JUNE 16TH, 2025

Economic, Fiscal and Energy-related Impacts of Data Centers in the Great Lakes Region

Regional Body/Compact Council and Science Team

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Outline of the Presentation

1. Project Overview and Timeline
2. Preliminary Data on Characteristics of Data Centers in the Great Lakes Region
3. Next steps
4. Q&A

Project Overview and Timeline

Project Goals

Analyze Economic Impact

Evaluate how data centers contribute to regional economies through impacts on job creation, GDP, tax revenues, and capital investments.

Assess Energy Demand

Examine the electricity requirements of data centers, including energy forecast scenarios and their implications for the region's energy systems.

Provide Policy Guidance

Develop actionable insights to inform policies on incentives and infrastructure planning.

Balance Priorities

Provide a framework to balance the economic benefits of data center growth with challenges related to energy transition, environmental sustainability, and regional priorities.

Tasks (May to September)

Task 5 - Economic Impact Analysis

- Quantify the economic contributions of data centers
- Use IMPLAN software to estimate data centers' economic impacts, including job creation, GDP contributions, and tax revenues, at regional and state levels

Task 6 - Scenario Development

- Explore the future through hypothetical scenarios
- Develop plausible growth trajectories at the state level and examine uncertainties around data center expansion

Tasks (September to December)

Task 7 - Electricity Demand Analysis

- Forecast the energy demands of data center growth by developing nonlinear forecasts to estimate the impact of data centers on the electricity grid
- Consider potential impacts on energy consumption patterns and on the energy market

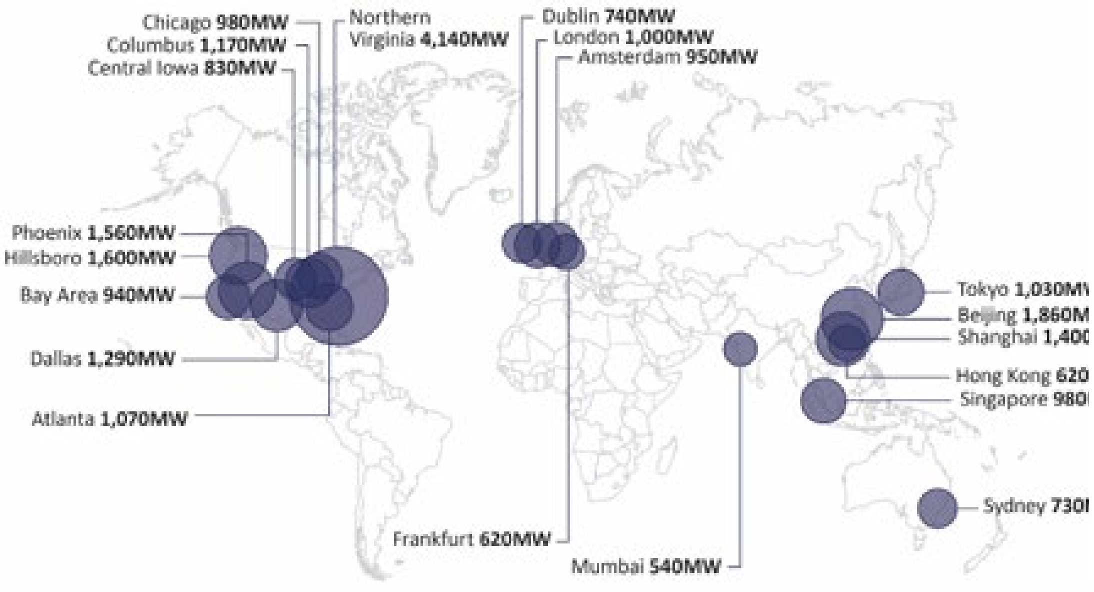
Final Report (December 2025)

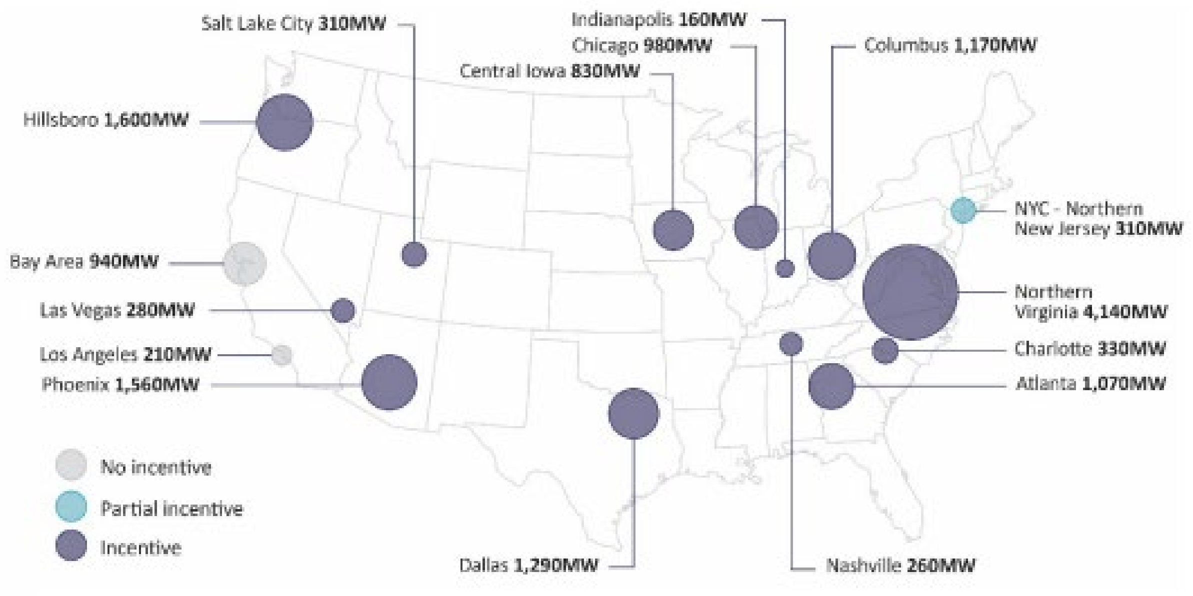
- Provide a comprehensive draft
  will summarize analysis and impacts and include actionable insights, strategies and recommendations
- Shared with partners/stakeholders for input and refinement

Preliminary Data on Characteristics of Data Centers in the Great Lakes Region

Location

Data Centers in the World

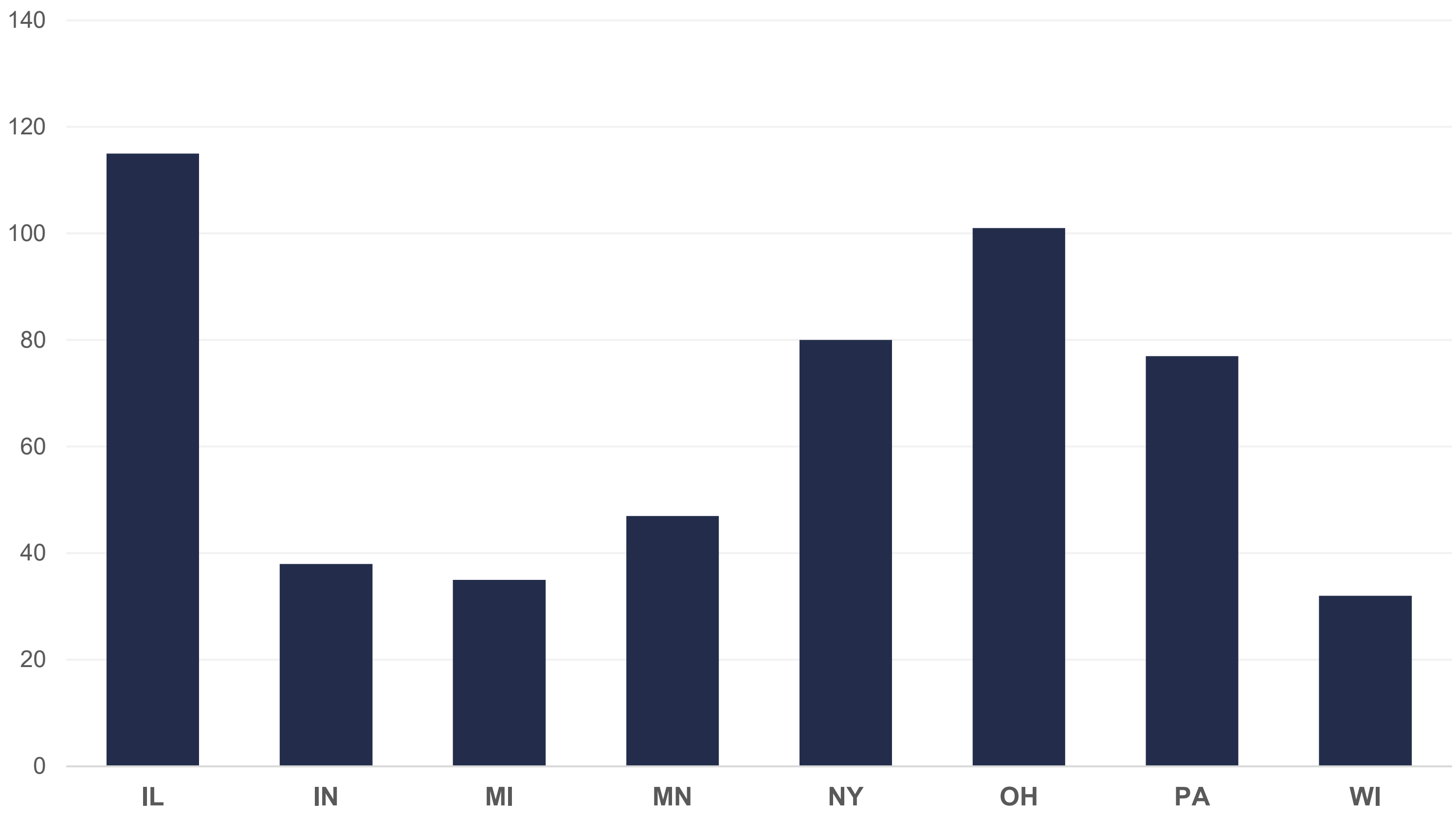




Source: JLARC (2024)

Data Centers in the Great Lakes - Operational

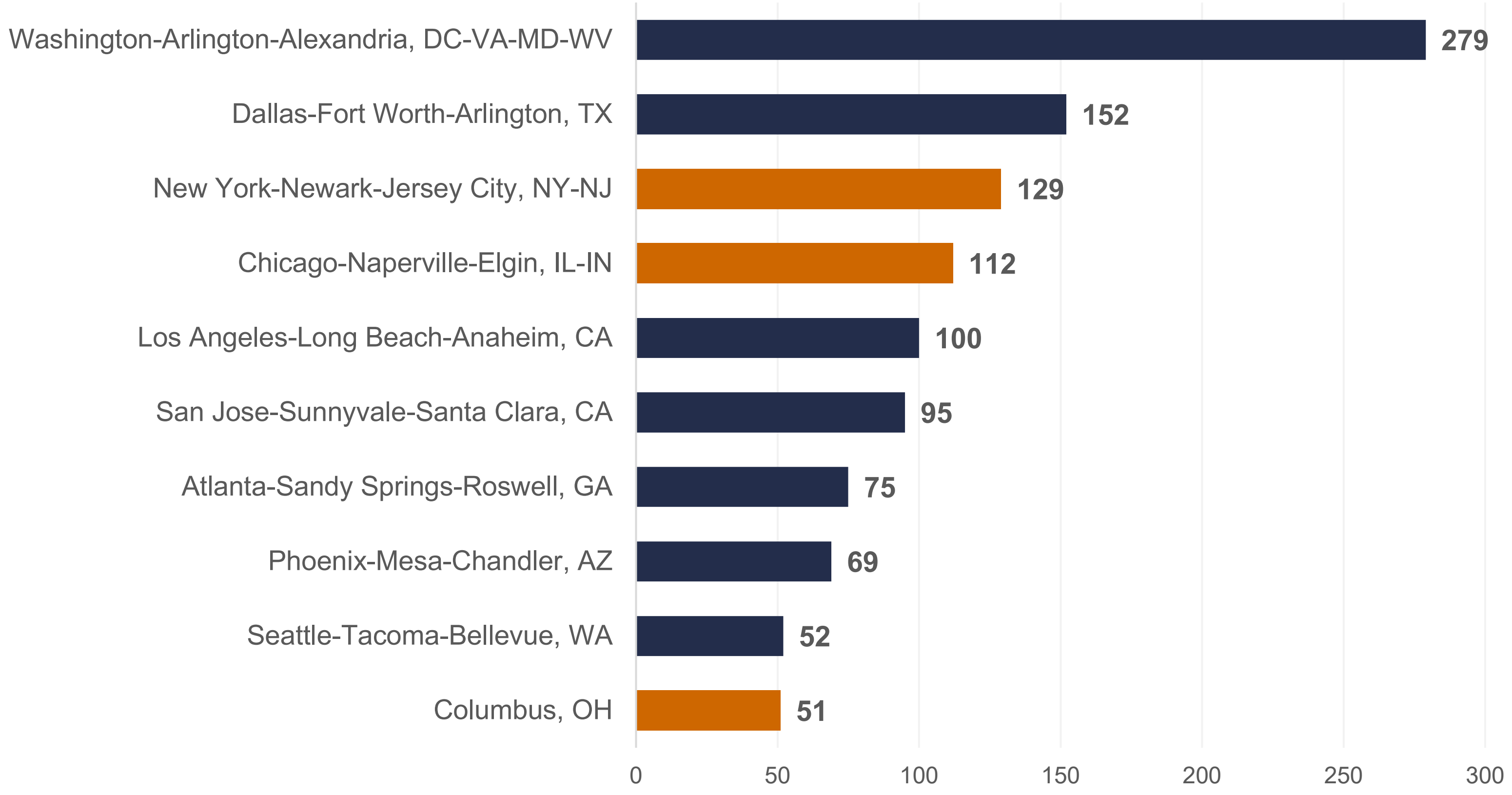
Data Centers by State



- **2,717** operational data centers in the US *(according to S&P).*
- Database presents a lower number of data centers than other databases.
  reduces double-counting and includes decommissioned facilities
- **20%** of data centers in US are in states around the Great Lakes.
  Virginia and Texas are the only states that have a comparable number of data centers

Data Centers in the Great Lakes - Location

Top MSAs in the US and Great Lakes

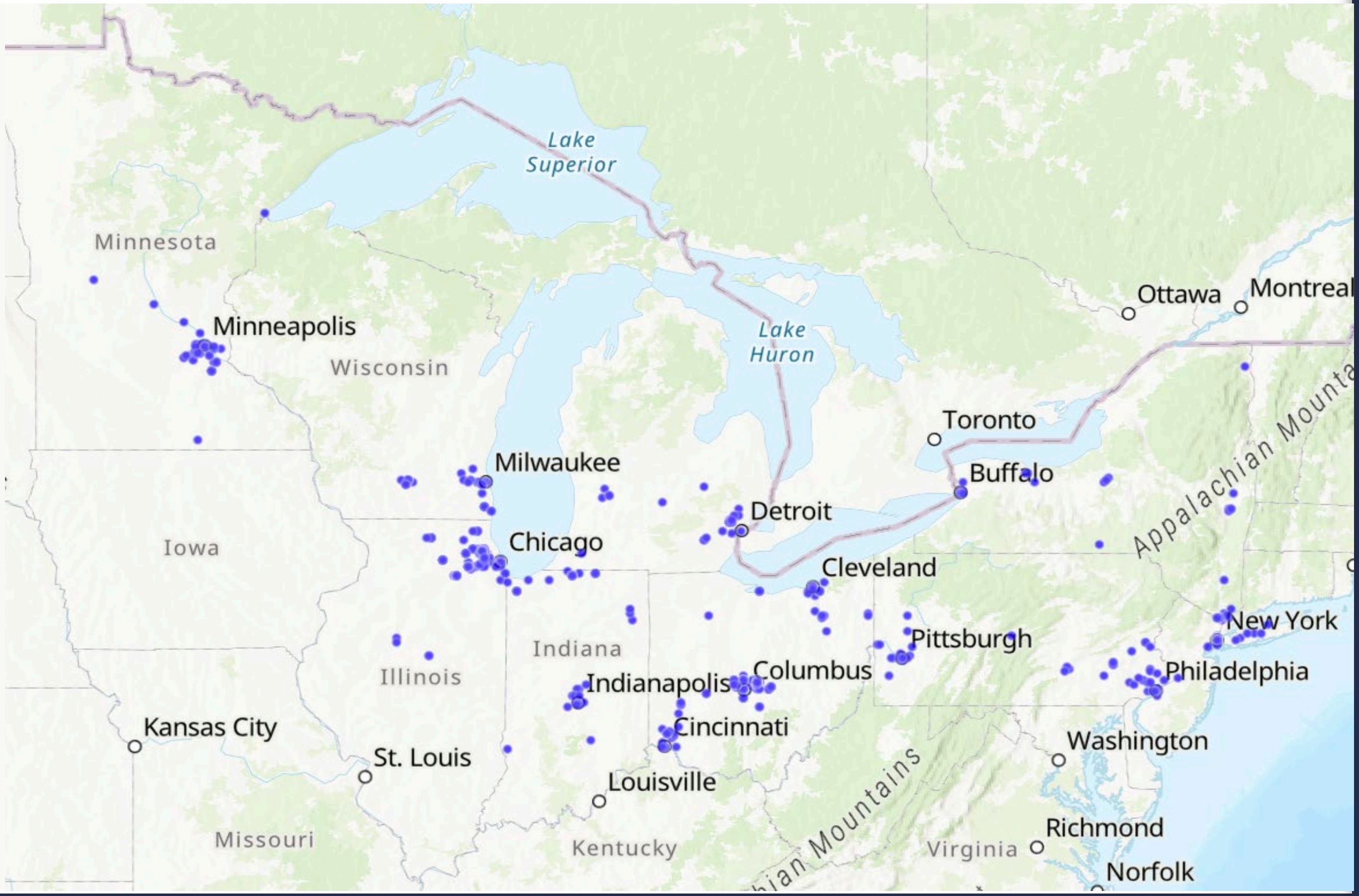


- **3** of Top 10 Metropolitan Statistical Areas (MSA's) are in the Great Lakes *(by number of data centers in the United States).*

- Other relevant MSA's in the Great Lakes region:
  - Minneapolis-St. Paul-Bloomington, MN-WI (42)
  - Philadelphia-Camden-Wilmington, PA-NJ-DE-MD (36)
  - Pittsburgh, PA (26)

Data Centers in the Great Lakes - Location

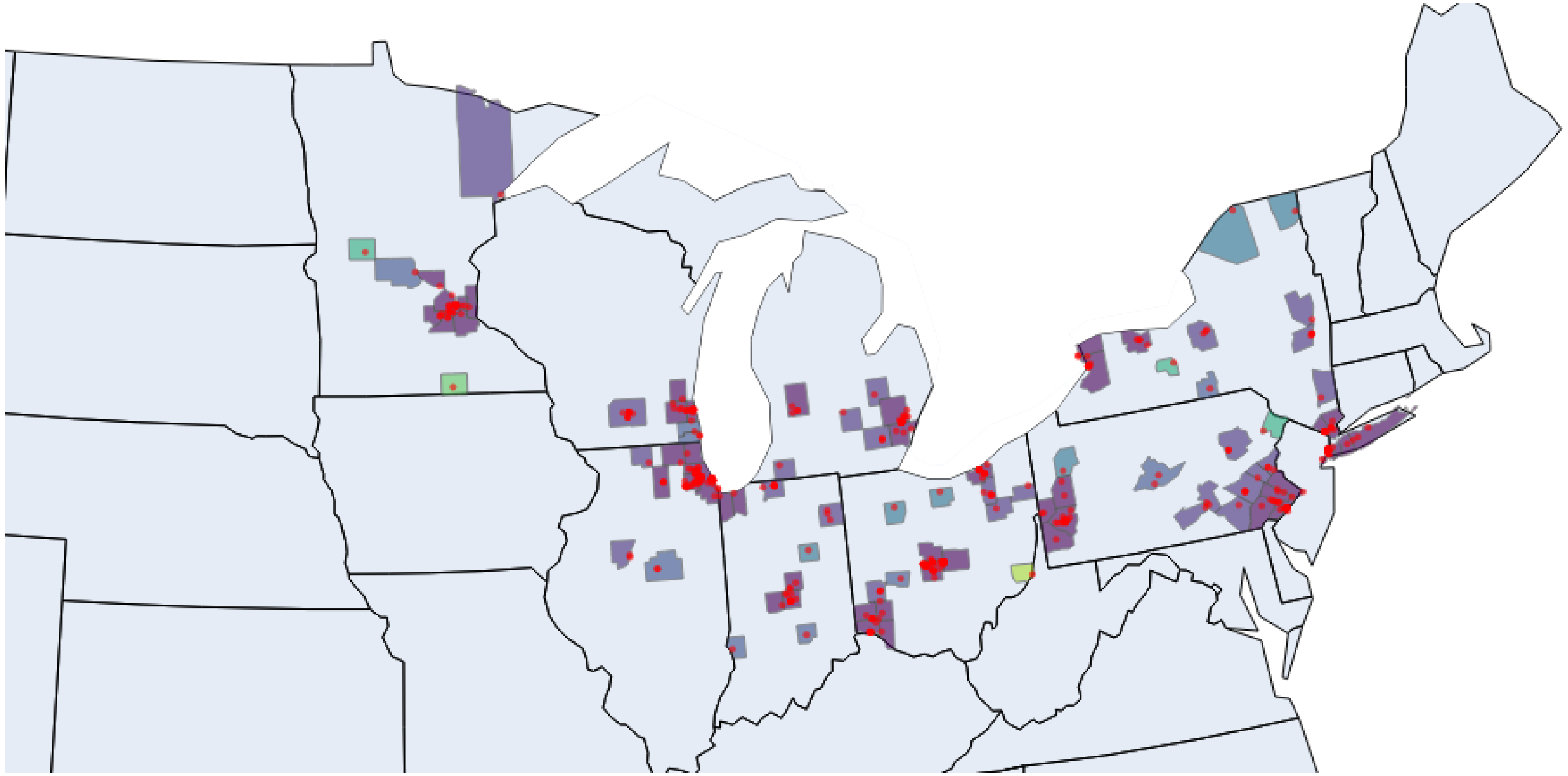
Identifying Patterns



- Working on identifying patterns based on locations of operational data centers.
- Wisconsin, Illinois, Michigan, and Indiana have a concentration around the Great Lakes.
- Agglomeration is one of the important aspects related to Data Centers.

Data Centers in the Great Lakes- Location

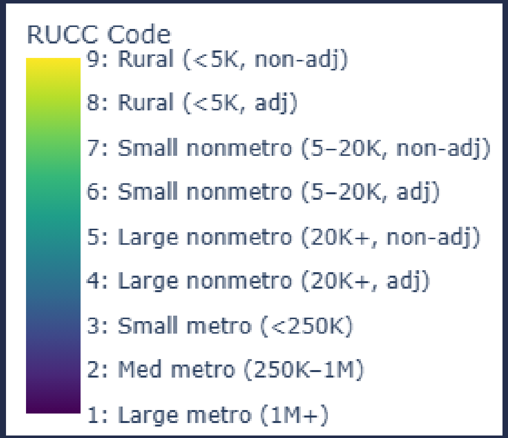
Data Centers are located in urban areas



Rural/Urban Characterization of counties with Data Centers

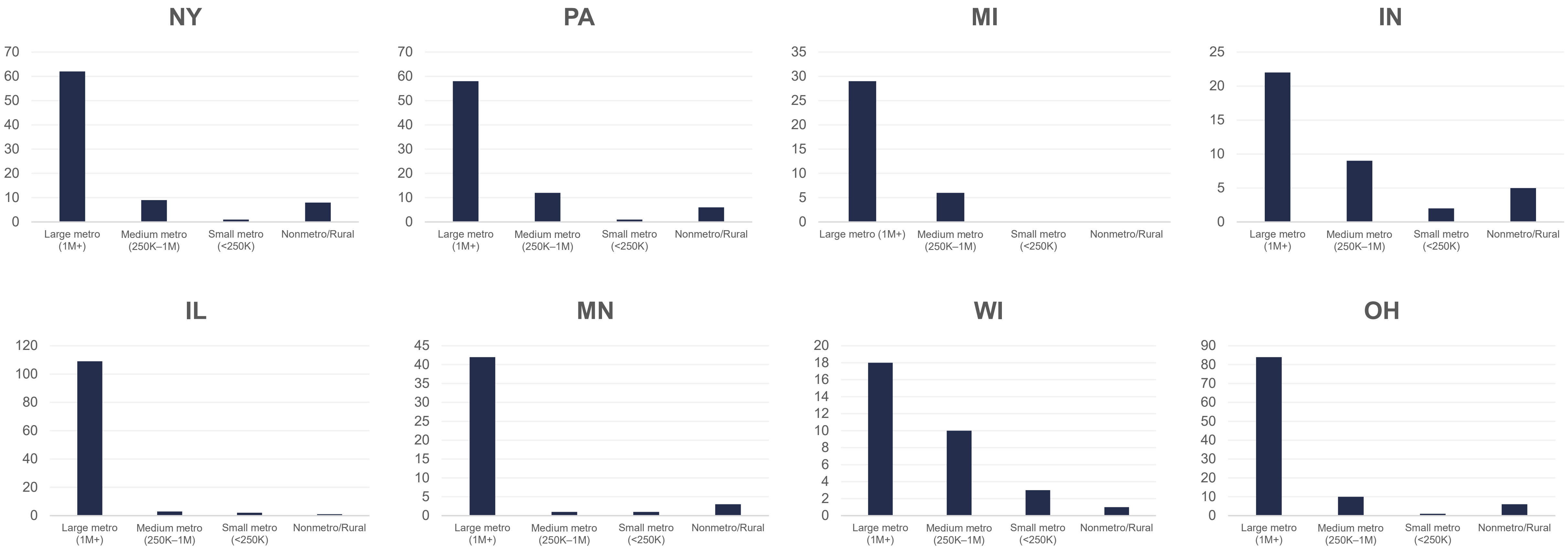
Great Lakes region data centers:

- Counties: 86
- Total: 499
- Large metro: 85.0%
- Medium metro: 12.0%
- Small or nonmetro: 3.0%



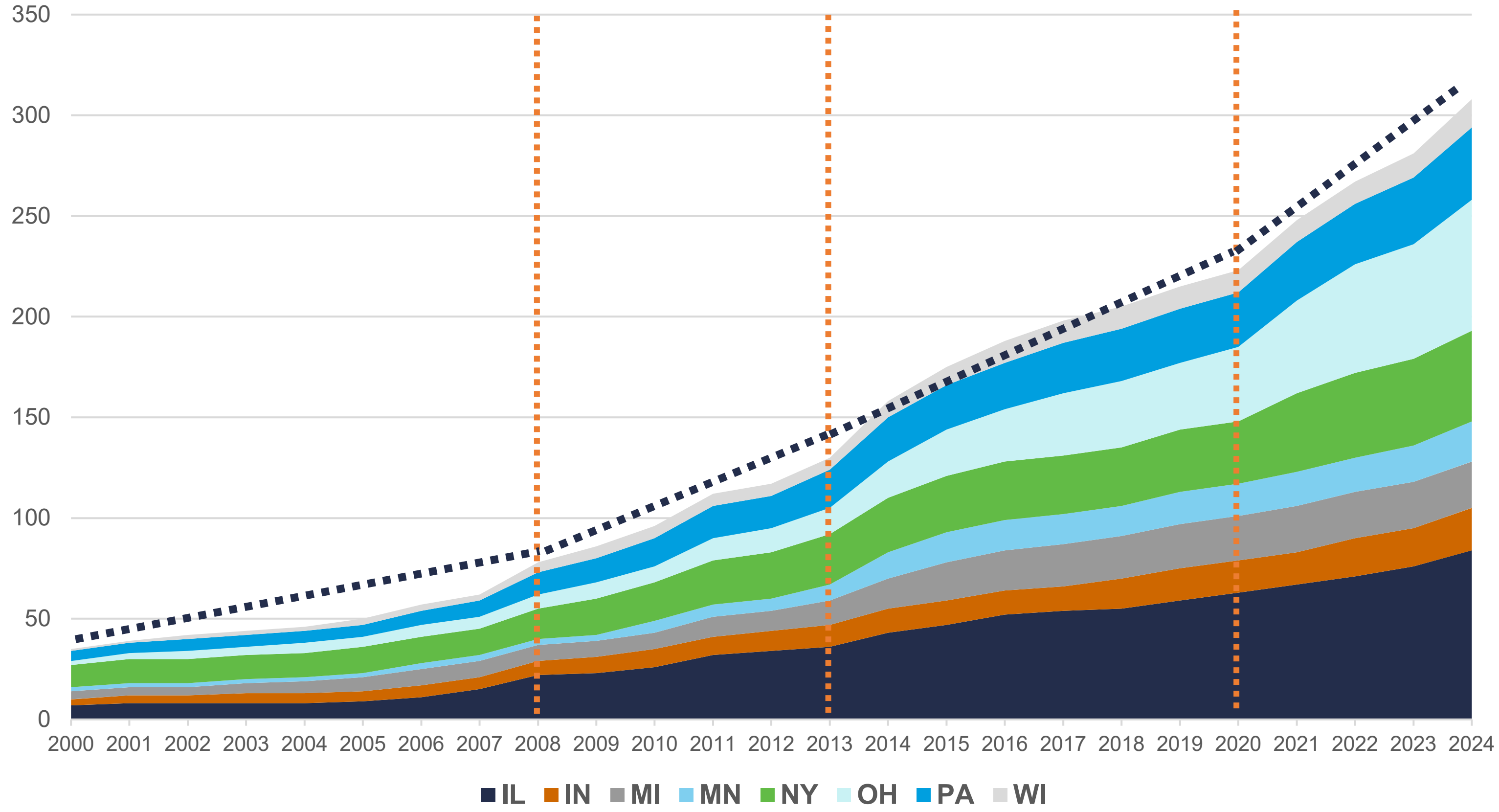
Data Centers in the Great Lakes - Location

Counties with Data Centers by State



Data Centers in the Great Lakes – Cumulative Growth

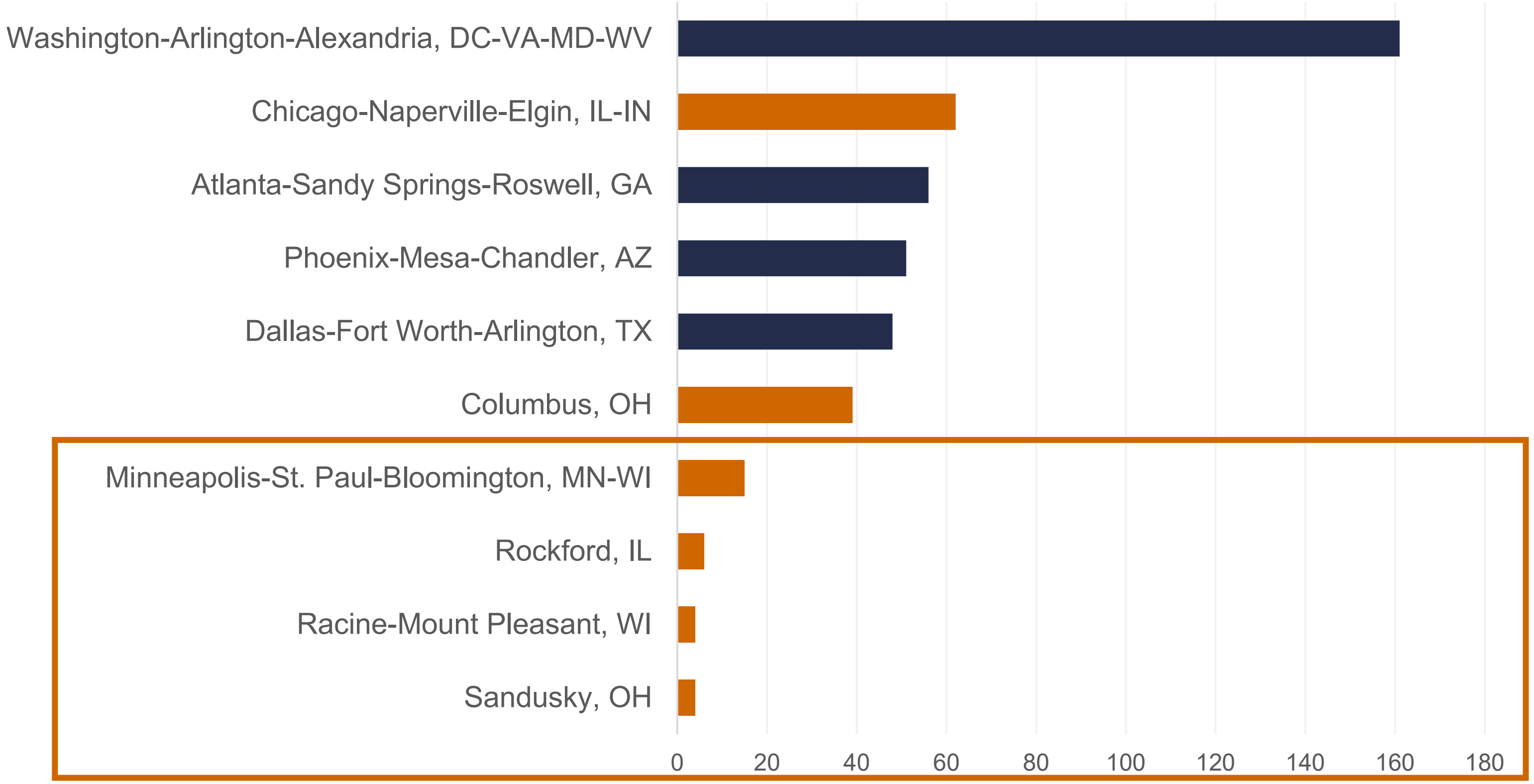
How Data Centers Have Expanded



Cumulative Growth of Data Centers in the Great Lakes

- Among 525 operational facilities in database, 60% have construction or refurbishment year data.
- Four clear growth phases:
  - 2000–2008: ~5 per year
  - 2008–2013: ~10 per year
  - 2013–2020: ~14 per year
  - 2020–2024: ~20 per year
- Growth has accelerated in recent years, reflecting increased investment in the region.

Planned Data Centers

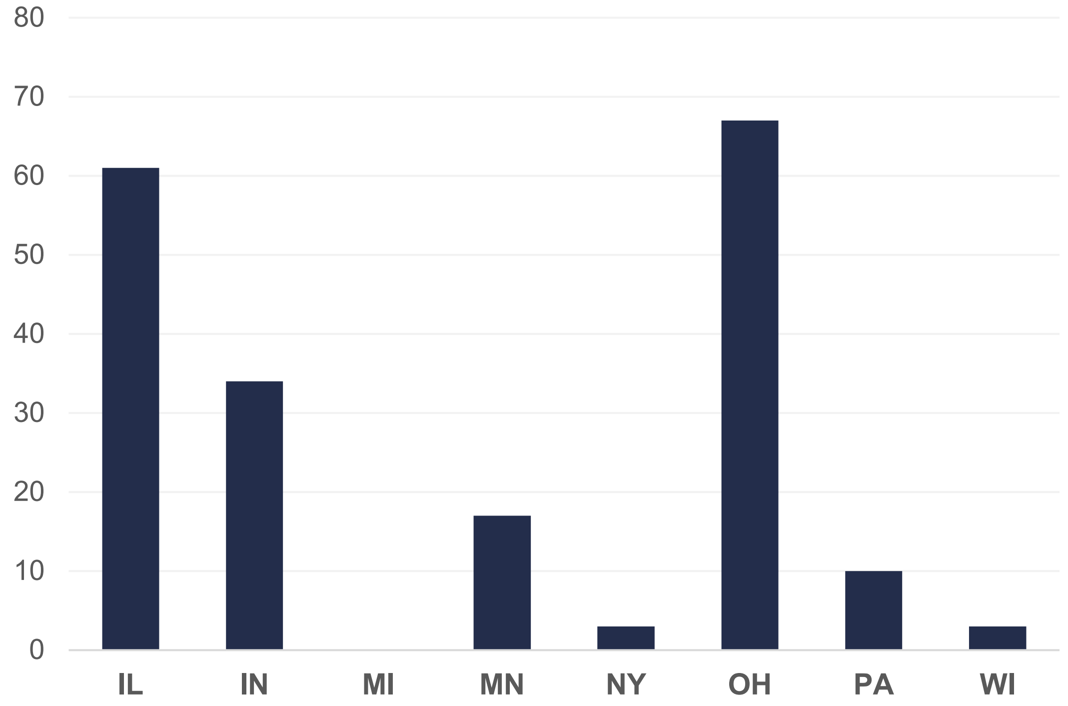


Top 5 MSA's in the US in terms of Planned Data Centers and other areas in the GL

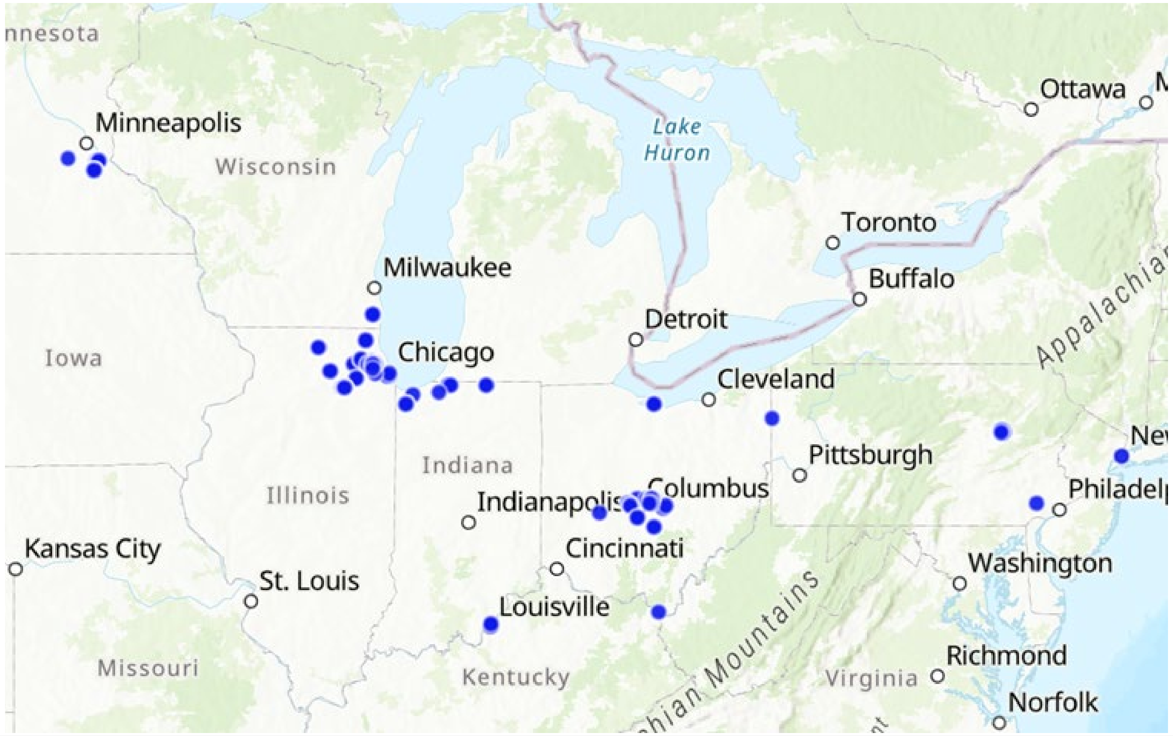
- Chicago-Naperville-Elgin MSA is poised to become one of the top five data center markets in the U.S., alongside Washington, DC and Atlanta.
- Columbus, OH, MSA ranks 6th nationally in terms of planned developments.
- Other Great Lakes metro areas—such as Minneapolis, Rockford, Racine, and Sandusky—are also showing notable growth in planned capacity.

Data Centers in the Great Lakes - Planned

Location of Planned Data Centers



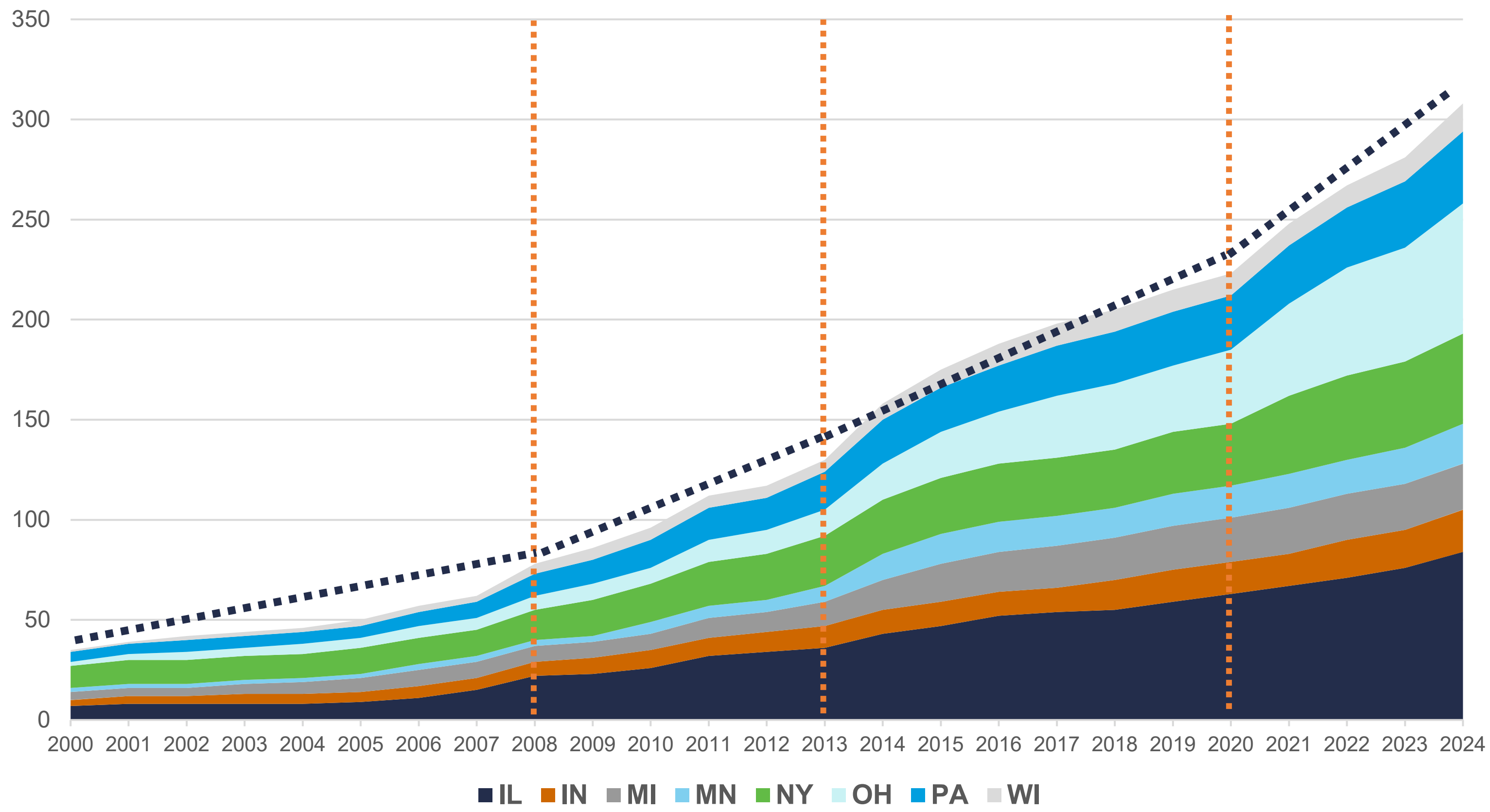
Planned Data Centers by State



Location of Planned Data Centers

Data Centers in the Great Lakes – Cumulative Growth

How Data Centers Have Expanded



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Data Centers in the Great Lakes – Cumulative Growth

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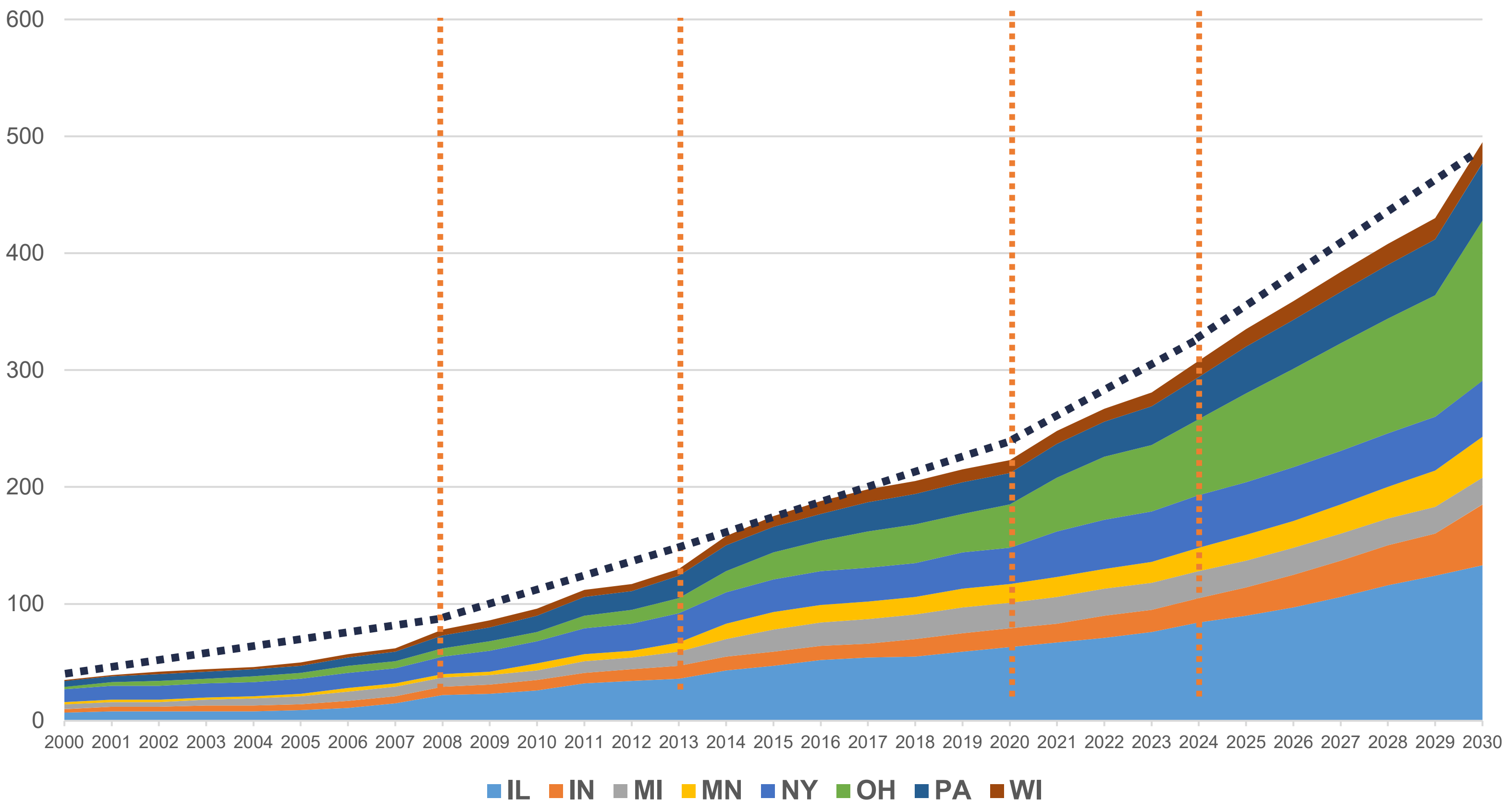
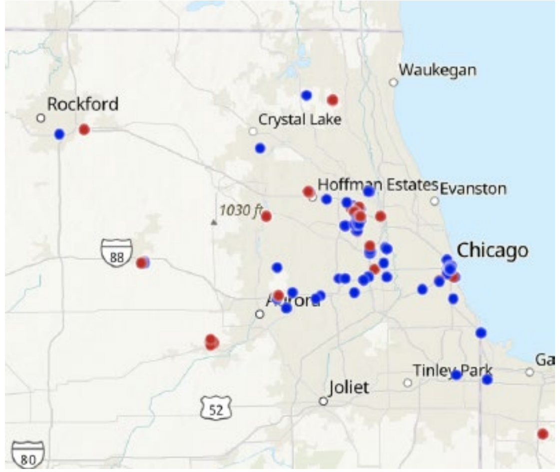
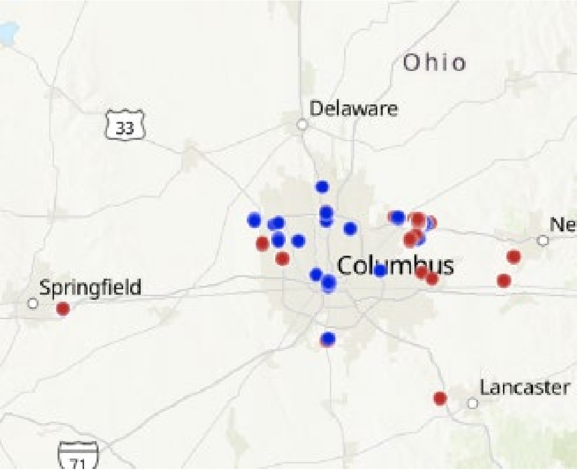


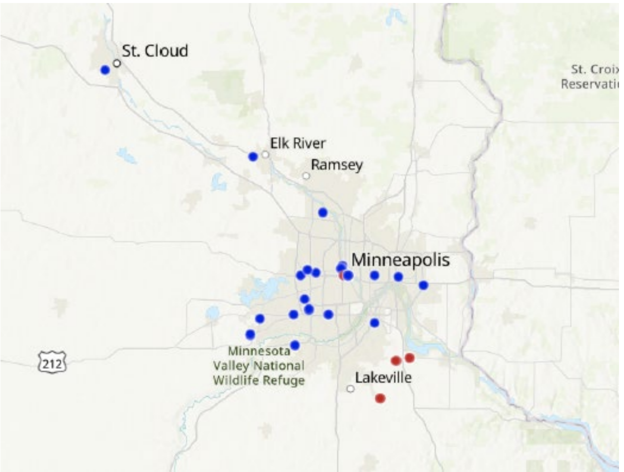
Cumulative Growth of Data Centers in the Great Lakes

- Of 223 new facilities in the Great Lakes, 164 have a date to start operating.
- Five growth phases:
  - 2000–2008: ~5 per year
  - 2008–2013: ~10 per year
  - 2013–2020: ~14 per year
  - 2020–2024: ~20 per year
  - 2024–2029: ~21 per year
- Growth is expected to stabilize, but this is only part of the history...

Other open avenues…







Analyze data center location patterns and potential urban impacts.

Identify data center ownership and potential connections to local industries and economic clusters.

Explore the potential effects of data centers on housing markets and affordability in surrounding areas.

Data center types

Not all the Data Centers are the same…

Crypto
Designed primarily for cryptocurrency mining—high power use, low latency needs, often minimal redundancy.

Hosting
Offers basic web and server hosting services, typically for smaller clients.

Hyperscale
Large-scale facilities operated by or for big tech (e.g., Amazon, Google); optimized for scalability and efficiency.

Investor
Owned as financial assets, often leased to operators; not always involved in technical operations.

Not all the Data Centers are the same...

Powered Shell
Infrastructure-ready but unfinished; tenants bring their hardware and systems.

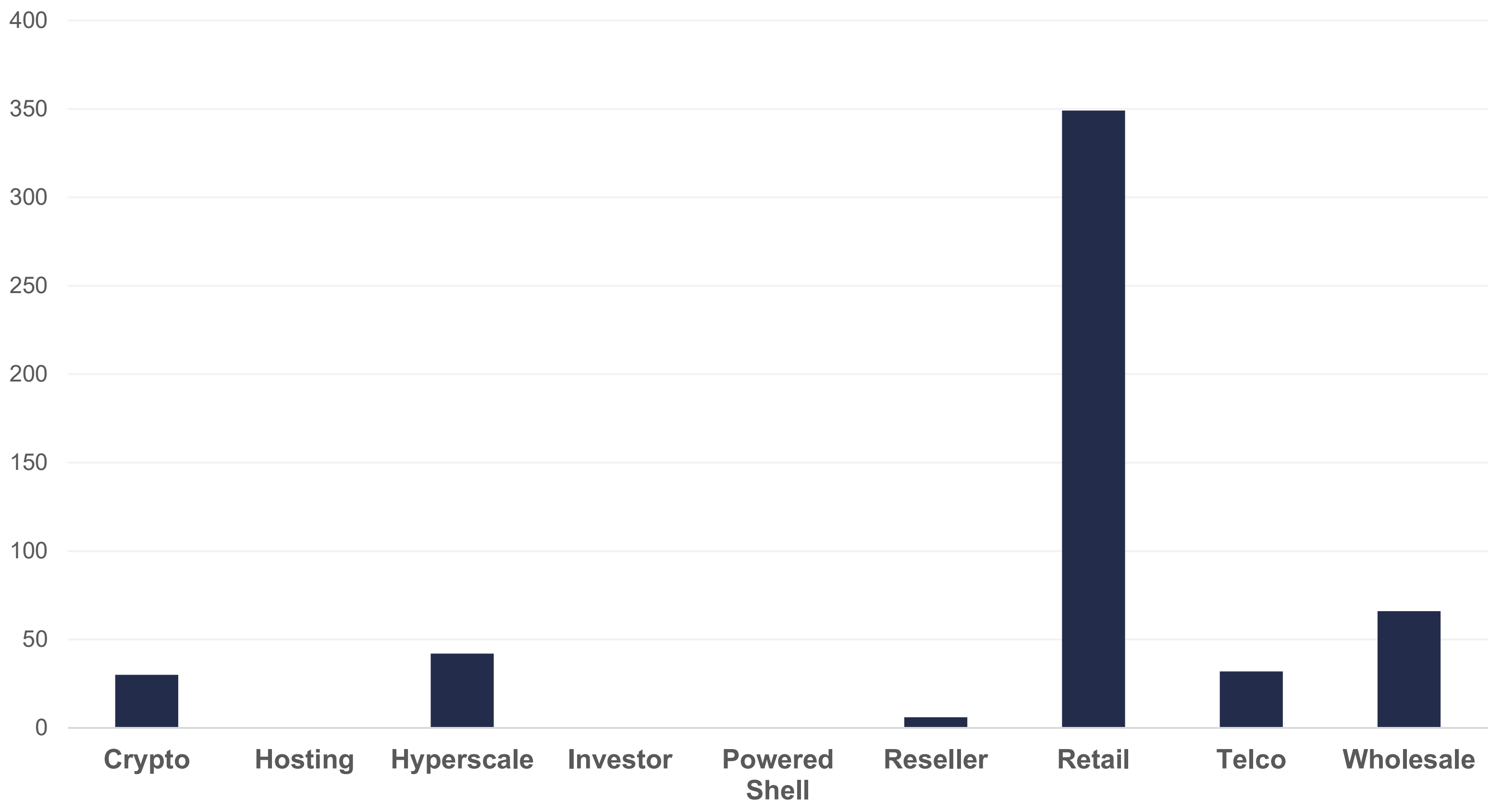
Reseller
Rent space or capacity from another provider and resells it to end clients—middleman model.

Retail
Offers space, power, and services to multiple small-to-medium clients; typically high-touch service.

Telco
Telecom providers run it and often integrate it with communication infrastructure and network hubs.

Wholesale
Leases large blocks of space and power to a single tenant (or very few), often on long-term contracts.

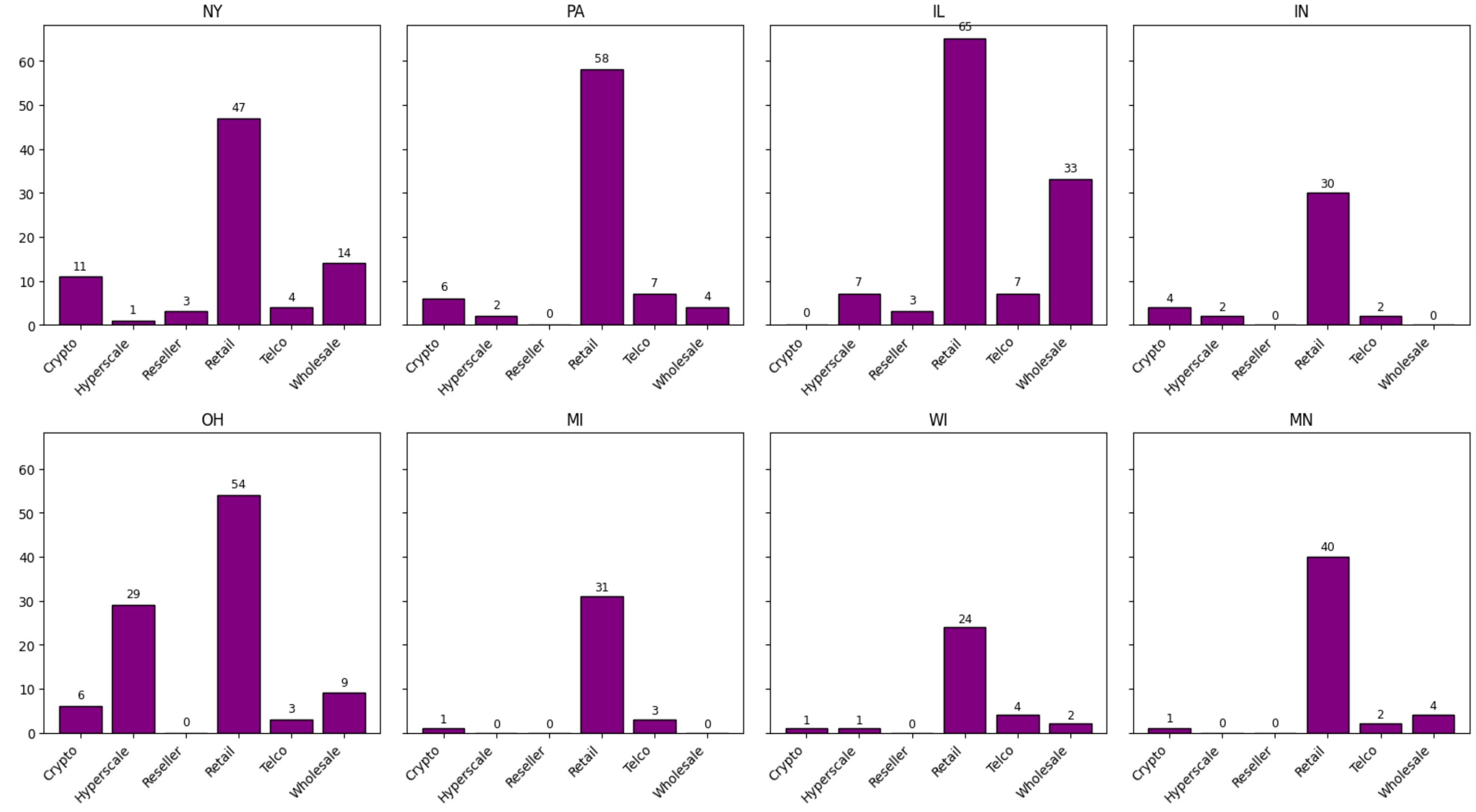
Types of Data Centers in the Great Lakes



Types of data centers in a region helps shape economic and infrastructure impact:

- Retail data centers dominate, making up about 66% of all facilities.
  typically smaller, multi-tenant centers
- Wholesale, Telco, Crypto, and Hyperscale each have distinct business models and infrastructure needs.

State-Level Patterns by Type



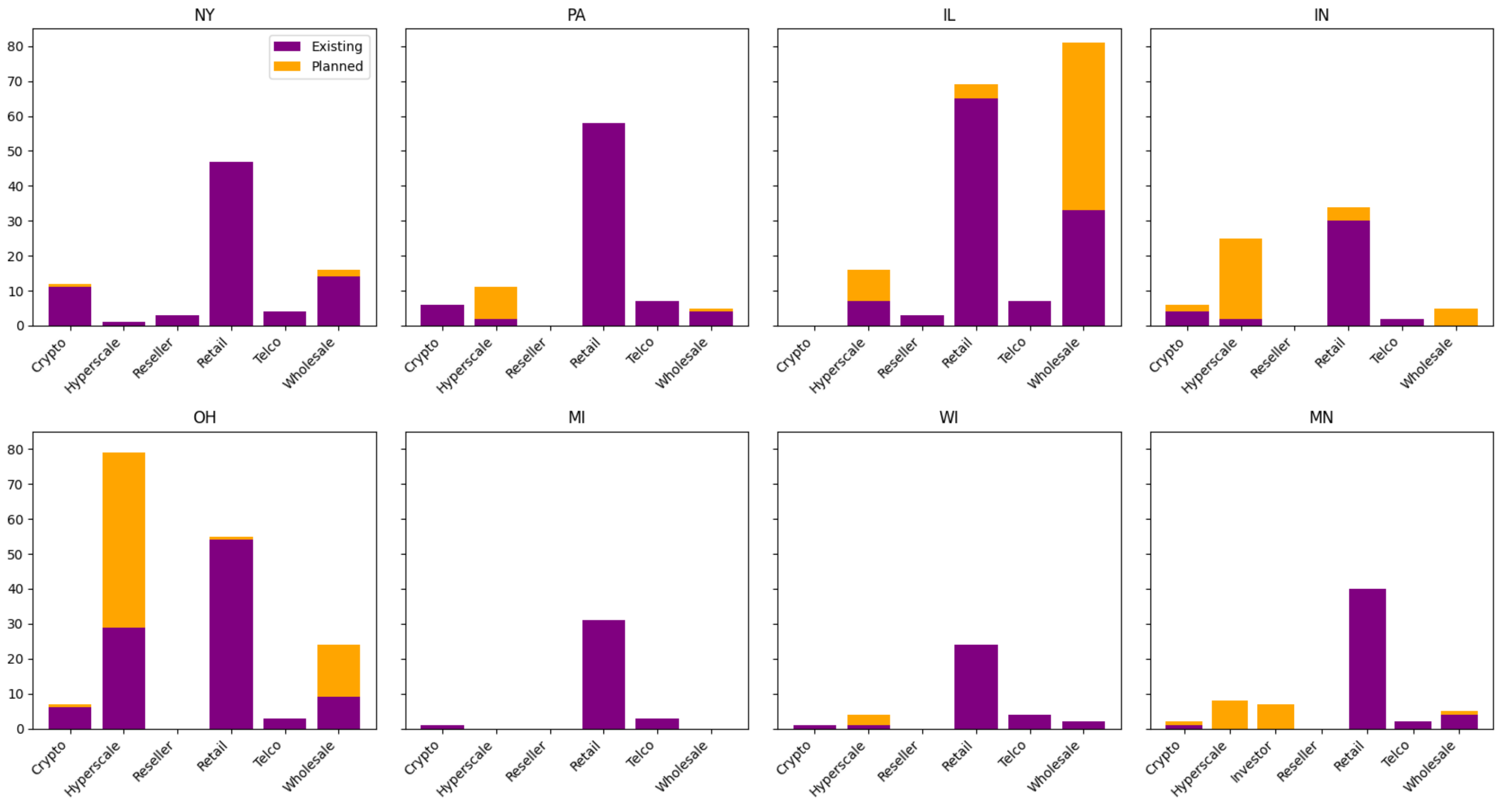
Data Centers by State and Type

Distribution of data center types varies across Great Lakes states.

- Retail and Telco centers are widespread.
- Hyperscale centers—typically large, cloud-provider-run facilities—are concentrated in Ohio.
- Wholesale data centers are primarily located in Illinois
- Crypto mining facilities are notably more common in New York.

Data Centers in the Great Lakes – by Type

Planned Development Reinforces Trend



Data Centers by State and by Type and Existent vs. Planned

Planned investments in data centers suggest a continuation— and in some cases—an intensification of current patterns:

- **Ohio**—leader in Hyperscale development (but also Indiana)
- **Illinois**—expanding its dominance in Wholesale centers
- Retail and Crypto show limited planned growth, signaling a possible plateau in these segments
- **Minnesota**—region's first Investor data center

Most states show some level of development, often aligned with their existing landscape.

Average sq ft of Data Centers by State and Type

	Crypto	Hyperscale	Investor	Reseller	Retail	Telco	Wholesale	Total
NY	145,100	2,900,000	-	1,000	44,000	20,700	173,300	113,500
PA	399,200	300,000	-	-	111,500	17,200	64,000	127,800
IL	-	374,500	-	2,000	96,100	8,200	248,900	149,100
IN	9,300	360,000	-	-	54,300	8,200	-	63,200
OH	168,600	307,400	-	-	31,400	5,100	153,300	128,500
MI	617,000	-	-	-	53,600	35,500	-	68,100
WI	94,000	500,000	-	-	12,300	5,400	74,000	33,000
MN	45,800	-	-	-	25,300	19,500	34,800	26,300
Total	211,300	790,300	-	1,500	53,600	15,000	124,700	88,700

Different data centers have distinct land use impacts.

Hyperscale: 790,300 sq ft
14 football fields

Crypto: second largest ||
Costco + Parking lot

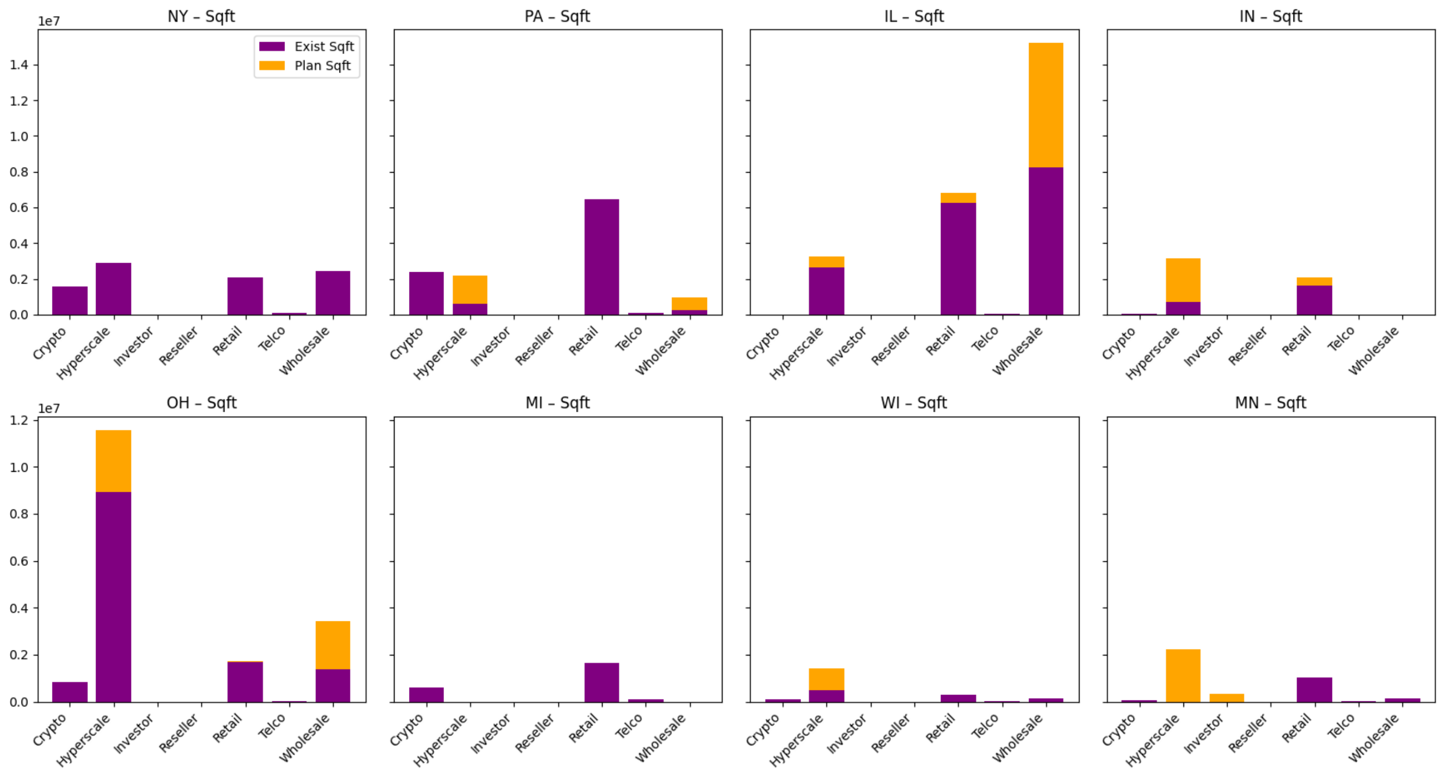
Wholesale: 127,400 sq ft
Factory building

Retail: 53,600 sq ft
Large high school gym

Telco: 15,000 sq ft
4 tennis courts

Data Centers in the Great Lakes – by Type

Planned Development Reinforces Trend



Data Centers by State and by Type and Existing vs. Planned Sq ft

- Limited information on the size of future data centers.
- On average, future data centers are much larger than the existing ones.
  - Illinois
    Current: 149,000 sq ft
    Future: 299,000 sq ft
  - Ohio
    Current: 128,500 sq ft
    Future: 205,000 sq ft
  - Minnesota
    Current: 26,300 sq ft
    Future: 271,900 sq ft
  - Wisconsin
    Current: 33,000 sq ft
    Future: 500,000 sq ft

Energy-related issues

Understanding Key Energy Indicators in Data Centers

- **Total UPS Power (kW)** - Represents the total backup power capacity available for IT equipment.

- **UPS Utilization -** Measures how much of the UPS capacity is actively in use.
  - Example: A data center with 10,000 kW UPS capacity using 6,000 kW has a 60% utilization rate.
  - Higher UPS utilization may indicate better use of infrastructure, but also potential constraints or capacity limits.
  - Utilization typically increases over time as compute loads expand. Mature facilities may reach 90–95% capacity.

- **Energy in a Data Center -** Power is primarily consumed by IT equipment and cooling systems. Managing this split is key to operational efficiency.

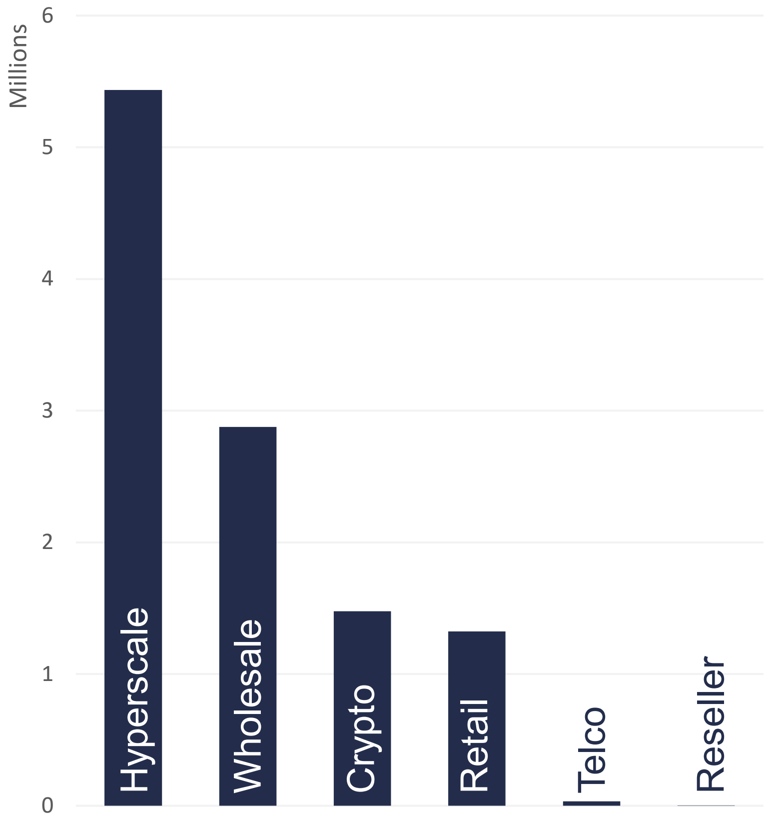
Understanding Key Energy Indicators in Data Centers

- **PUE (Power Usage Effectiveness):** Total Facility Power / IT Equipment Power
  - PUE measures how much extra energy (beyond the IT equipment itself) is used to run a data center, primarily for cooling, lighting, and power delivery systems.
  - A lower PUE means a smaller share of energy is being used for overhead services. For example, a PUE of 1.3 means 30% of the energy goes to non-compute functions.

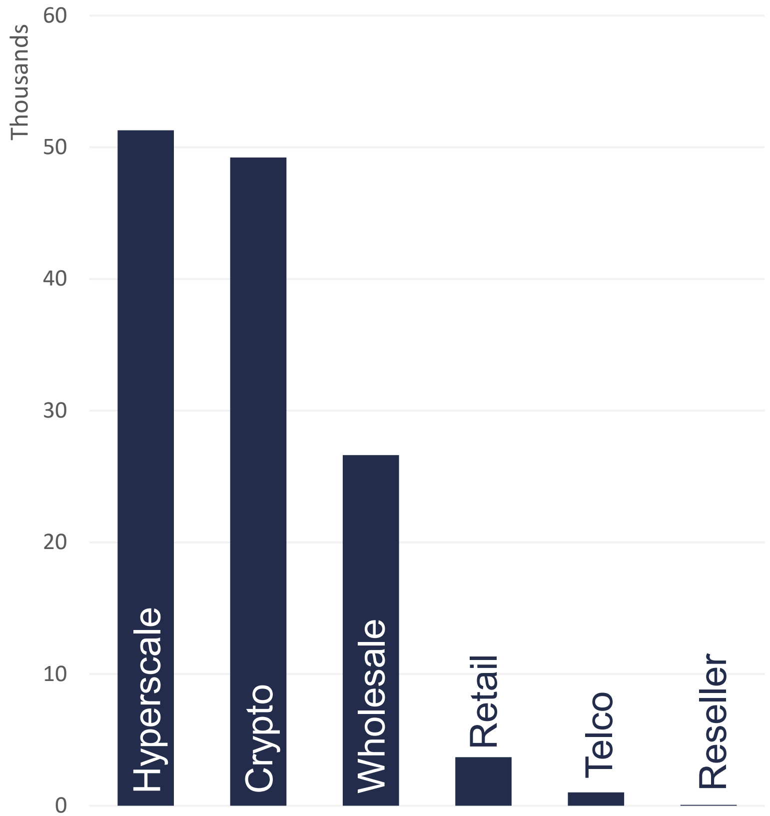
- PUE is **not a measure of how efficiently a data center performs computing tasks**. It simply tells us how efficiently energy is delivered to IT equipment—not how much useful computing is being done.

- Imagine upgrading all servers in a data center to new processors that use half the energy per unit of computation. By using the same energy, you have twice the computation. The total IT load (and thus the denominator in the PUE formula) would stay the same, and so would the PUE as the PUE wouldn't change.

Energy Demand Varies Widely by Type



Total UPS Power (kW) by Type



Average UPS Power (kW) by Type

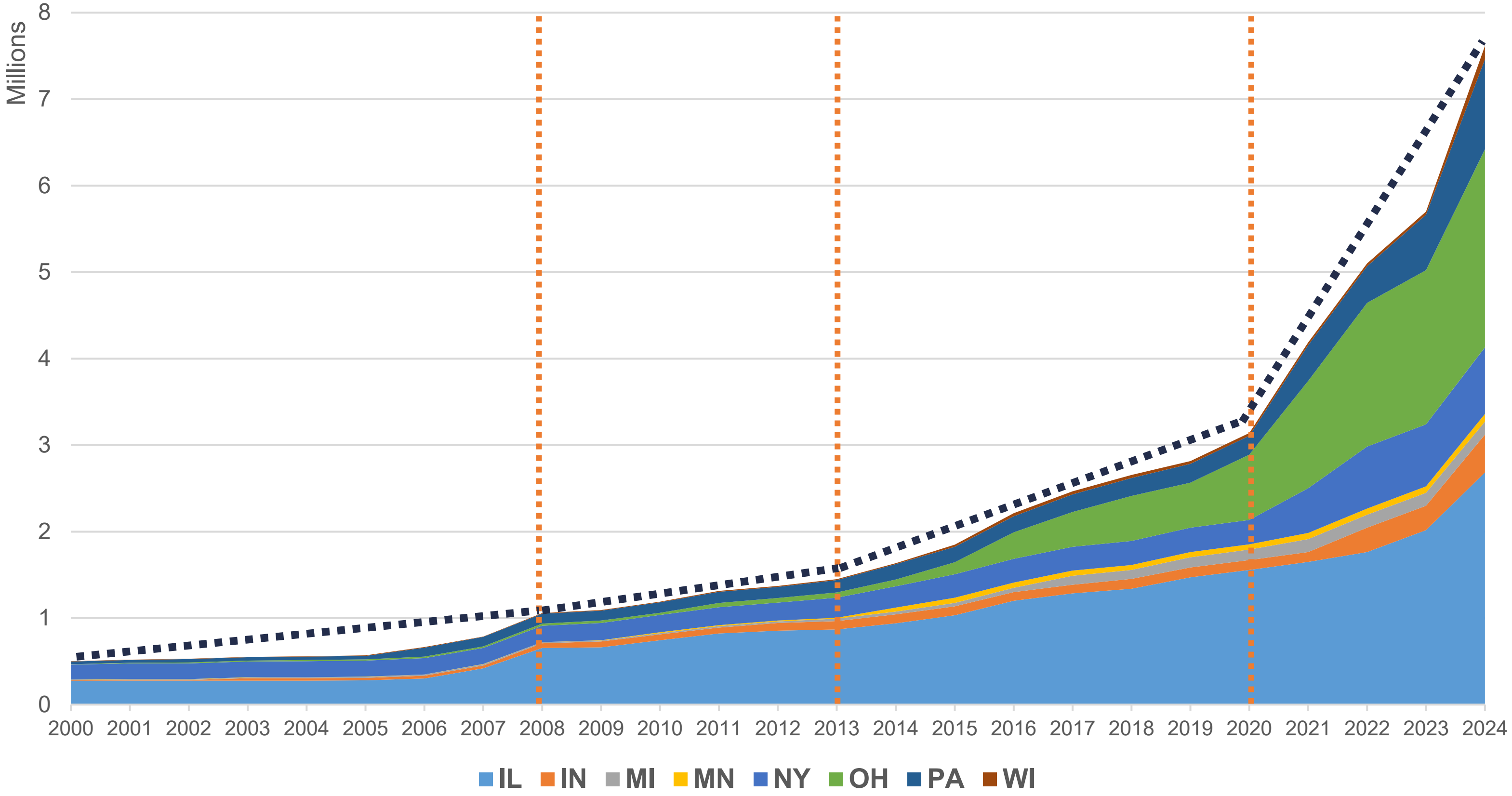
Energy needs shape economic and environmental footprint. Each facility type has different energy demand.

- Hyperscale and Cryptocurrency centers show the highest energy requirements per facility.
- Wholesale types have substantial average demands.
- Retail and Telco centers use significantly less energy on average.

Understanding these distinctions is essential for anticipating infrastructure needs and regional energy impacts.

Data Centers in the Great Lakes – Cumulative Growth

How Energy usage has increased

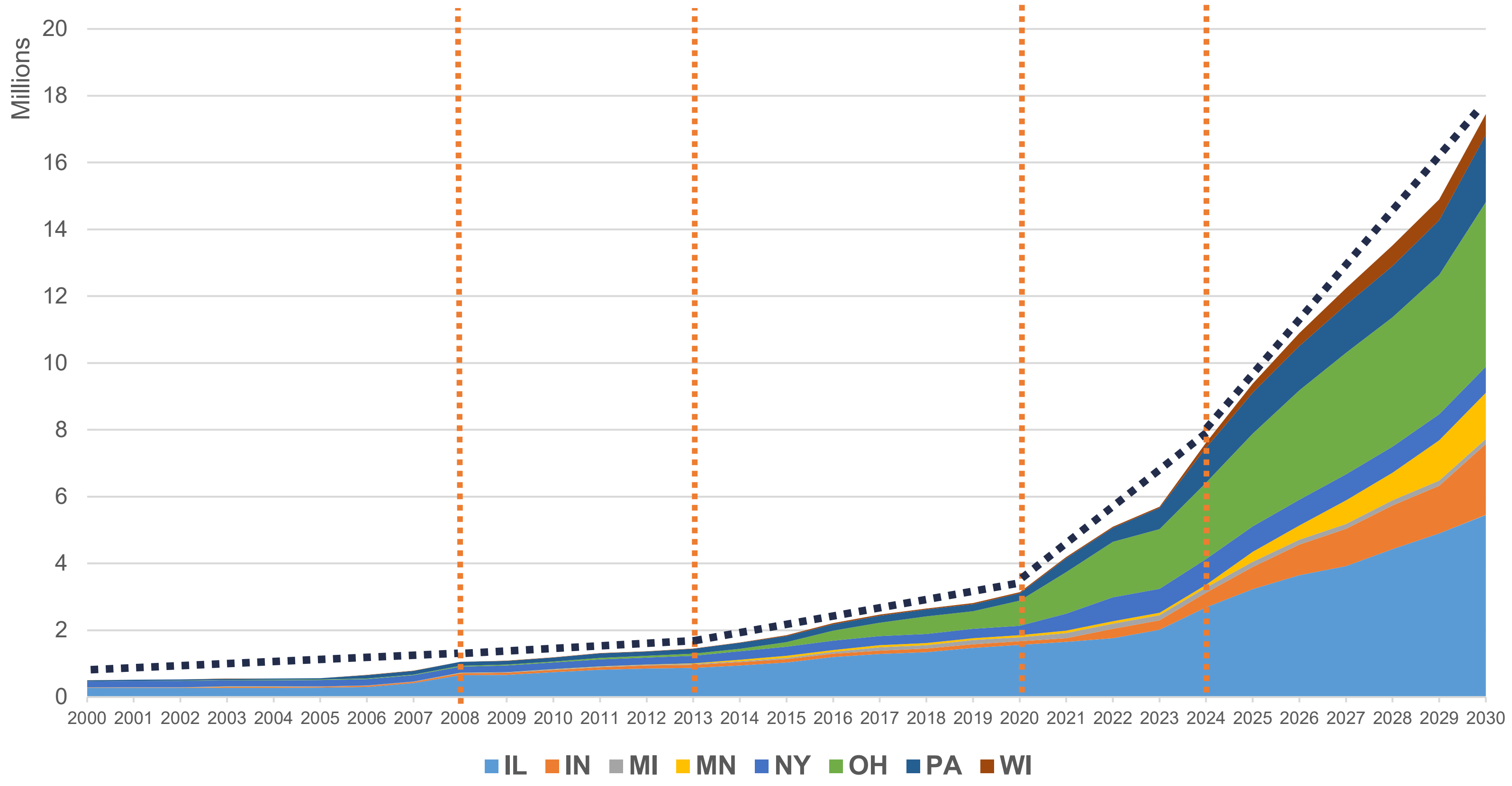


Cumulative Growth of Data Centers in the Great Lakes

- The energy use pattern across time is definitely different than the one observed for the number of data centers.
- Growth path:
  - 2000–2008: +69 MW per year
  - 2008–2013: +78 MW per year
  - 2013–2020: +242 MW per year
  - 2020–2024: +1119 MW per year
- The growth pattern, in terms of energy consumption, exacerbated since 2020.

Data Centers in the Great Lakes – Cumulative Growth

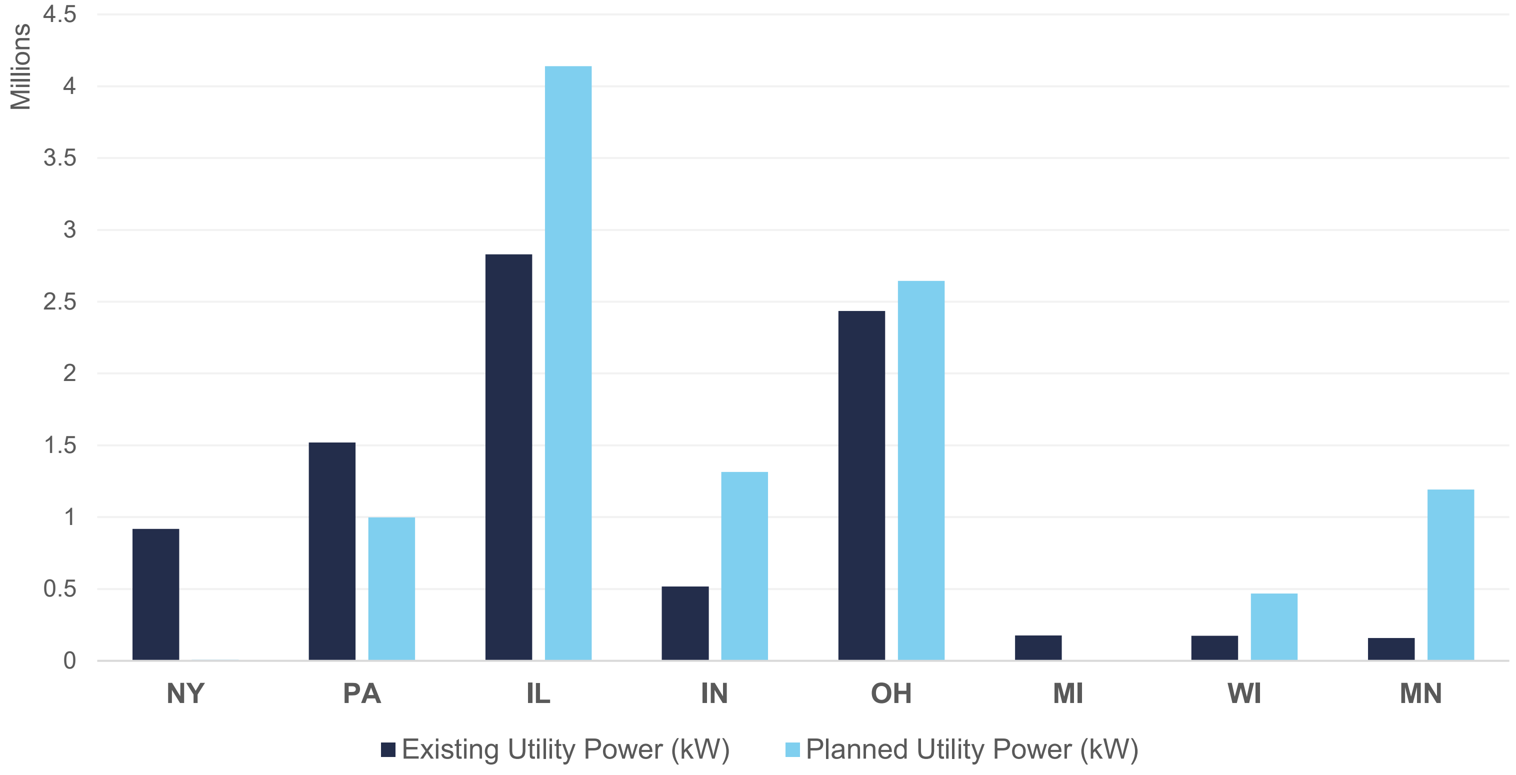
How Data Centers Have Expanded



Cumulative Growth of Data Centers in the Great Lakes

- Of 223 new facilities in the Great Lakes, most are hyperscale and wholesale.
- Five growth phases:
- 2000–2008: +69 MW per year
- 2008–2013: +78 MW per year
- 2013–2020: +242 MW per year
- 2020–2024: +1119 MW per year
- 2024-2029: +1311MW per year
- In terms of MW, the growth tendency is expected to increase.

Surging Energy Demand

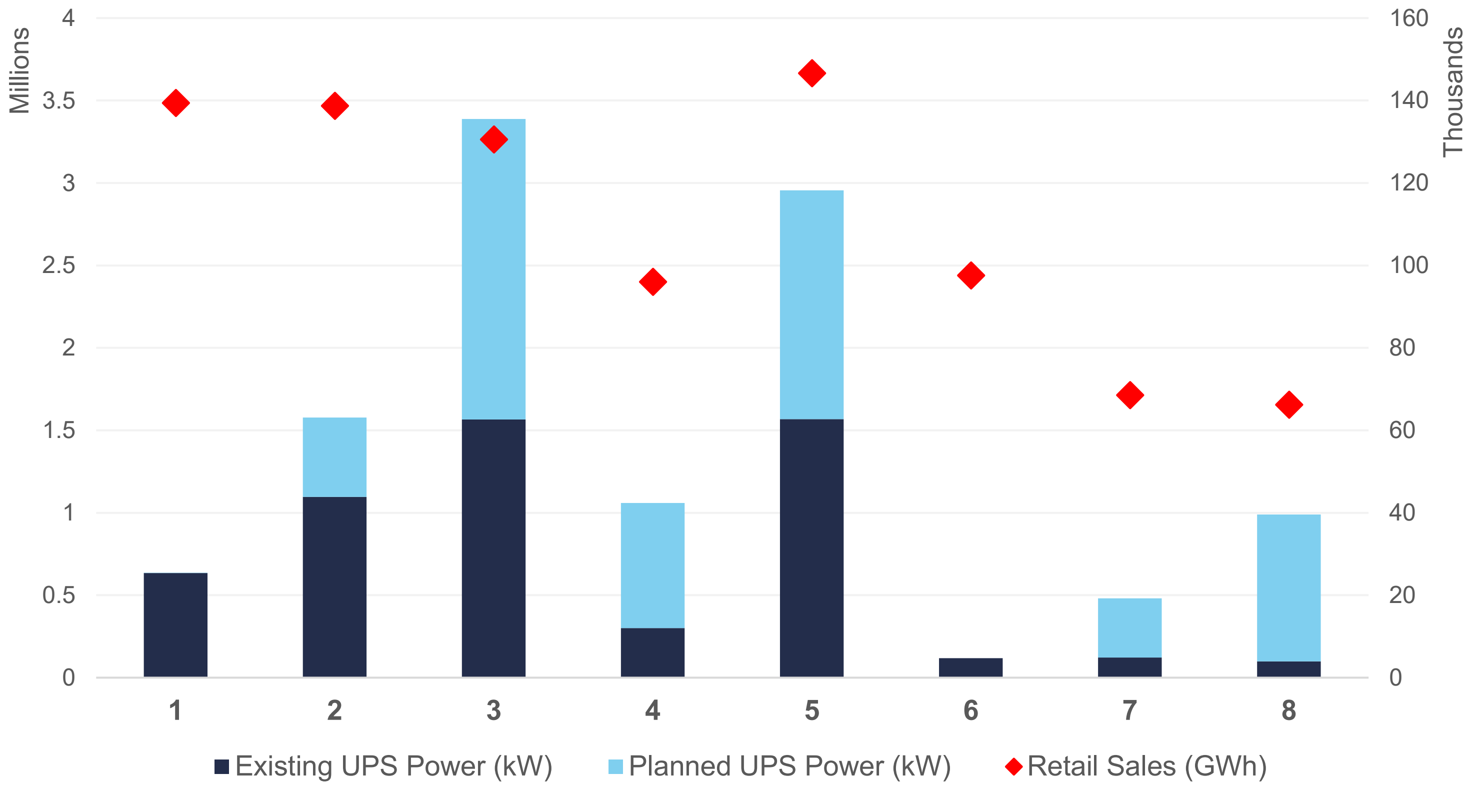


Existing UPS Power (Kw) of Data Centers by State

Several GL Data Centers are expected to significantly increase their electricity demand.

- **Illinois** leads in both current and planned UPS power capacity even though many facilities are Wholesale.
- **Ohio** shows one of the highest total demands, and planned growth will push it even further.
- **Minnesota** and **Indiana** have steep percentage increases in planned energy use—indicating these states may face the most rapid change relative to their current footprint.
- **New York** and **Michigan** appear to be nearing a plateau.

Grid Pressure & Energy Demand Don't Always Align



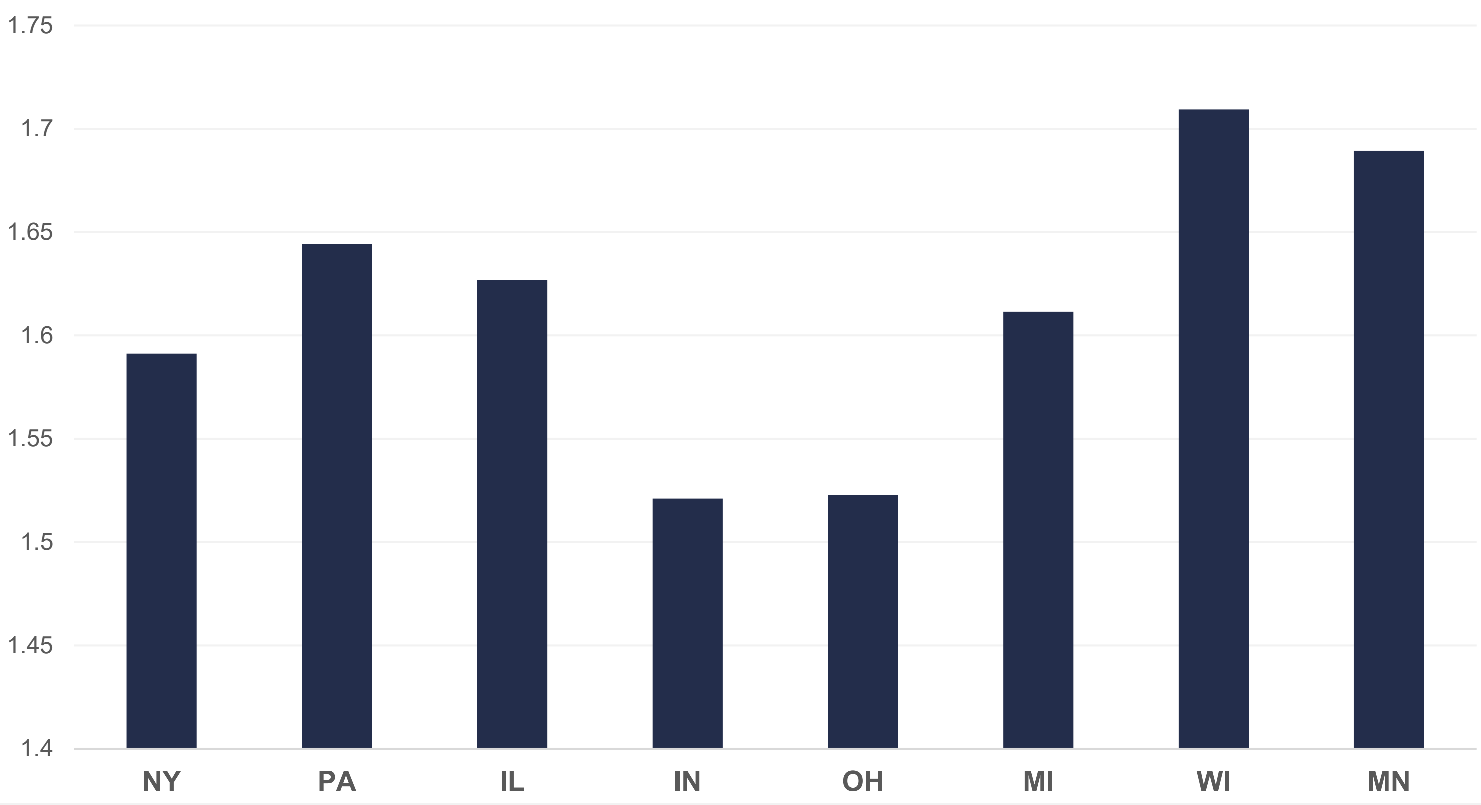
Existing and Planned UPS Power (Kw) of Data Centers

Data center electricity demand doesn't always occur in the states with the highest retail electricity consumption or production.

- **Illinois** ranks only fourth in total retail electricity sales among these states, yet it's projected to experience the greatest increase in data center energy demand.
- This suggests a greater relative strain on the grid, especially if infrastructure doesn't keep pace.

Understanding this imbalance—between existing electricity use and new energy demands from planned data centers—will be a key focus in our next phase of analysis.

Homogenous Energy Efficiency across States

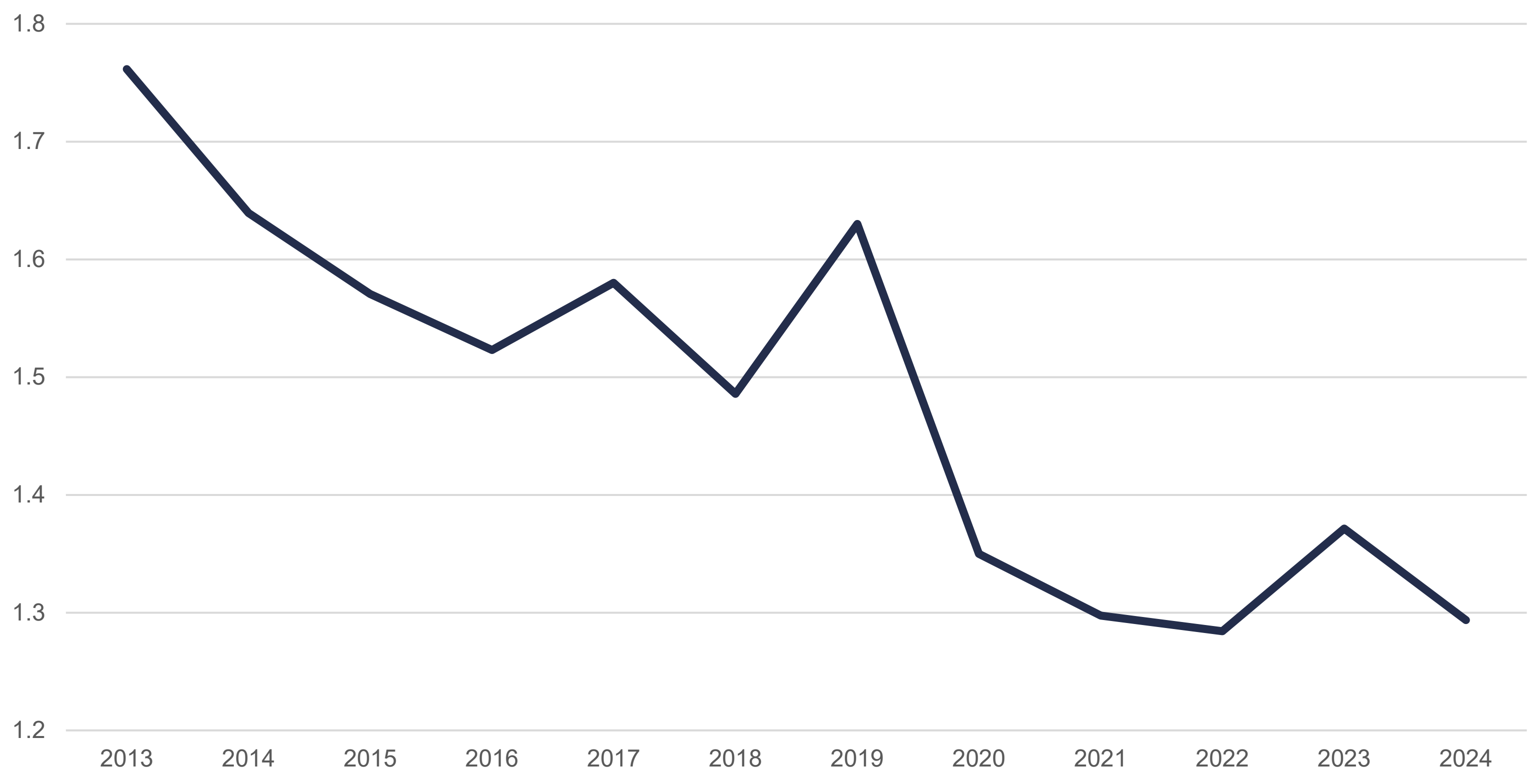


Average PUE by State

- **Average PUE** appears relatively uniform (typically ranging between 1.5 and 1.7). suggesting GL data centers operate with comparable energy efficiency levels—likely due to shared industry standards and technologies.

- Lower PUE does not necessarily mean lower overall energy use. It simply reflects a more efficient facility design — often allowing more servers (and computing power) to be added without increasing total power demand.

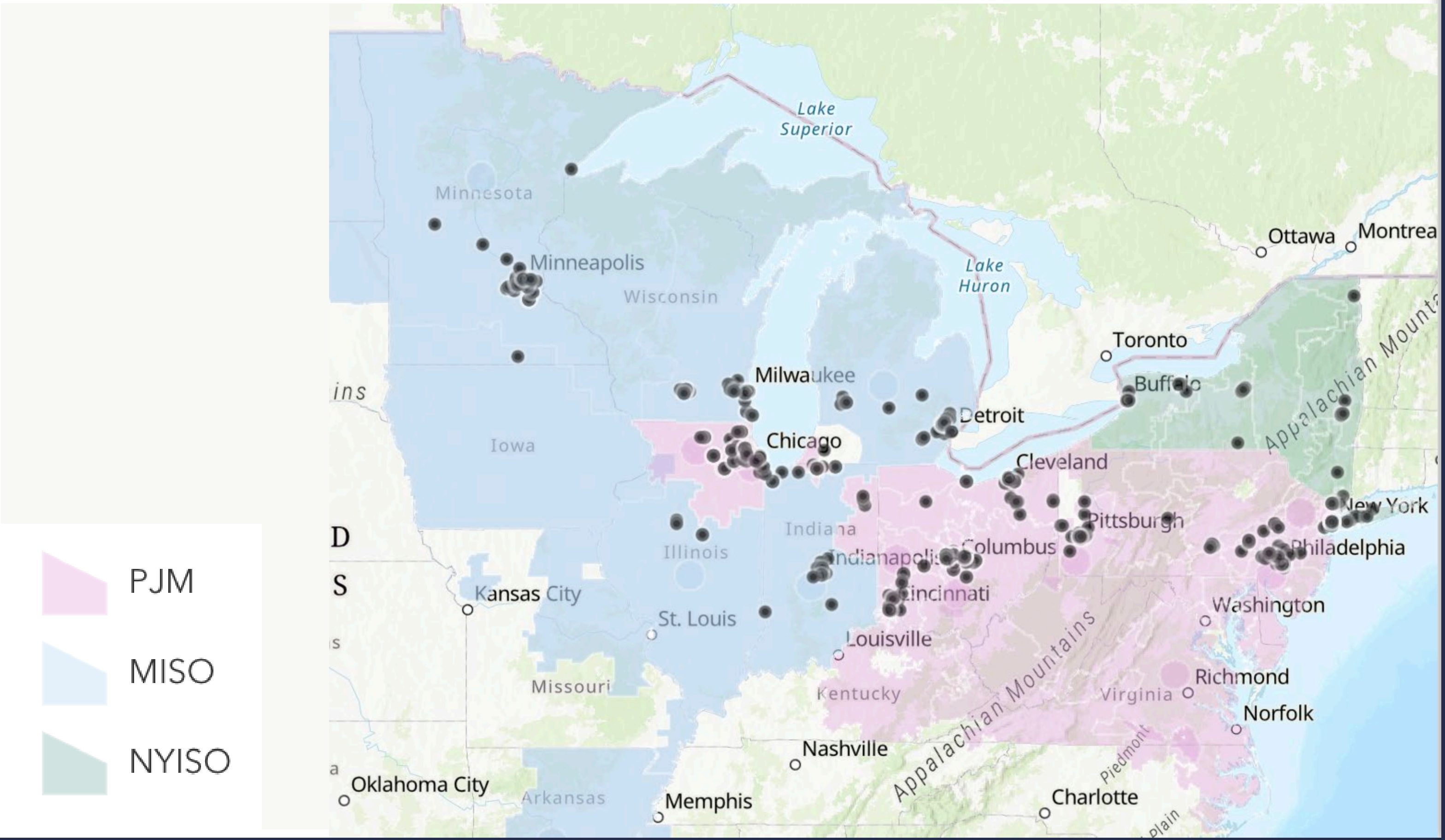
Improving Energy Efficiency Over Time



Average Power Usage Effectiveness in the Great Lakes across time

- **Key trend: steady decline in average PUE**; indicates that the non-IT energy use in data centers is becoming more energy-efficient, likely due to:
    - Advances in cooling technologies and infrastructure design
    - Stricter efficiency standards and sustainability goals
    - Industry shifts toward larger, more optimized facilities.
- Lower PUE doesn't always mean a lower environmental footprint.
  Gains in electrical efficiency may come at the cost of higher water usage, particularly in facilities using evaporative or water-based cooling systems.
- WUE (Water Usage Effectiveness) is not consistently measured.
  Further research is needed to fully understand the trade-offs between energy and water consumption.

A Framework for Energy Impact



Many factors to consider when evaluating implications of data center growth in the GL:

- **Location and type of data centers** (e.g., Hyperscale vs Retail, geographic clustering)
- **Energy intensity and UPS capacity** (both current and planned)
- **Efficiency metrics over time** (PUE, utilization rates, infrastructure trends)
- **Electricity market boundaries** (PJM, MISO, NYISO) and how they overlap with state-level

Goal: develop scenario-based forecasts that reflect real-world constraints and regional market dynamics—so utilities, planners, and policymakers can make informed decisions.

The MISO 2024 Forecast

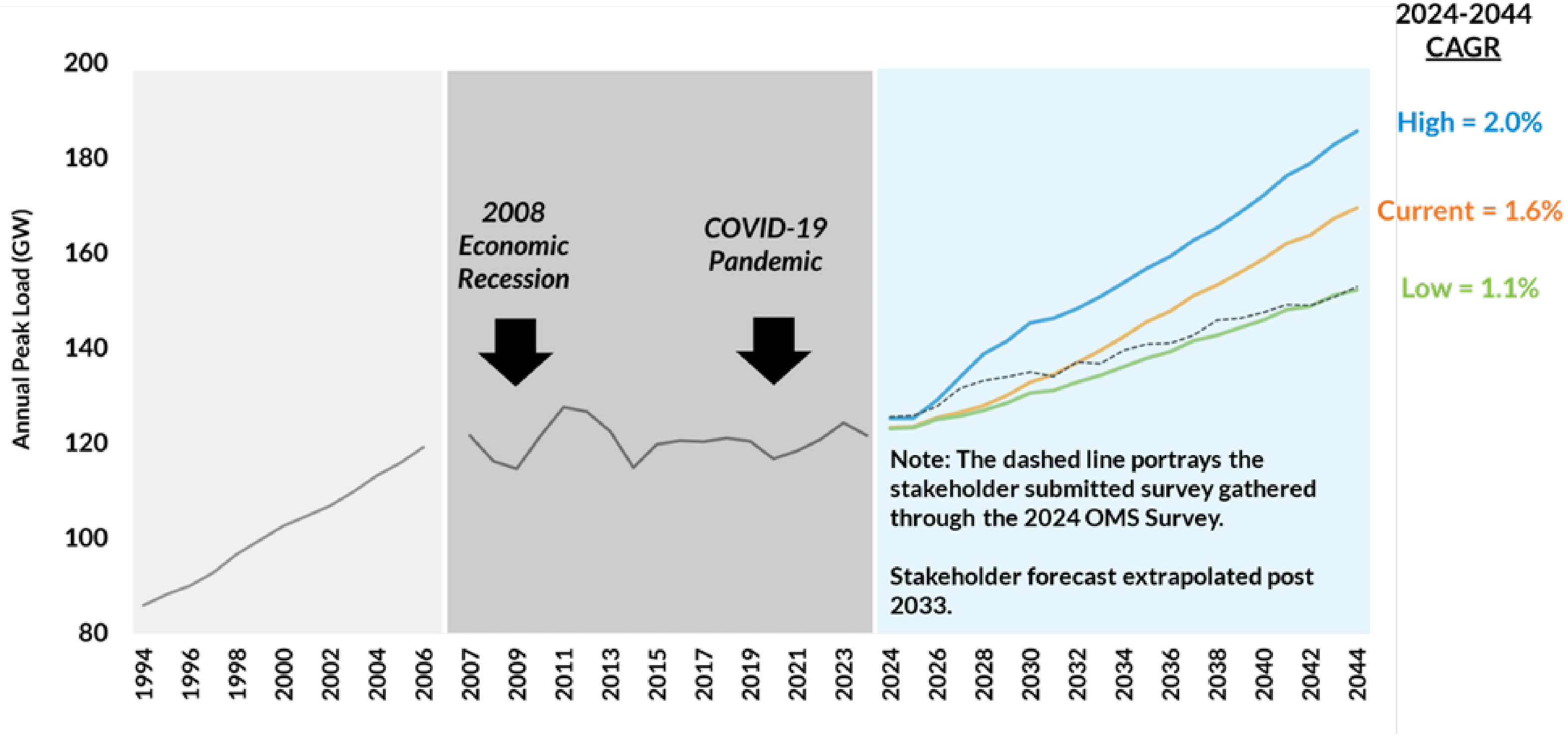
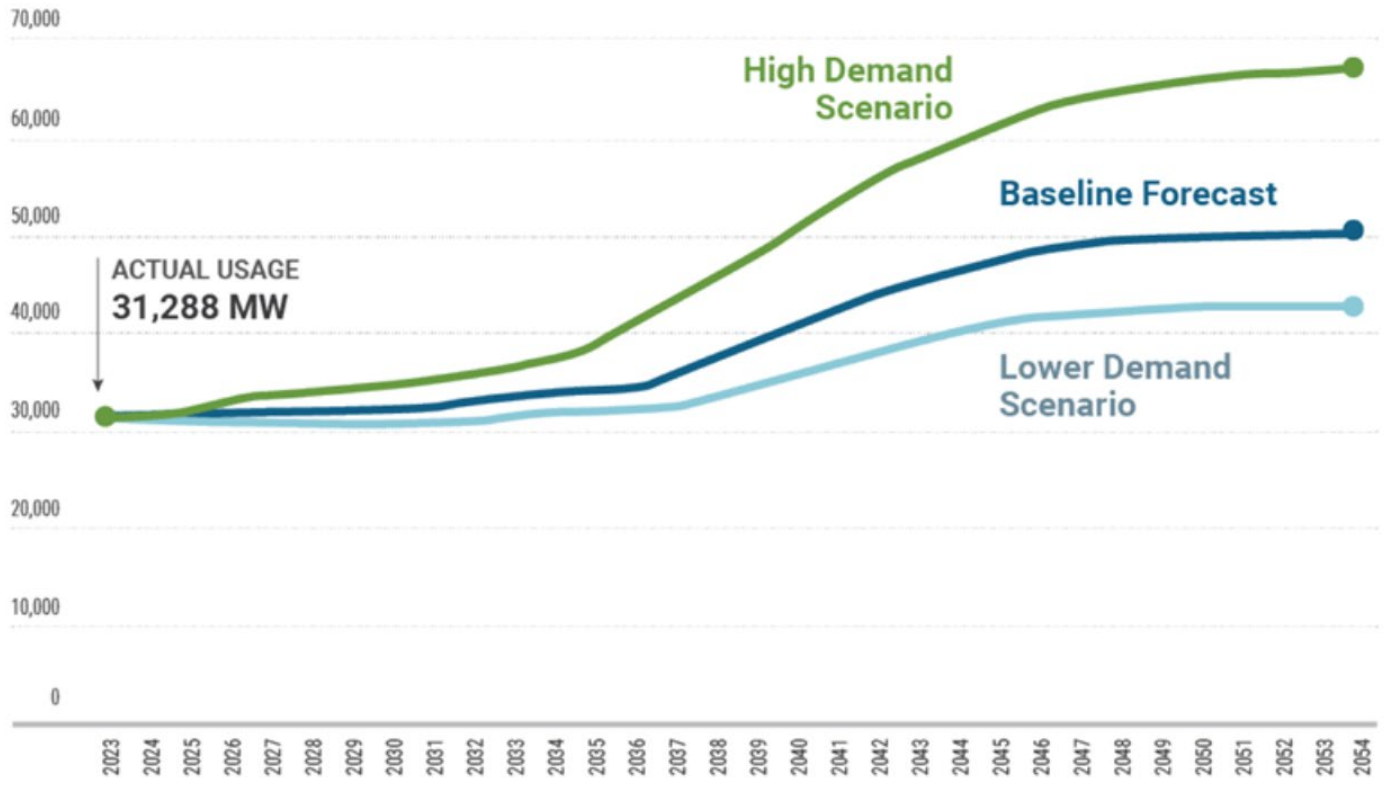


Figure 1: MISO's Net Peak Load Expectations Over Time (1994-2044)

MISO forecast

- Anticipates a significant increase in installed energy capacity from 2029 through 2043, driven in large part by data center expansion due to
  - the AI and cloud computing boom
  - continued investment in hyperscale facilities
  - regional shifts in digital infrastructure demand
- Indicates energy demand from data centers alone could grow by 149 to 241 TWh by 2044.

The NYISO 2024 Forecast



Actual & Forecast Peak Demand (MW)—Electric Engery Demand Forecast in NY State (2023-2054)

NYISO forecast

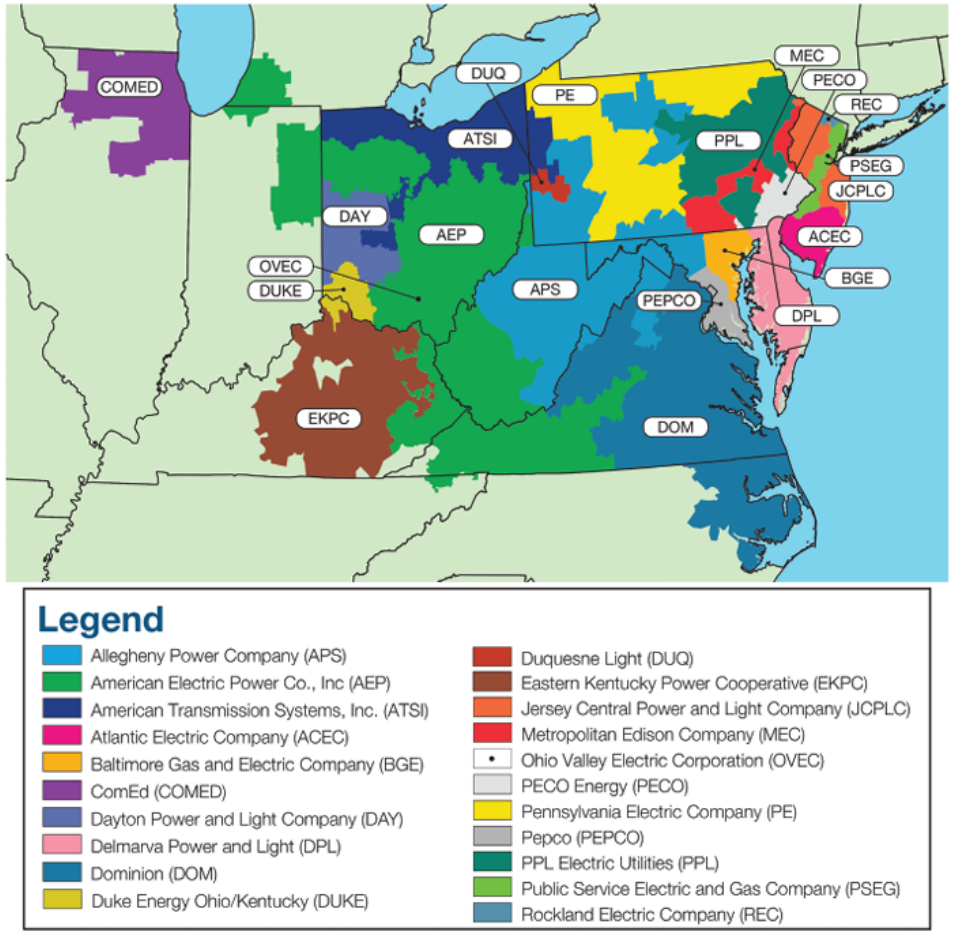
Current peak usage is around 31,288 MW, but outlook varies depending on the scenario:

- **High Demand Scenario**: Driven by data center expansion, this scenario anticipates demand surpassing 60,000 MW by mid-century.
- **Lower Demand Scenario**: Reflects slower digital adoption and energy efficiency gains, with demand stabilizing around 40,000 MW.

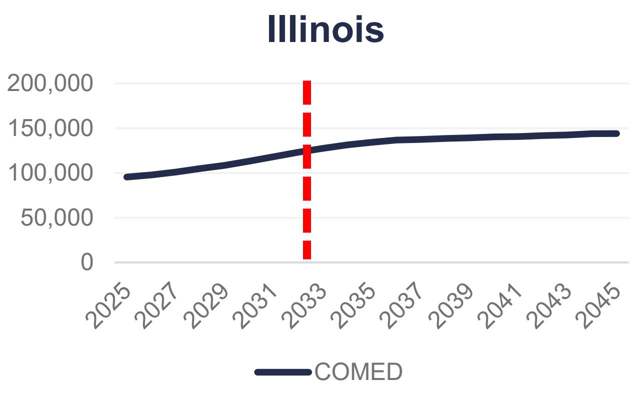
Data Centers in the Great Lakes - Forecasting

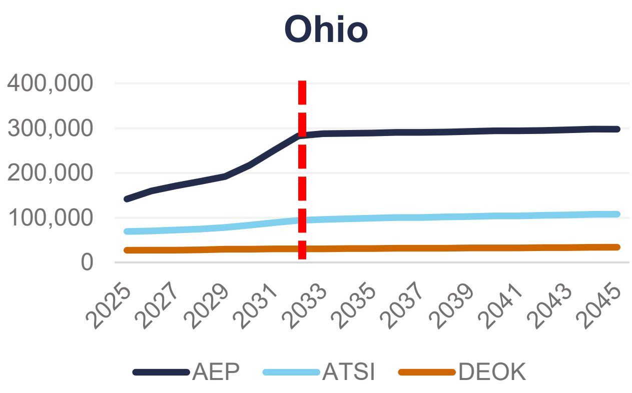
PJM Interconnection

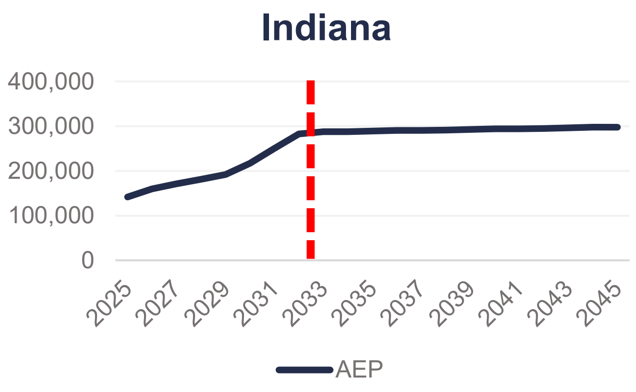
Illinois	ComEd
Indiana	AEP
Ohio	ATSI
	AEP
	DEO&K
Pennsylvania	ATSI
	DLCO
	PENELEC
	METED
	PPL
	PECO

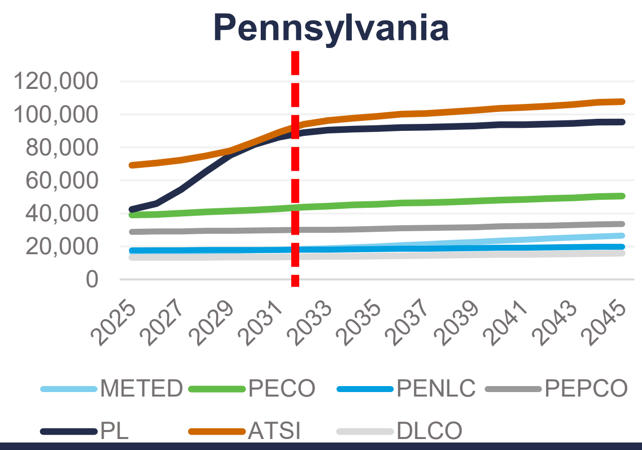


The PJM Forecasts









PJM Forecasts

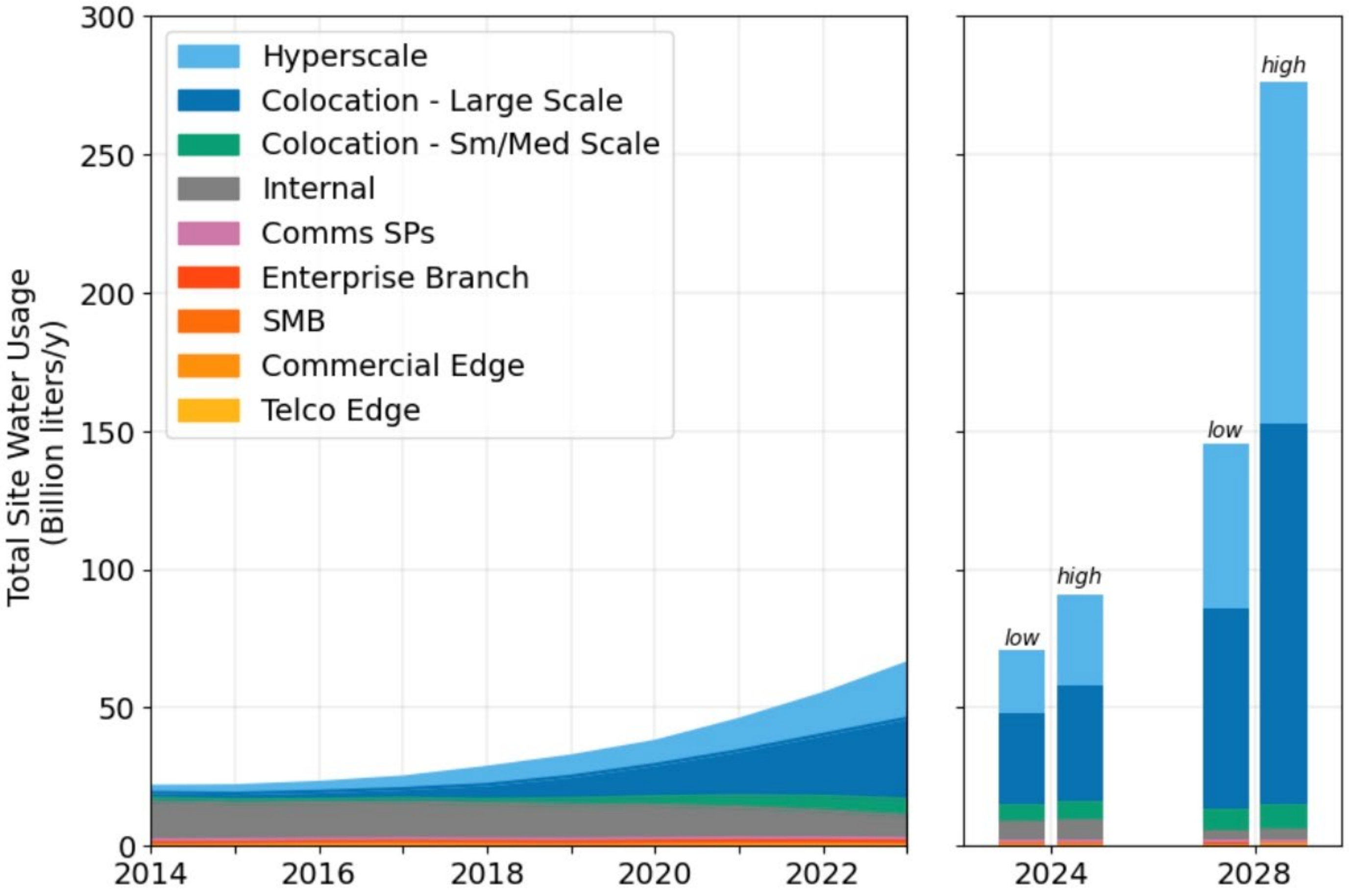
Substantial variation across states and utility zones

- **Illinois and Indiana**, while part of PJM, also fall within the MISO footprint, making it more challenging to reconcile projections and avoid double-counting load growth.
- **Ohio** displays significant growth, especially under the AEP service area, with flatter trends in ATSI and DEOK, underscoring intra-state differences.
- **Pennsylvania** presents one of the biggest forecasting challenges: the state is highly fragmented across multiple utility service territories.

A harmonized approach should be put in place to ensure policy relevance and analytical accuracy.

Data Centers – Moving towards Energy?

Water Usage Effectiveness (WUE)



Source: Berkeley Lab (2024)

WUE

- measures onsite water consumption used for cooling data center infrastructure.
- is key metric for understanding water footprint of digital infrastructure.
- matters because as data centers expand, cooling needs to grow, especially for AI-intensive ops.

  In 2023, hyperscale and colocation centers accounted for 84% of total direct water use. Even with efficiency gains, total direct water consumption could reach approximately 250 billion liters by 2028 nationwide.

Water extraction by state:

- Illinois: ≈ 29.1 trillion liters/year (0.43%)
- Michigan: ≈ 14.8 trillion liters/year (0.84%)

Data Centers – Moving towards Energy?

Why Water Measurement Matters

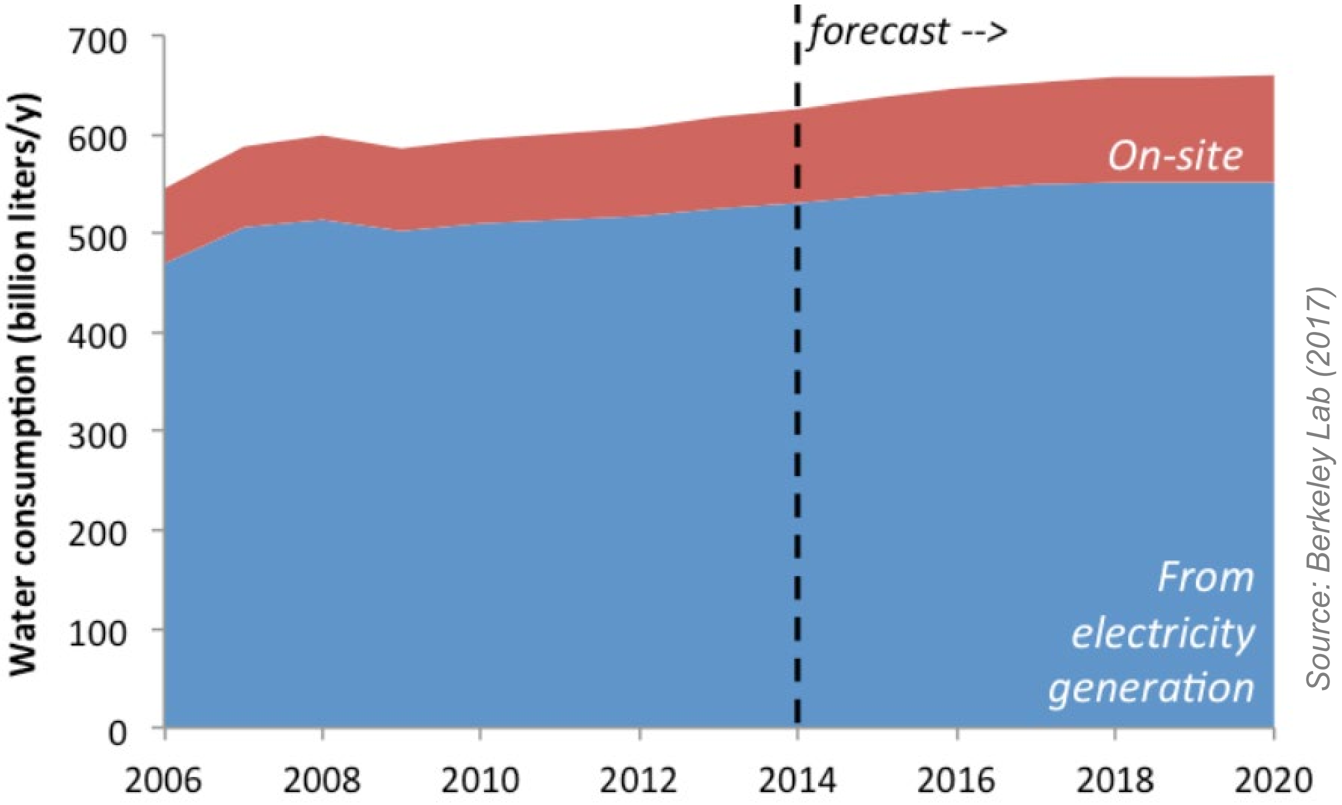


Figure 25. Direct vs. Indirect U.S. Data Center Water Consumption

Unlike PUE, which is widely tracked, WUE is not consistently measured across most U.S. data centers.

- This limits our understanding of local water stress and makes regional comparisons difficult.
- Need to establish reporting standards that treat WUE like PUE, requiring data centers to report both direct (on-site) and indirect (grid-related) water usage annually.

"Data centers consumed approximately 176 TWh in 2023. The total indirect water footprint of U.S. data centers is nearly 800 billion liters, attributed to water consumed indirectly through electricity use, based on the regional electricity grid mix for U.S. data center locations."

Berkeley Lab (2024)

Next step: Economic Impact and Energy-Related Assessment

State-level Economic Impact Analysis

In our work, we will

- Estimate economic impacts separately for each Great Lakes state
- Include these key dimensions of analysis:
  - Employment
  - Gross Value Added (GVA)
  - Labor Income
  - Tax revenues
- Separate by phase:
  - Construction Phase: One-time, short-term impact
  - Operation Phase: Ongoing, long-term impact.

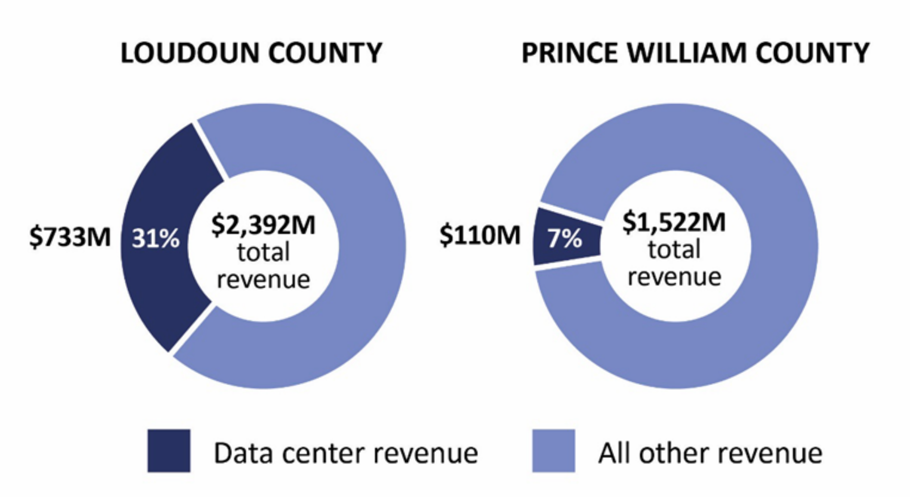
State-level Economic Impact Analysis

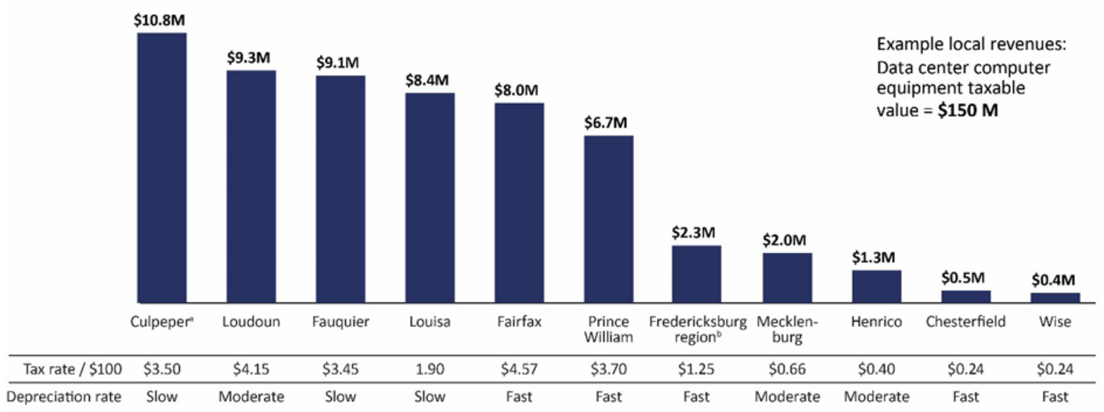
Impacts of initial capital investment in Virginia and by region, annual average FY21–FY23

Impact	Employment	Labor income	Virginia GDP	Total output
Statewide				
Direct	35,110	$2,646.6 M	$3,342.1 M	$7,887.7 M
Indirect	9,945	843.8	1,504.2	2,806.8
Induced	13,992	791.9	1,570.9	2,596.8
Total	**59,047**	**$4,282.4 M**	**$6,417.2 M**	**$13,291.3 M**
Northern Virginia				
Direct	27,703	$2,368.5 M	$2,957.6 M	$6,625.6 M
Indirect	5,577	585.4	1,30.1	1,733.3
Induced	7,510	490.3	963.7	1,488.2
Total	**40,790**	**$3,444.2 M**	**$4,951.4 M**	**$9,847.0 M**
Other regions of the state				
Direct	5,761	$406.5 M	$517.0 M	$1,262.5 M
Indirect	1,584	116.6	212.5	418.0
Induced	2,106	107.3	219.6	373.4
Total	**9,451**	**$630.4 M**	**$949.2 M**	**$2,053.9 M**

Source: Weldon Cooper Center (2024)

Other open avenues...





Source: JLARC (2024)

Can data centers be a source of new tax revenues and contribute to improve local amenities and services?

Business Property Tax rates (on computer equipment) and Depreciation rate can influence the outcome at the local level.

State-Level Energy-Related Analysis

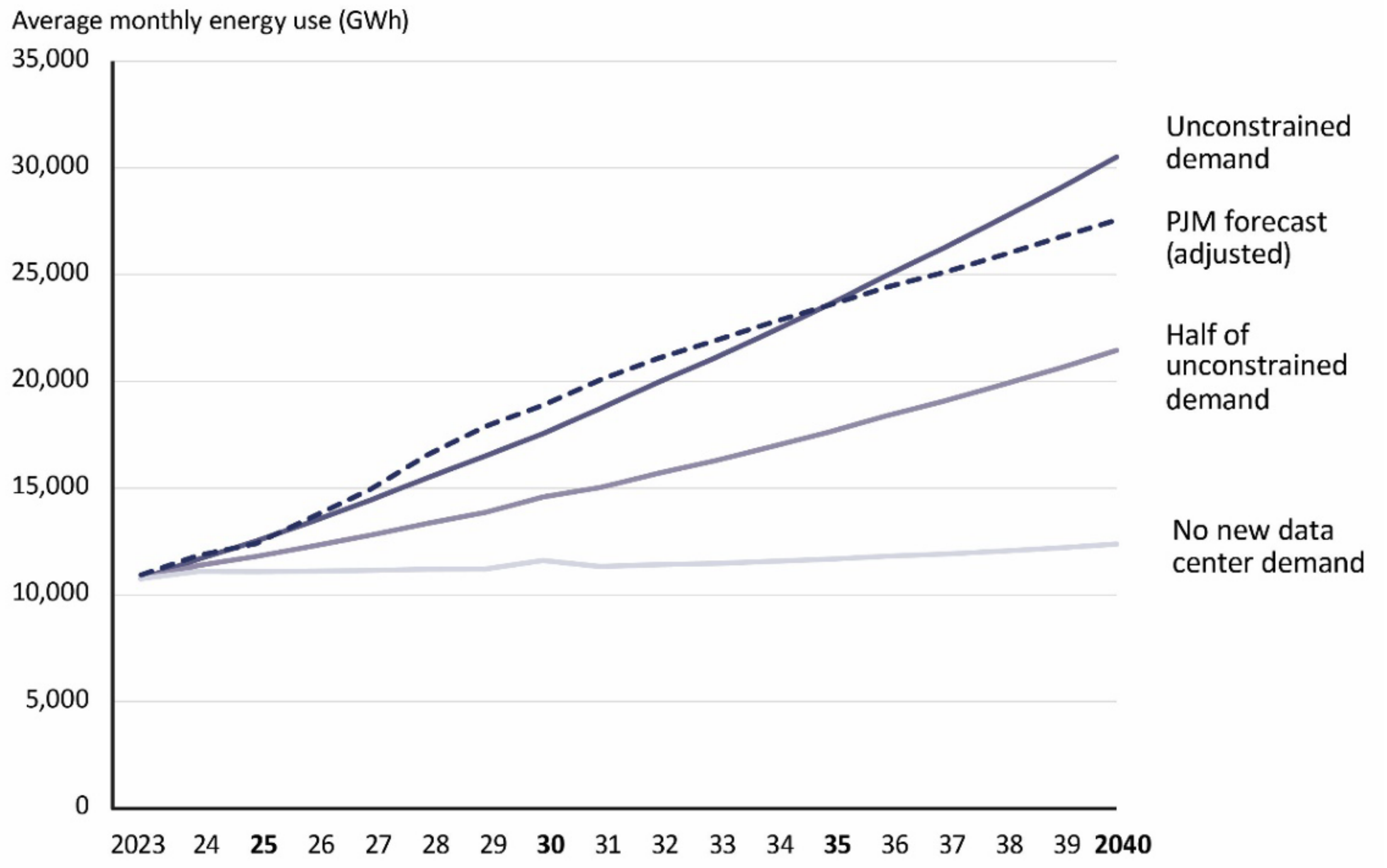
Energy impacts are a critical dimension of data center development, especially in states where electricity supply, pricing, and emissions are key policy concerns.

Key Focus Areas:

- **Electricity Demand**
  Projecting how much additional power data centers will require in each state, factoring in growth scenarios and efficiency trends.
- **Grid Capacity and Reliability**
  High-level discussion of whether the existing infrastructure can support future demand, especially in rural or industrial zones.
- **Energy Mix and potential impact on carbon footprint**

These energy-related impacts are not evenly distributed and may produce costs or benefits depending on local grid conditions, market rules, and the pace of clean energy adoption.

State-Level Energy-Related Analysis



Source: Weldon Cooper Center (2024)

Data center demand would drive immense increase in energy demand in Viriginia

based on Weldon Cooper Center for JLARC study

Thank you

Q&A