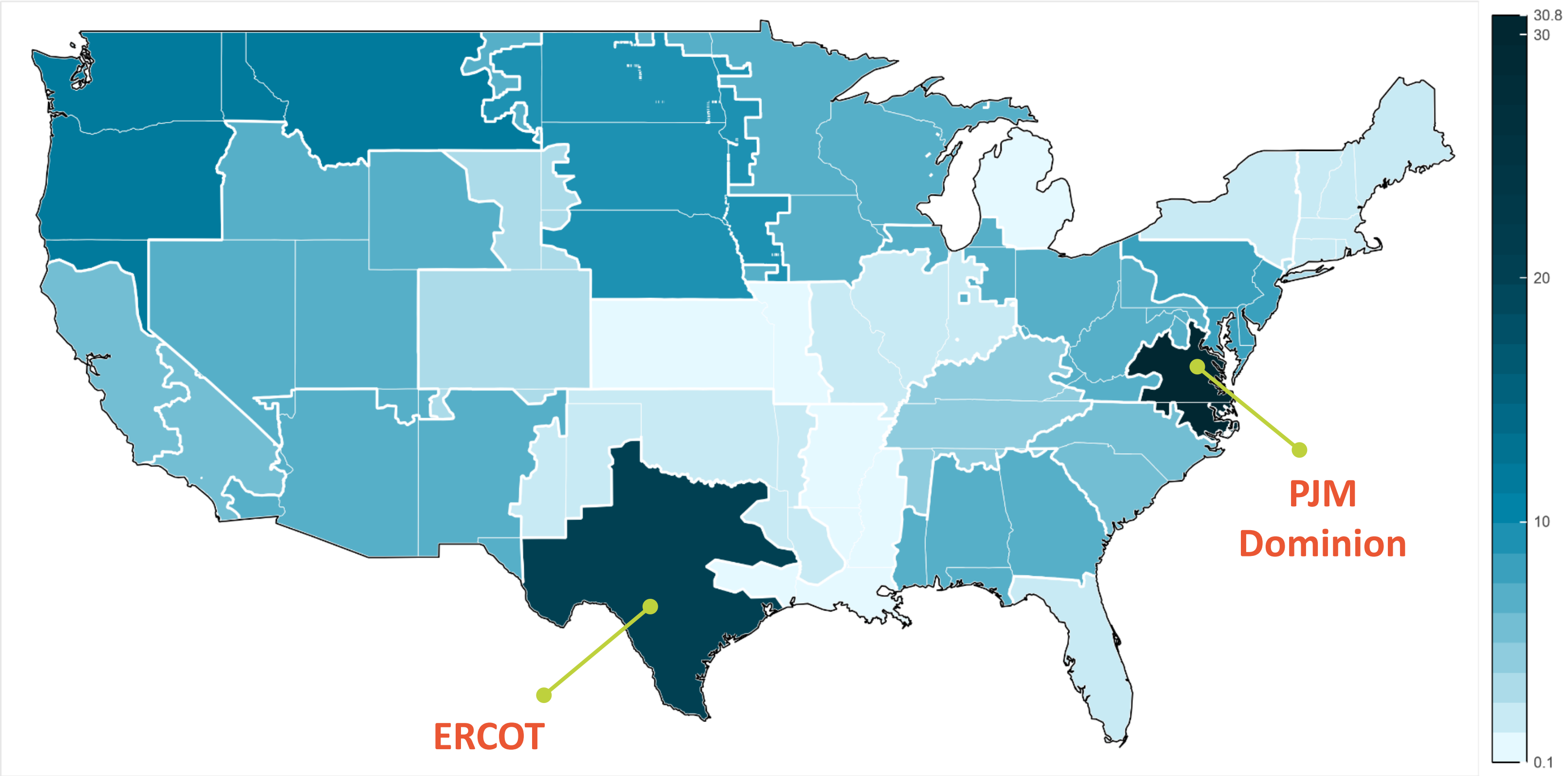
Highly Concentrated Demand Is Reshaping Regional Power Systems

Data Center Demand By Electric Reliability Region in 2023 (TWh)



- Data centers are located in most U.S. regions but are highly concentrated in the PJM Dominion (VA) and ERCOT (TX) electric reliability regions.
- Each region has policies and attributes that make them more or less attractive for data center development.
- Regional differences in energy resources and generation mix mean location of additional demand from data centers directly impacts capacity expansion planning and grid reliability.

Source: OnLocation

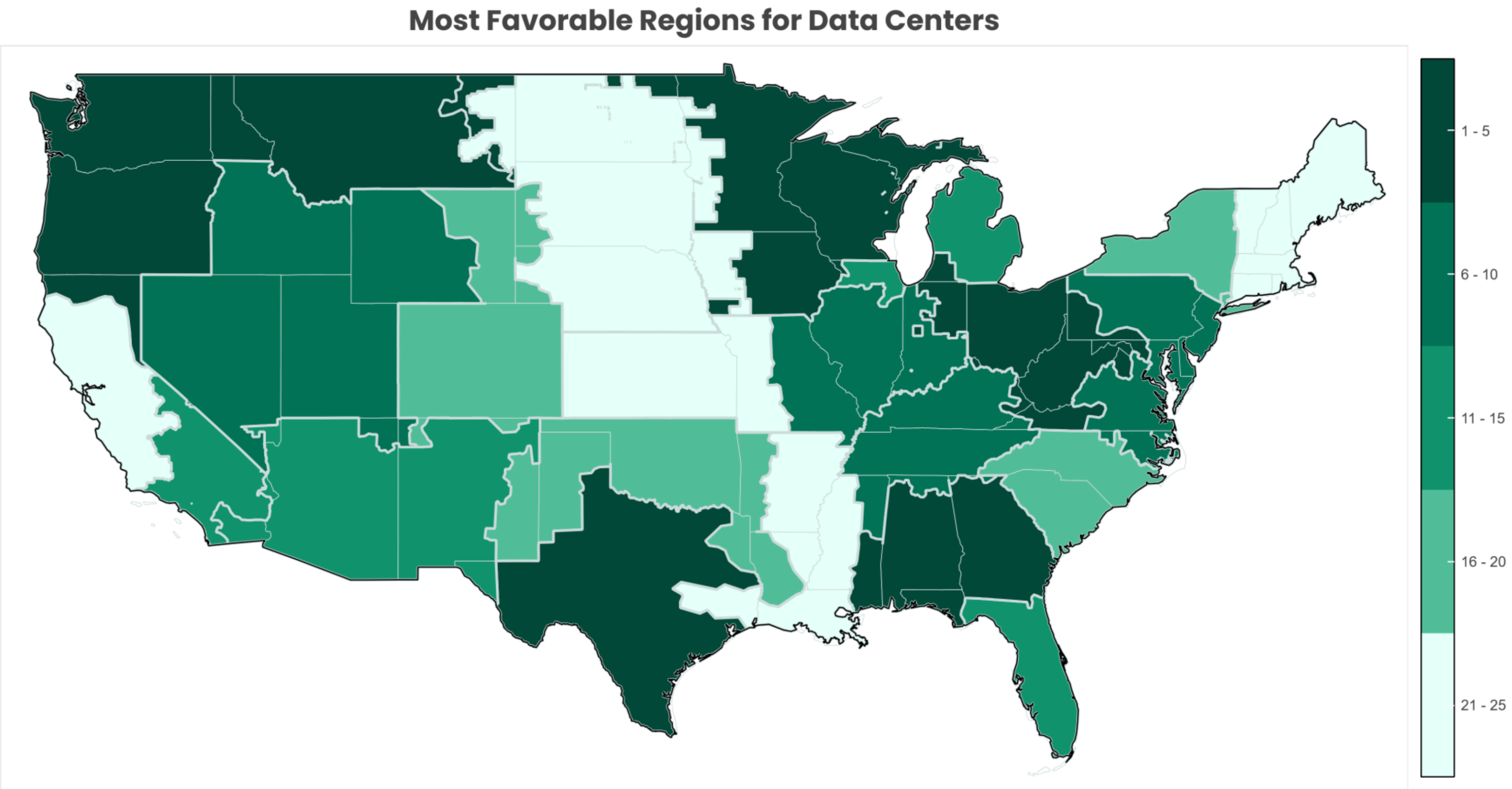
Note: Map uses state level data from EPRI 2024: Powering Intelligence, Analyzing Artificial Intelligence and Data Center Energy Consumption mapped to EIA's Electricity Reliability regions

Key Factors for Regional Deployment

Data center developers weigh many considerations when selecting sites, but five interrelated dimensions consistently drive decision-making:

- **Power Availability and Affordability:** Reliable, affordable electricity—available quickly—is the top priority.
- **Favorable Policy and Business Environment:** Permitting efficiency and incentive structures are an important driver for development. States offering tax abatements, equipment tax exemptions, and deregulated power options are often preferred.
- **Infrastructure Readiness:** Beyond electricity, data centers require access to fiberoptic backbones, water for cooling, and low-cost land with minimal permitting barriers.
- **Workforce Accessibility:** Successful operations depend on skilled labor—from construction to technical maintenance.
- **Environmental Resilience:** Cooler temperatures reduce cooling costs, and a low risk of natural disasters such as hurricanes improves uptime and long-term reliability.

Ranking of U.S. Regions for Data Center Deployment



Source: OnLocation

Note: Map shows each region shaded by its ranked group based on our analysis.

OnLocation's research and analysis identified the most favorable regions for new data center development by applying its ranking of key decision factors and dimensions.

The top 5 regions that stand to gain the most data center load growth (see darkest shaded regions):

1. Texas Reliability Entity (TX)
2. PJM/West (OH, WV, part of PA)
3. SERC/Southeast (GA, AL, part of LA)
4. MISO/West (WI, MN, IA)
5. Northwest Power Pool (WA, OR, MT)

PJM/Dominion (VA), which currently has the most data center capacity, ranks in the top 10 regions but future growth is expected to slow.

Development of AI Data Center Scenarios

Development of OnLocation Scenarios

The recently published Annual Energy Outlook (AEO) 2025 version of the National Energy Modeling System (NEMS) was used as the basis for developing OnLocation's version of NEMS (OL25-NEMS). The AEO 2025 includes laws and regulations as of December 2024.

Two OnLocation scenarios, **OL High and Low Data Center Growth**, were created with the following assumptions.

Recent Policy Changes

- **IRA Tax Credits:** Phased out Inflation Reduction Act (IRA) Clean Electricity Tax Credits for renewable and nuclear generation.
- **EPA 111 Regulations:** Removed the U.S. Environmental Protection Agency (EPA) Clean Air Act Section 111 greenhouse gas regulations for fossil fuel-fired power plants.
- **Other Policies:** Removed EPA greenhouse gas tailpipe rule, latest CAFE standards, and Advanced Clean Truck rule.

AI Data Center Growth

- **OL High Data Center Growth Scenario:** Reflects a higher expected growth rate based on published forecasts.
- **OL Low Data Center Growth Scenario:** Reflects a more modest growth rate through 2050.
- **Demand growth projections** used for these scenarios are described on the next slide.

Data Center Location & Energy Source

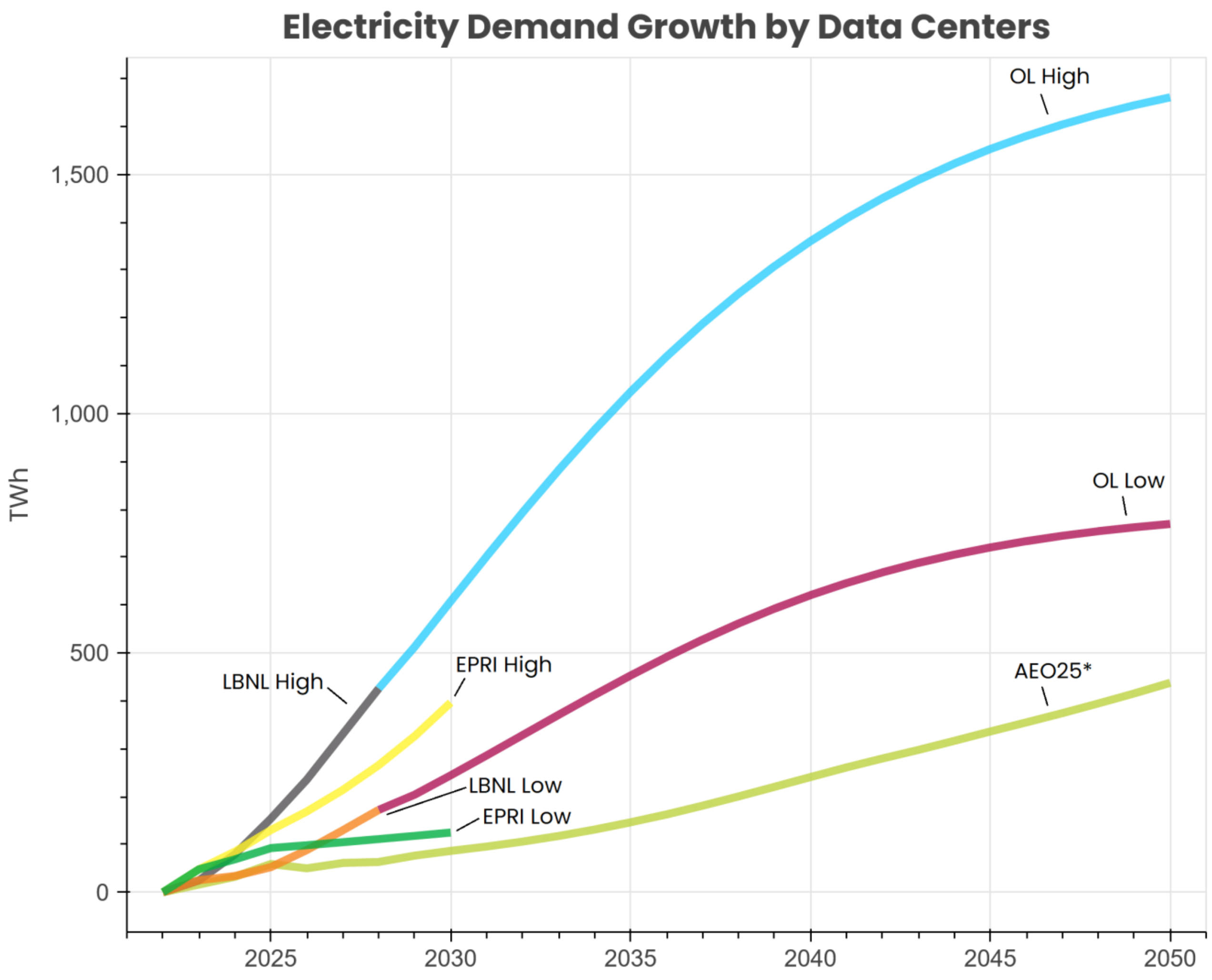
- **New data center locations** vary across the model's 25 electric reliability regions and are based on rankings of key decision factors used by data center developers.
- **Electricity demand** for all data centers is assumed to be fully met by grid-based electricity. The use of off-grid sources and microgrids to power data centers was not considered in this analysis.

Growth is Significant but Highly Uncertain

- We compare two OnLocation (OL) scenarios to determine the impact of expected data center demand growth:
  - **OL High Growth:** Projects national data center electricity use by fitting an S-curve to Lawrence Berkeley National Laboratory's (LBNL) high-growth estimates for 2022–2028, then extrapolates this trend to 2050.
  - **OL Low Growth:** Uses LBNL's lower bound estimates as the basis for a more gradual S-curve projection of national data center electricity use.

- Other estimates, e.g., the Electric Power Research Institute (EPRI) high and low projections, show a range of estimates that highlight uncertainty.

*Note: The values shown for Annual Energy Outlook 2025 (AEO25) are OnLocation's estimates of the embedded data center demand.

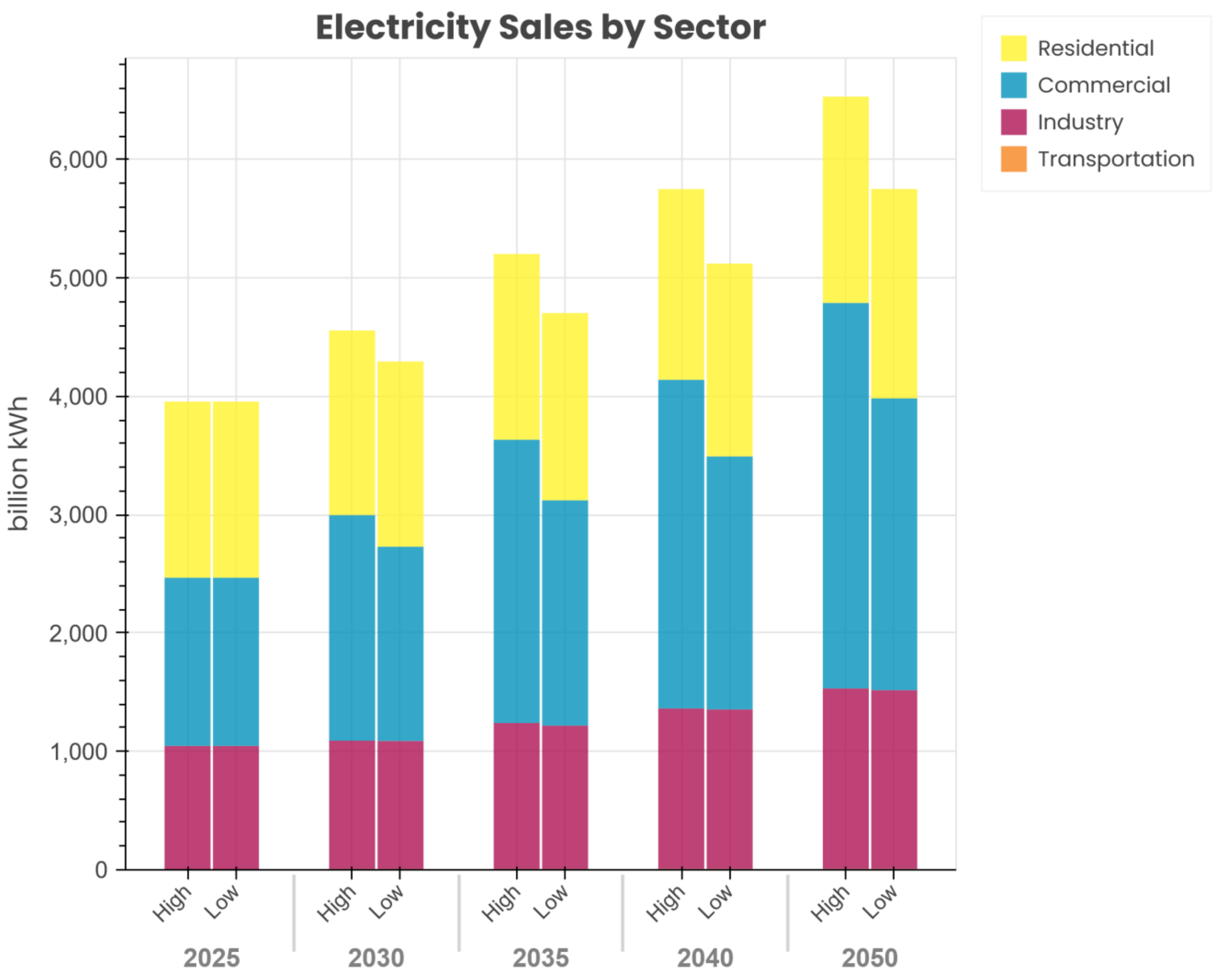


Source: OnLocation

OL25-NEMS National & Regional Projections

National Electricity Demand

- The OnLocation **High Growth** scenario includes nearly 1800 TWh of growth in data center demand over the next 25 years, while the **Low Growth** scenario includes half of that, about 900 TWh.
- Data centers add significant demand to overall load growth, leading to electricity sales growth not seen in recent decades.
- **Data centers are included in commercial sector demand** as shown here. Demand from electric vehicle charging is included in the sector that performs the charging (i.e., the residential and commercial sectors).

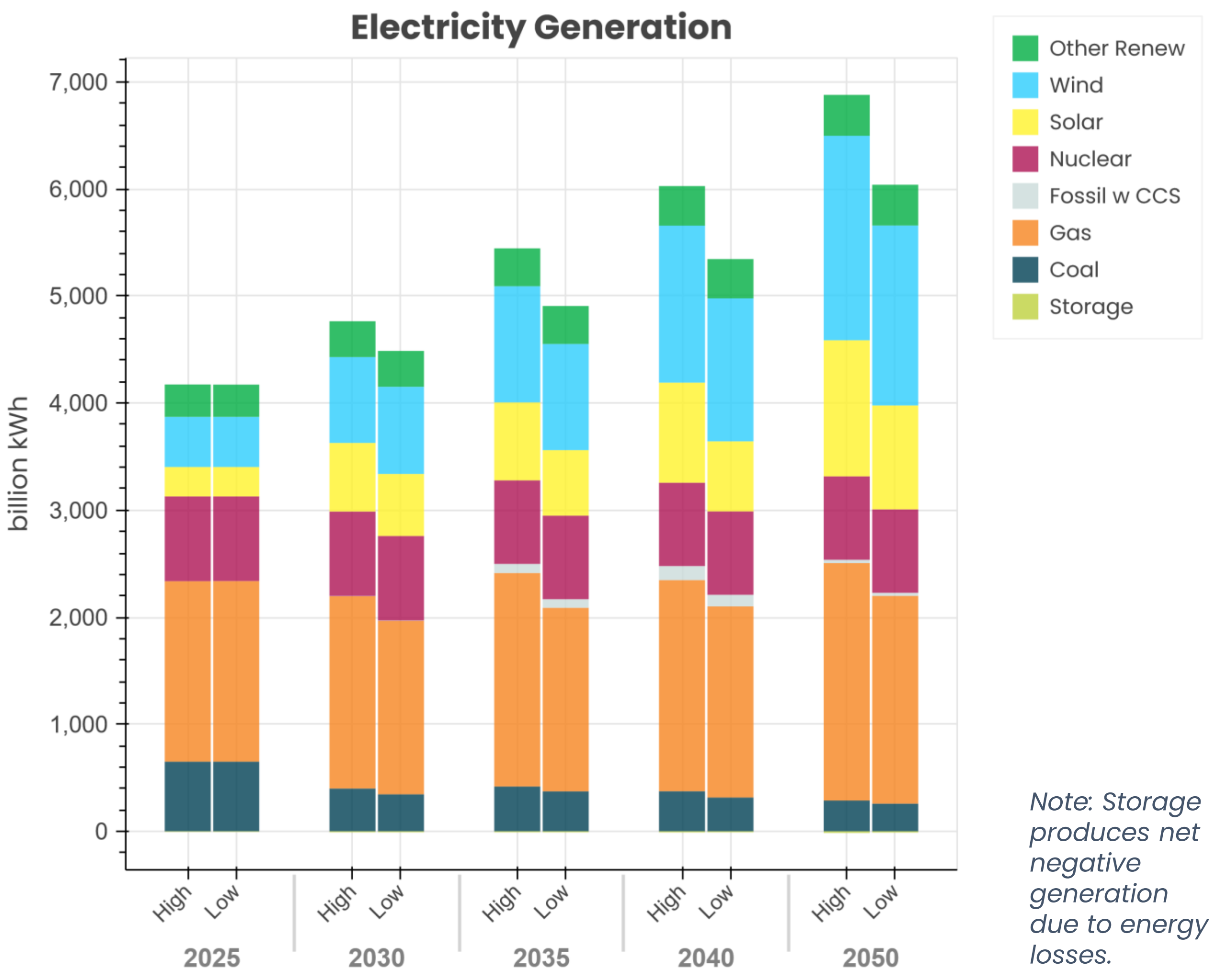


Source: OnLocation

National Electricity Generation

- Data center demand in **both scenarios** leads to increasing generation from low-cost renewables along with increasing natural gas and decreasing coal generation.
  - Many hyperscalers continue to prefer low carbon power where available due to their sustainability goals even though speed to power tends to be the more dominant driver.

- However, there are important differences between the scenarios:
  - The **Low scenario** shows a continued preference for new renewables to meet increasing demands.
  - The **High scenario** relies more on gas and coal generation to meet the growing demand, including increased use of both new and existing natural gas generation over time, in addition to adding new renewable generation.

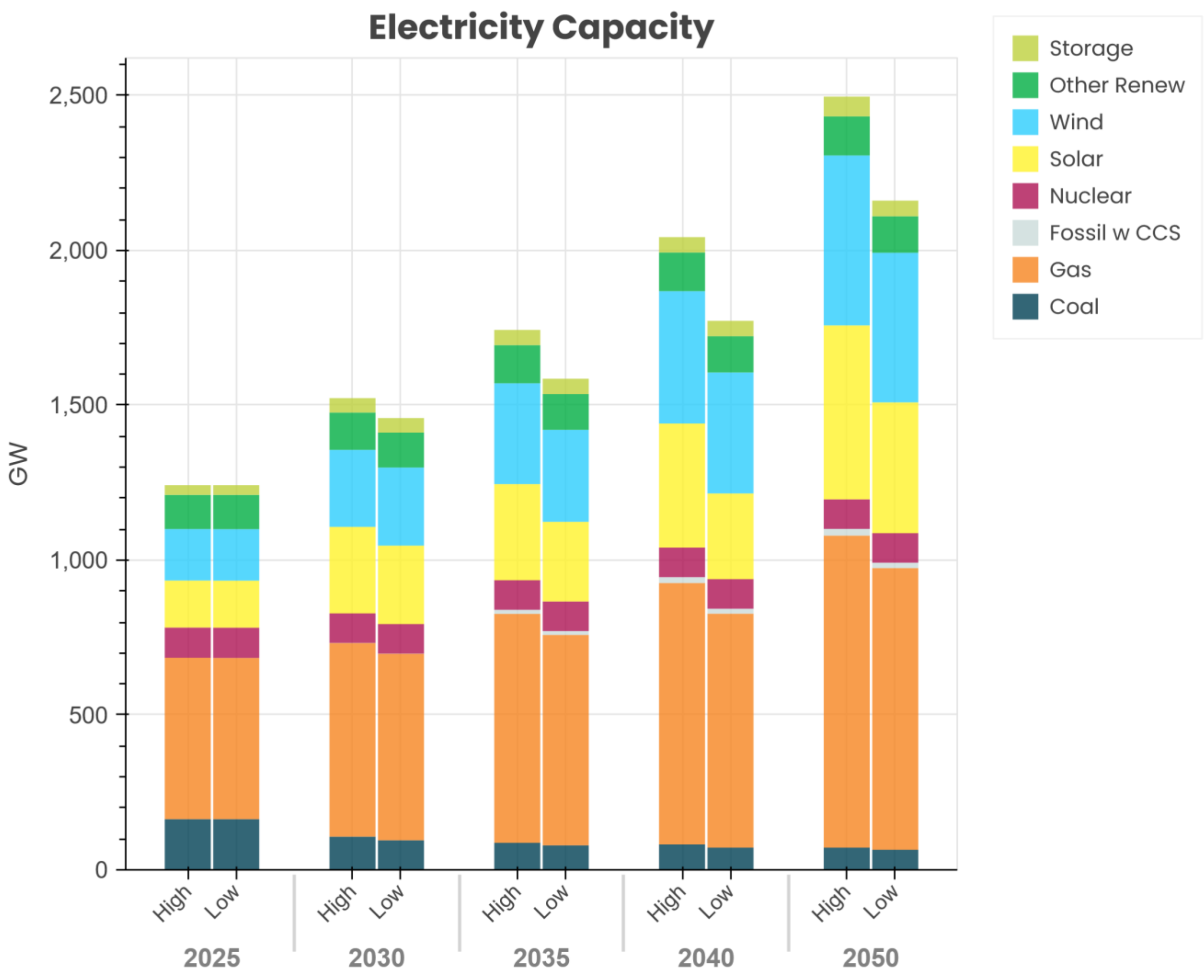


Note: Storage produces net negative generation due to energy losses.

Source: OnLocation

National Electricity Capacity

- A large amount of investment in new capacity will be needed to meet the growing demand. Total capacity is expected to be roughly double current levels by 2050.
- In **both scenarios**, capacity additions are largely made up of solar and wind, with new natural gas turbines and battery storage added in later years to provide essential grid support.
- In the **Low scenario**, less natural gas capacity (both baseload and turbines) and renewable and storage capacity is added compared to the **High scenario**, and slightly more coal capacity retires.

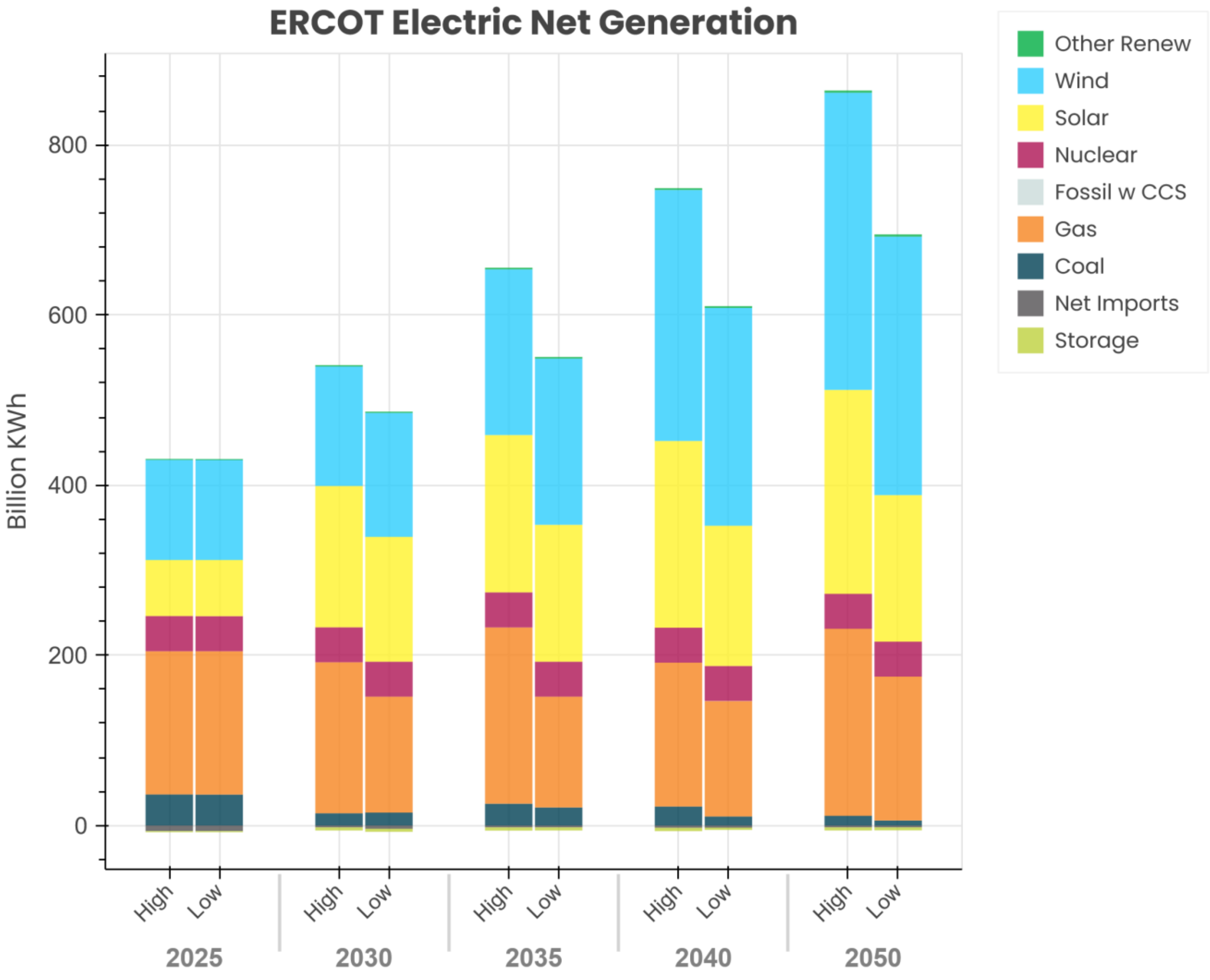


Source: OnLocation

Electricity Generation in ERCOT Region

- In 2023, ERCOT (Texas) accounted for 14% of national data center electricity demand. ERCOT has limited ability to trade with neighboring regions, so building new capacity is critical for meeting increasing demand.

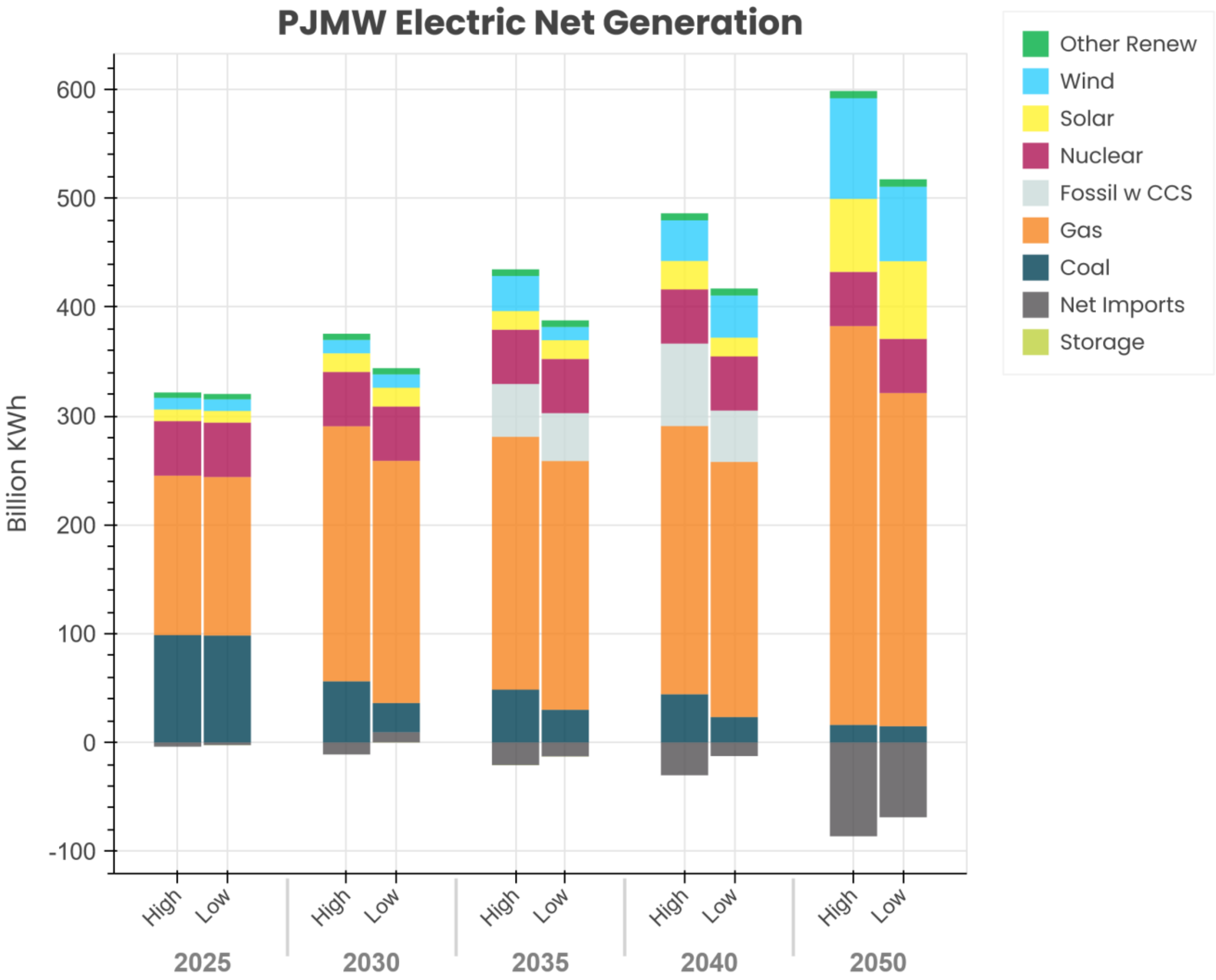
- Scenario differences include:
  - The **High scenario** results in a faster buildout of solar and wind as well as new gas generation needed to meet rising demand.
  - The **Low scenario** results in lower natural gas and renewable generation compared to the High scenario, and more coal generation retires.
  - Gas generation growth is higher in the High scenario compared to the Low scenario in the early years, but the gap narrows in later years.



Source: OnLocation

Electricity Generation in PJM/West Region

- In 2023, PJM/West accounted for 4% of national electricity demand from data centers, but by 2050 the region is projected to account for nearly 7%.
- **Both scenarios** result in significant additions of new natural gas generation and a smaller amount of wind and solar generation over time.
- Scenario differences include:
  - The **High scenario** results in more additions of new natural gas generation over time and a slower decline in coal generation.
  - The **Low scenario** results in slower additions of new gas generation and a steeper decline in coal generation.
- This region also includes some generation from gas with carbon capture by 2035 and increasing regional net exports of electricity over time.



Source: OnLocation

Key Takeaways

Data center energy demand growth continues to be a driving force in the U.S. and will require new investments in electric generation and transmission.

Regional decision factors will drive the geography of data center deployment, especially for hyperscale centers. Priority factors include Power Availability and Affordability, Favorable Policy and Business Environment, Infrastructure Readiness, Workforce Accessibility, and Environmental Resilience.

The future electricity generation mix will depend on regulations and policies that influence capacity investments and utilization of energy sources as well as the regions chosen for new data centers.

Multiple energy sources will be essential for meeting the growing energy demand for data centers, including conventional fossil fuels, conventional & advanced nuclear power, renewables, and battery storage.

Cryptocurrency operations and other large loads, which have different determining factors for location and operating characteristics, require further study to develop a comprehensive view of future power sector requirements.

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Priority Questions and Further Research Needs

- **This analysis is a first step** in highlighting how the energy plans made by utilities and data center developers may change in response to data center growth, regional factors driving placement of data centers, and policy changes.
- **As policies and data center projections evolve, so will the need for additional modeling and analysis**.
- **Additional priority questions** include:
  - ✓ Are we overbuilding or underbuilding for AI demand?
  - ✓ How will resource availability (labor, land, water) change regional data center deployment?
  - ✓ How will data center growth affect grid reliability?
  - ✓ What is the impact on electricity prices from data center energy demand?
  - ✓ Will microgrids become an attractive solution for powering data centers, improving reliability and security?
  - ✓ How will cryptocurrency data center demands evolve?
  - ✓ How will new policies & regulations change as more data centers are developed?

Modeling and Analysis Caveats

Scope of Analysis

1. **Time Horizon**: The projections extend to 2050, and longer-term implications beyond this period are not considered. The uncertainty of projected data center electricity demand increases significantly over the time horizon.

2. **Spatial Coverage**: This analysis is focused on U.S. energy markets and assumes business-as-usual policies in the rest of the world.

3. **Technological Development**: While the model is comprehensive, not all emerging technologies are fully represented. Assumptions about future technological advancements and their adoption rates are speculative and subject to significant uncertainty.

Modeling Framework

1. **Policy Assumptions:** Scenarios assume continuation and full implementation of current laws and regulations unless otherwise noted. Any changes in policy direction could significantly alter projected outcomes.

2. **Economic Assumptions:** Macroeconomic growth rates, natural gas supply and prices, and other economic projections could vary with market fluctuations and policy changes.

3. **Consumer Behavior**: Assumptions about consumer acceptance of new technologies, such as electric vehicles and small modular reactors, are uncertain and may not materialize as projected.

4. **Modeling Challenges**: As with all models, OL25-NEMS is an economic abstraction of the energy industry and may not fully reflect the complexities associated with significant energy transitions including electric grid reliability and infrastructure buildout.

Data Center Uncertainty

1. **Current Data Center Demands**: Even current demands are uncertain with an almost 2-fold estimated range in published sources.

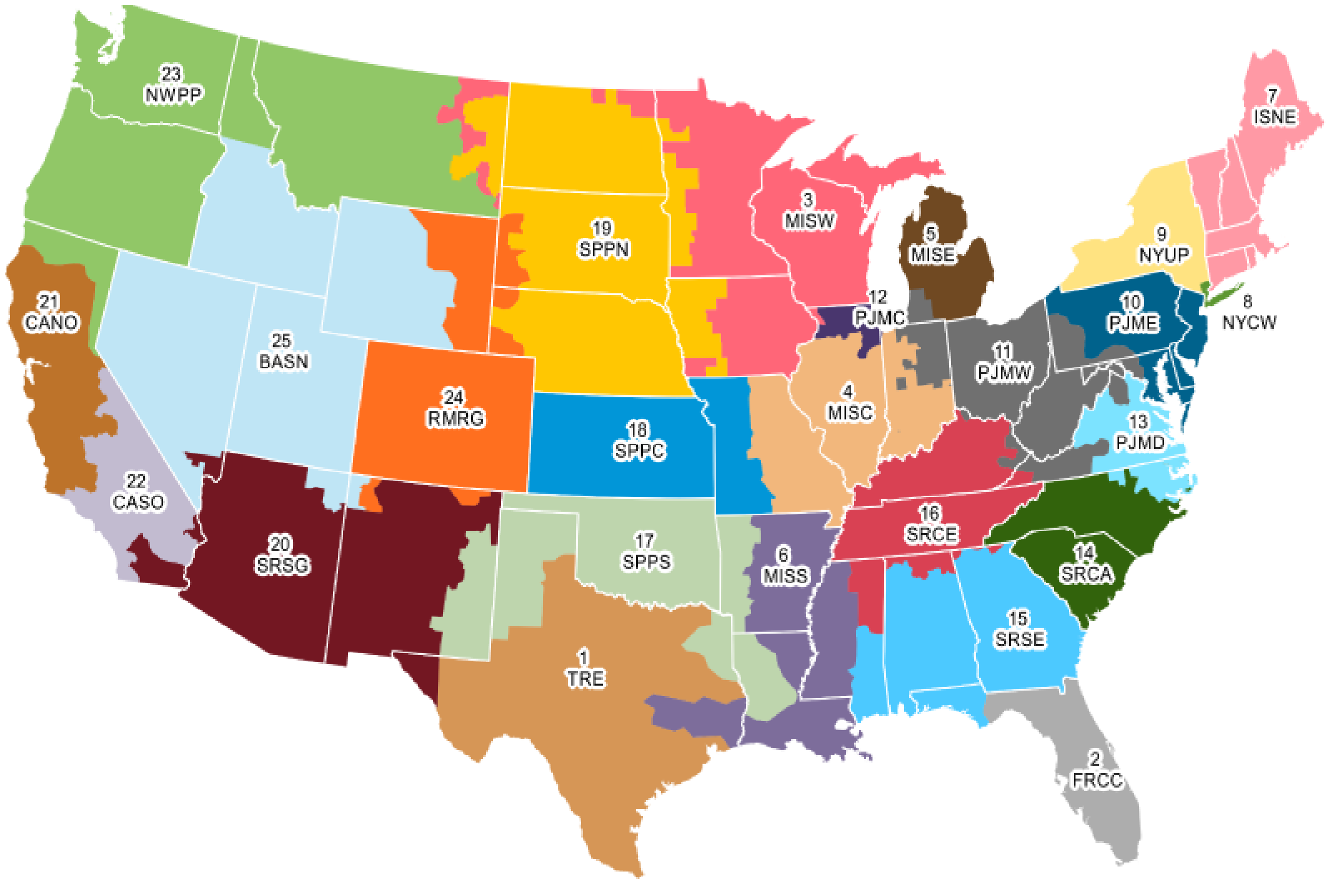
2. **Projected Regional Data Center Growth**: Regional growth in data centers is assumed to occur based on analysis of decision factors that may change over time. Future infrastructure limitations, generation resources, electricity prices, and other factors may lead to future shifts in data center locations.

3. **Central vs. On-site Generation**: Grid-based power sources are assumed in this analysis. While critical for reliability, backup generation and microgrids are not explicitly modeled.

4. **Data Center Operations and Electricity Loads**: Data center loads are assumed to be fairly constant throughout the day and year as the most cost-effective method of operations given their capital intensity. Alternative patterns of operations, including participation in utility demand side management programs, could affect their grid impact.

NEMS Electricity Market Module (EMM) Regions

https://www.eia.gov/outlooks/aeo/pdf/nerc_map.pdf



Region ID	NERC/ISO subregion	Geographic Name*
1- TRE	Texas Reliability Entity	Texas
2- FRCC	Florida Reliability Coordinating Council	Florida
3- MISW	Midcontinent ISO/West	Upper Mississippi Valley
4- MISC	Midcontinent ISO/Central	Middle Mississippi Valley
5- MISE	Midcontinent ISO/East	Michigan
6- MISS	Midcontinent ISO/South	Mississippi Delta
7- ISNE	NPCC/ New England	New England
8- NYCW	NPCC/NYC & Long Island	Metropolitan New York
9- NYUP	NPCC/Upstate NY	Upstate New York
10- PJME	PJM/East	Mid-Atlantic
11- PJMW	PJM/West	Ohio Valley
12- PJMC	PJM/Commonwealth Edison	Metropolitan Chicago
13- PJMD	PJM/Dominion	Virginia
14- SRCA	SERC Reliability Corporation/East	Carolinas
15- SRSE	SERC Reliability Corporation/Southeast	Southeast
16- SRCE	SERC Reliability Corporation/Central	Tennessee Valley
17- SPPS	Southwest Power Pool/South	Southern Great Plains
18- SPPC	Southwest Power Pool/Central	Central Great Plains
19- SPPN	Southwest Power Pool/North	Northern Great Plains
20- SRSG	WECC/Southwest	Southwest
21- CANO	WECC/CA North	Northern California
22- CASO	WECC/CA South	Southern California
23- NWPP	WECC/Northwest Power Pool	Northwest
24- RMRG	WECC/Rockies	Rockies
25- BASN	WECC/Basin	Great Basin

NERC=North American Electric Reliability Corporation, ISO=Independent System Operator NPCC = Northeast Power Coordinating Council, WECC = Western Electricity Coordinating Council
* Names are intended to describe approximate locations. Exact regional boundaries do not necessarily correspond to state borders or to other regional naming conventions.

Data Sources

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