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

Final Presentation

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Outline of the Presentation

1. Project Overview
2. Location, Typology, and Size
3. Energy Impacts
4. Economic and Fiscal Impacts
5. Summary and Policy Impacts
6. Q&A

Project Overview

Project Goals

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.

Analyze Economic Impact

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

Balance Priorities

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

Project Timeline

FIRST QUARTER

- Data gathering and cleaning
- Methodology discussion
- Current vs. future

SECOND QUARTER

- Establishing location patterns
- Scenario development
- Calibrating energy requirements and demand

THIRD QUARTER

- Estimating regional and state
- Energy impacts
- Economic and fiscal impacts

Project Timeline

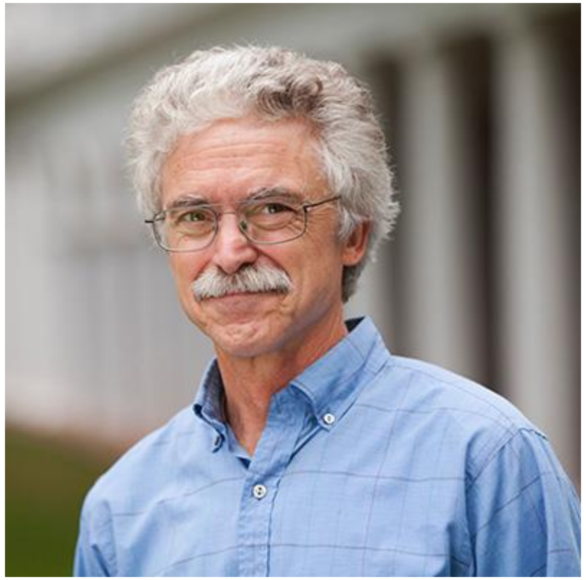
Expected Deliverables

- **Report**
  - Detailed assumptions, methodology, and results
- **12 Fact Sheets**
  - 8 state-oriented: location, economic, and energy-related assessments
  - Four topic-oriented: aggregated and analyzed findings as well as implications for local and state policy making
- **Web site resources (report and FAQs)**
- **Communications & Outreach**
  - Targeted LinkedIn posts
  - Press release/media contacts

Main Project Team

from the Weldon Cooper Center for Public Service, University of Virginia

João Ferreira
Regional Economist



William Shobe
Director Emeritus CEPS

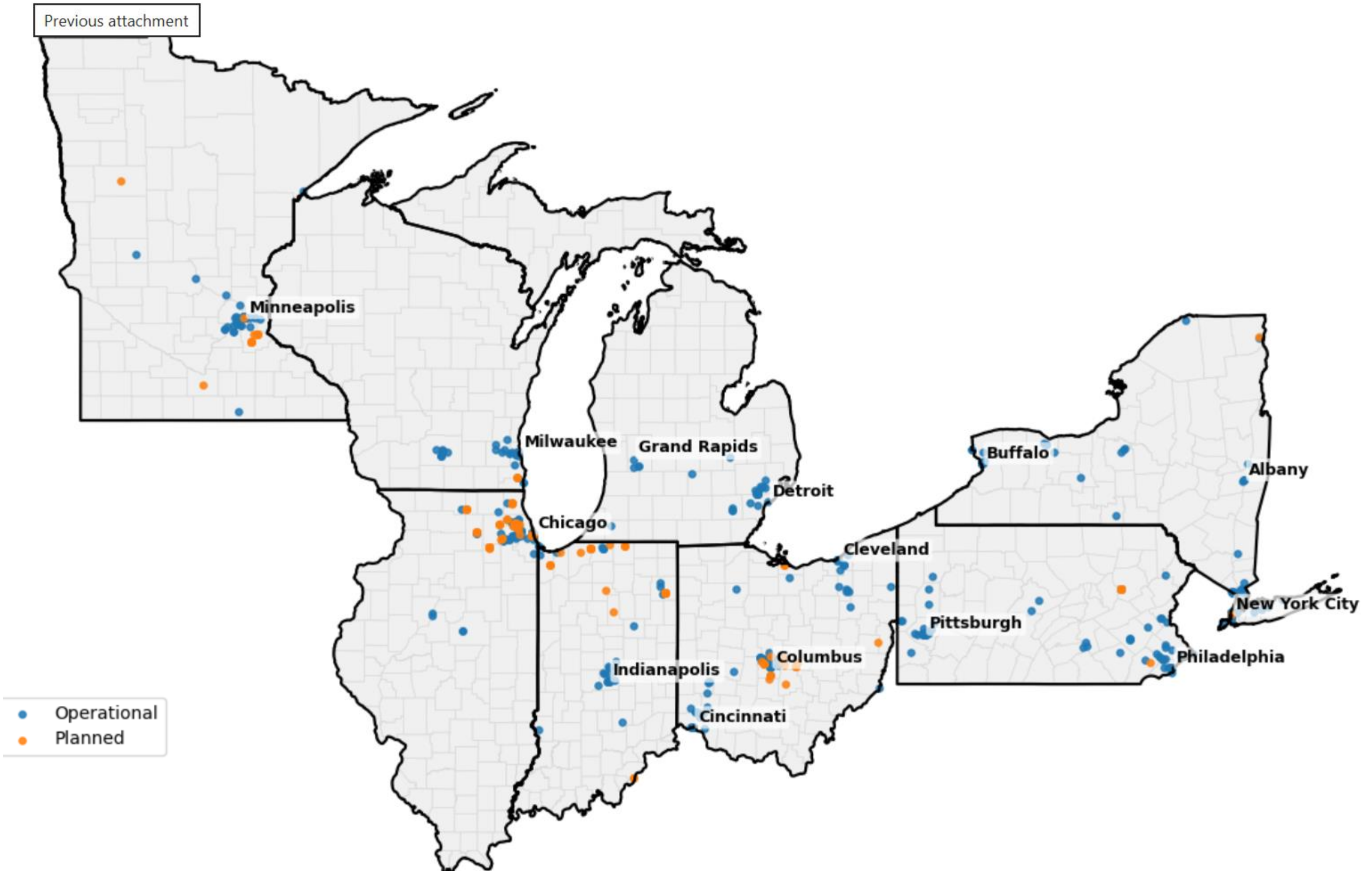
Terance J. Rephann
Regional Economist

Matt Scheffel
Economist

Location, Type and Size of Data Centers in the Great Lakes Region

Data Centers in the Great Lakes – Operational and Planned

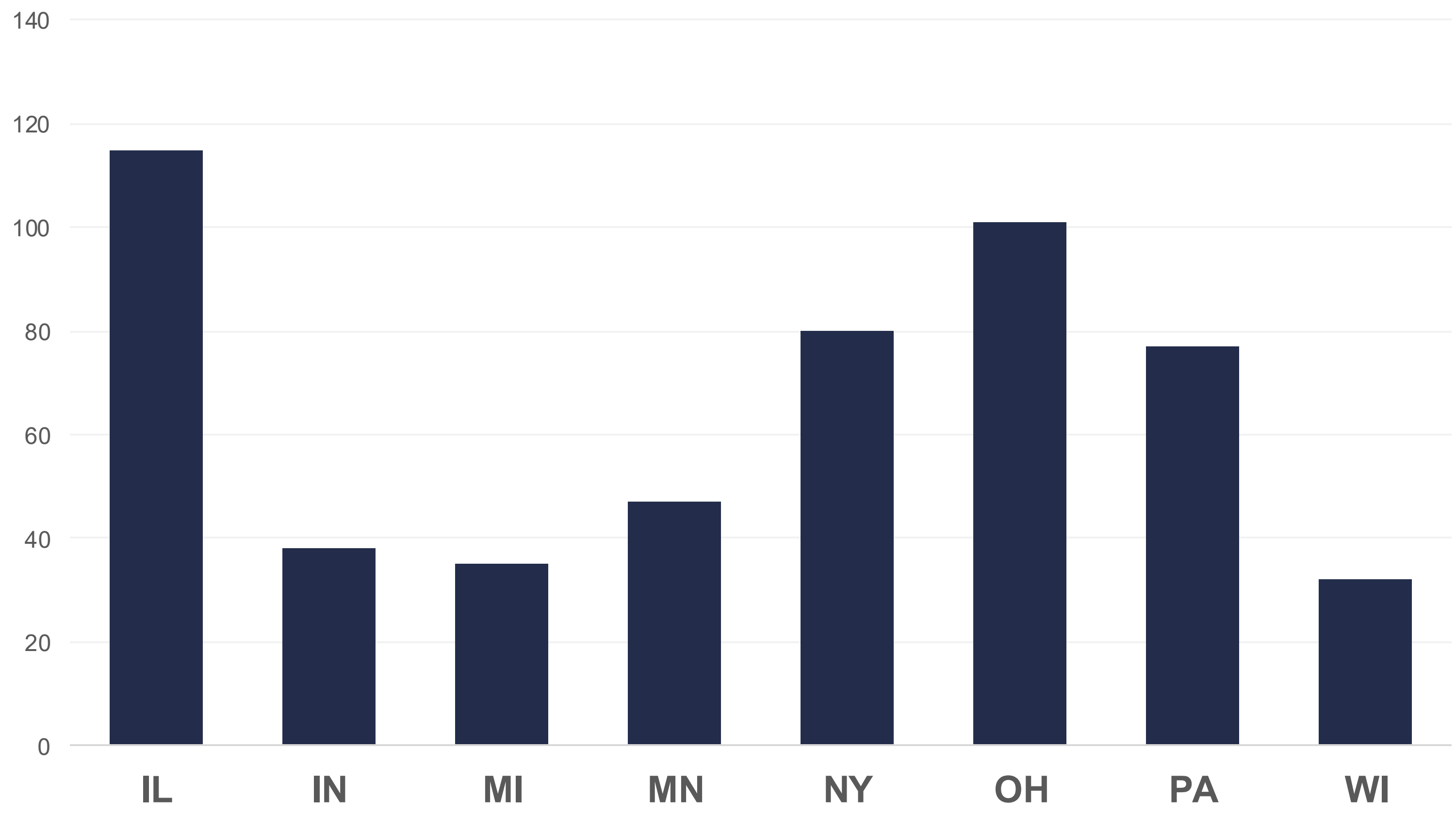
Data Centers by State



- **2,717** operational data centers in the U.S. *(according to S&P)*
- Database presents a lower number of data centers than other databases.
  - reduces double-counting and includes decommissioned facilities
  - includes detailed information on square feet and energy-related data.

Data Centers in the Great Lakes - Operational

Data Centers by State

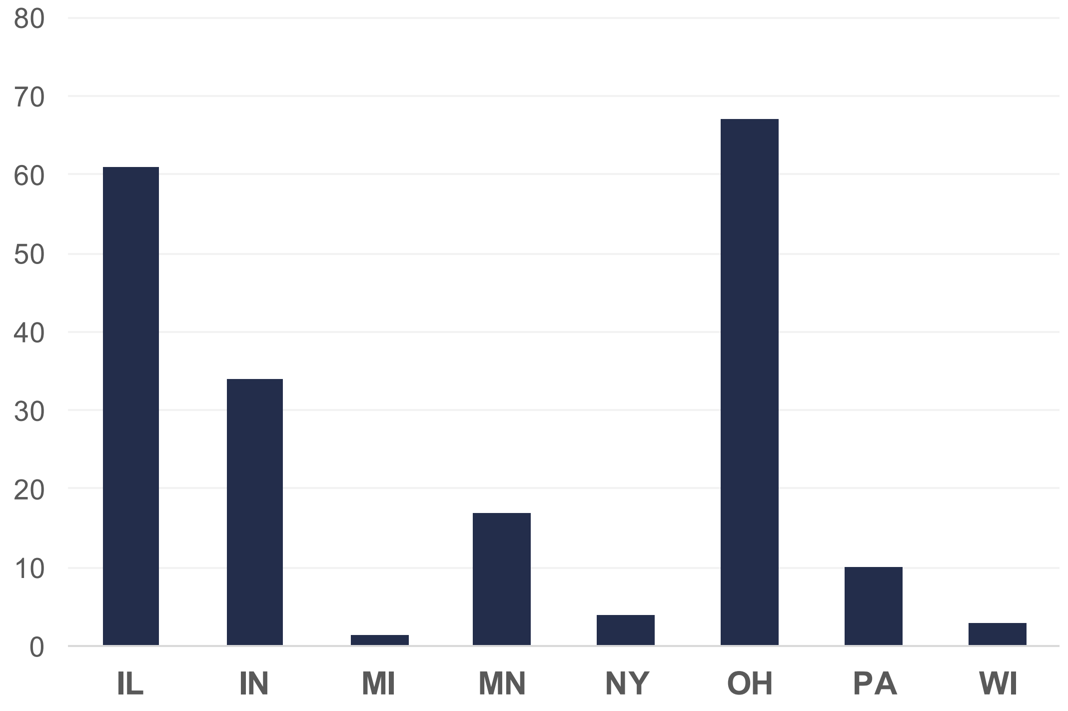


- **20%** of data centers in U.S. are in states around the Great Lakes

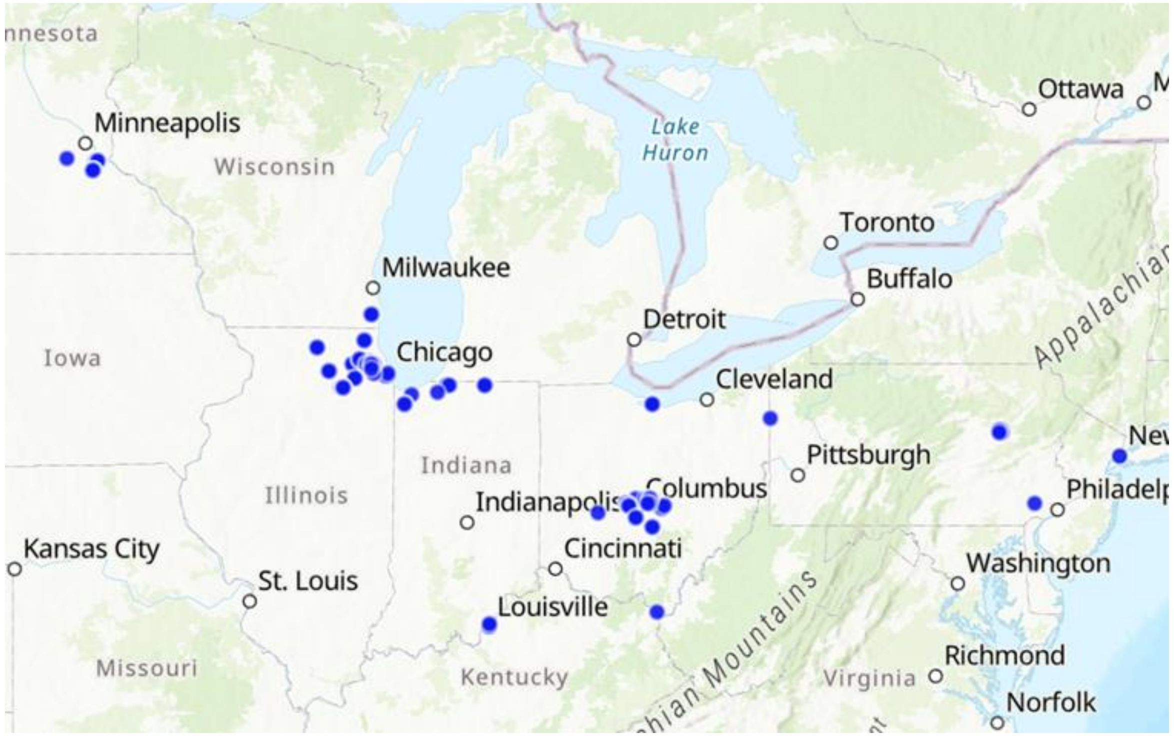
  Virginia and Texas are the only states that have a comparable number of data centers

- **Illinois and Ohio** represent more mature markets, followed by **Pennsylvania and New York**

Location of Planned Data Centers



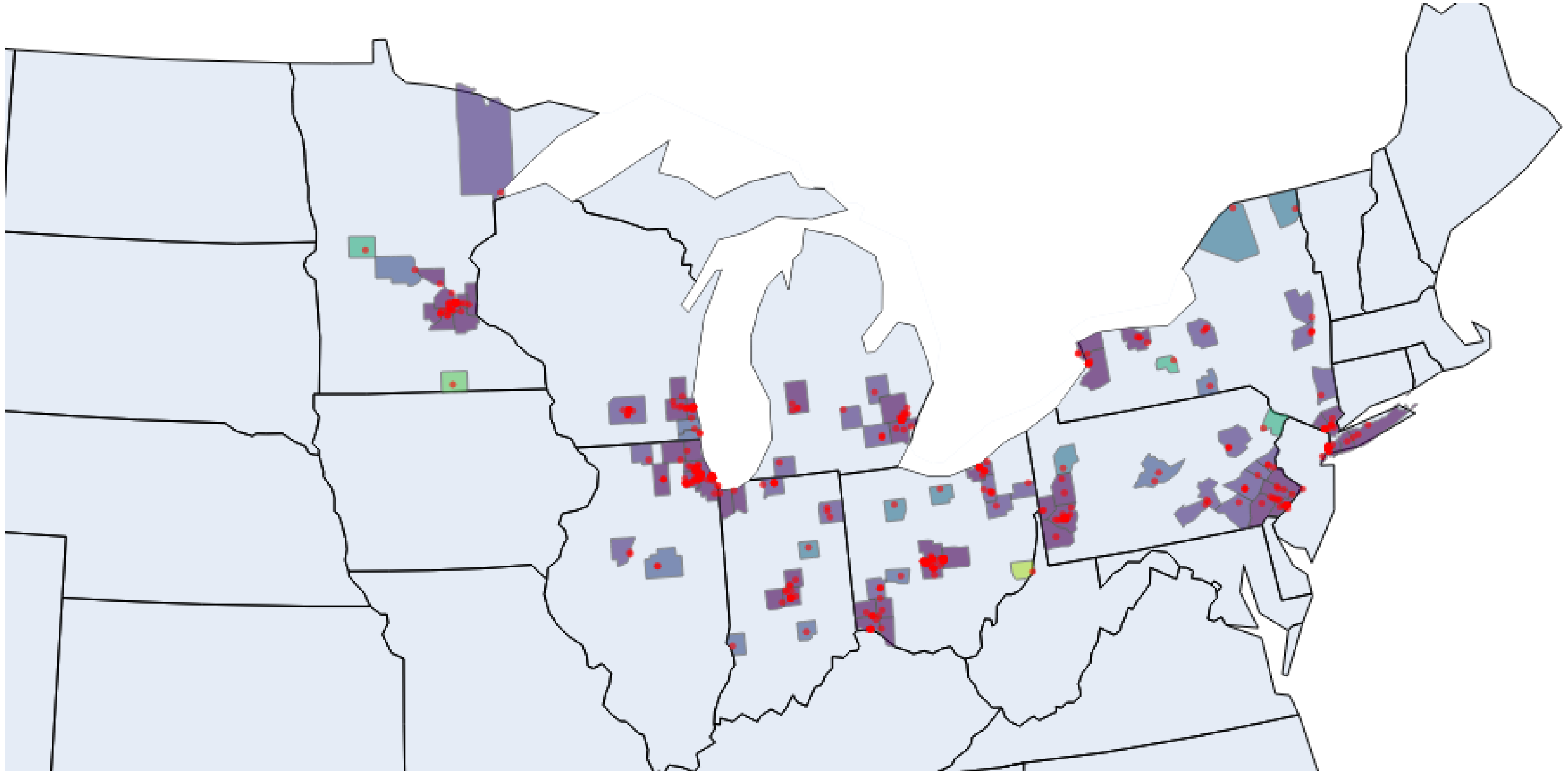
Planned Data Centers by State



Location of Planned Data Centers

Data Centers in the Great Lakes- Location

Data Centers Location in Urban Areas



Rural/Urban Characterization of counties with Data Centers

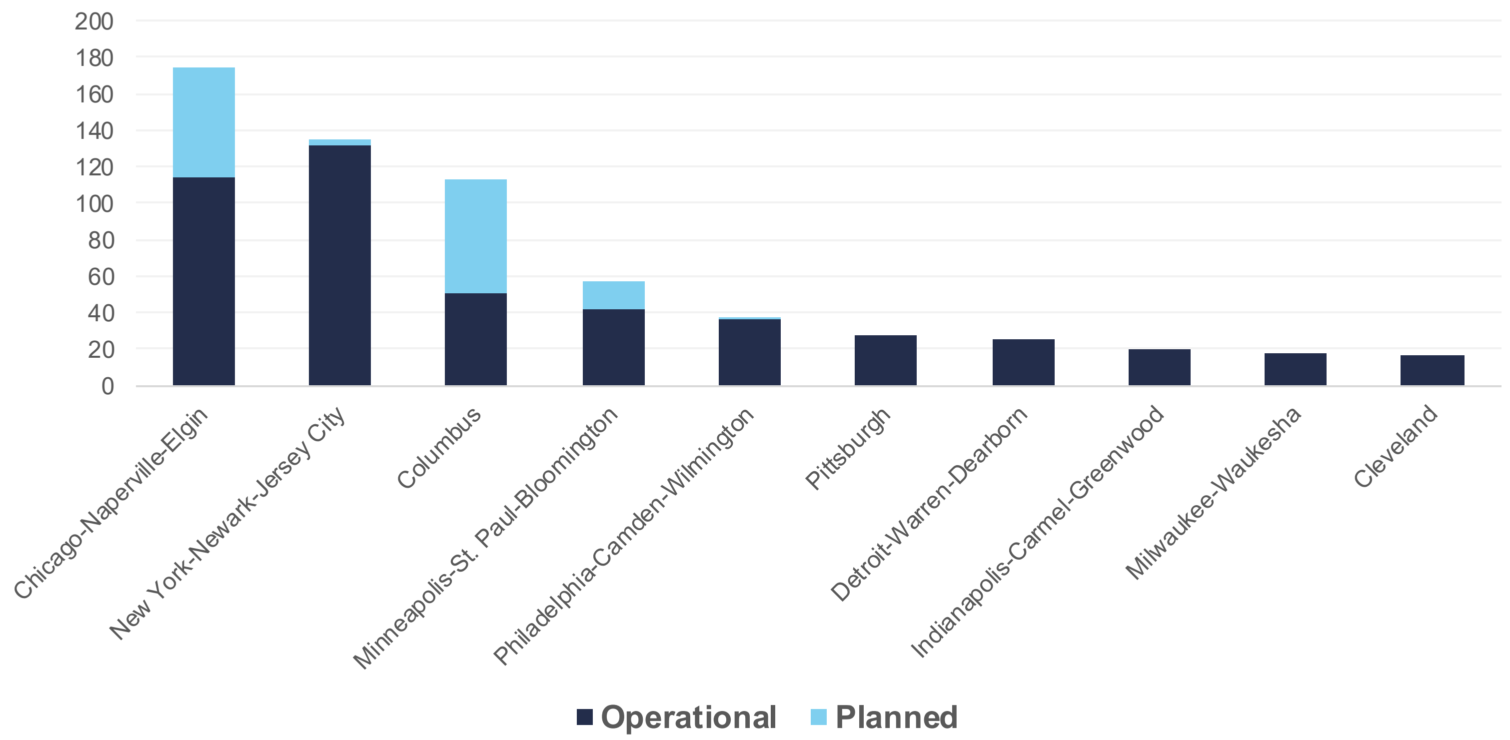
Most data centers are located in urban areas.

Urban vs rural typology counties where data centers are located:

- Large metro (>1 M): 82.0%
- Large metro (250k-1M): 13.0%
- Small metro (<250k): 3%
- Others: 2%

Data Centers in the Great Lakes- Location

Data Centers Location in Urban Areas



Data Centers by MSA in the Great Lakes region

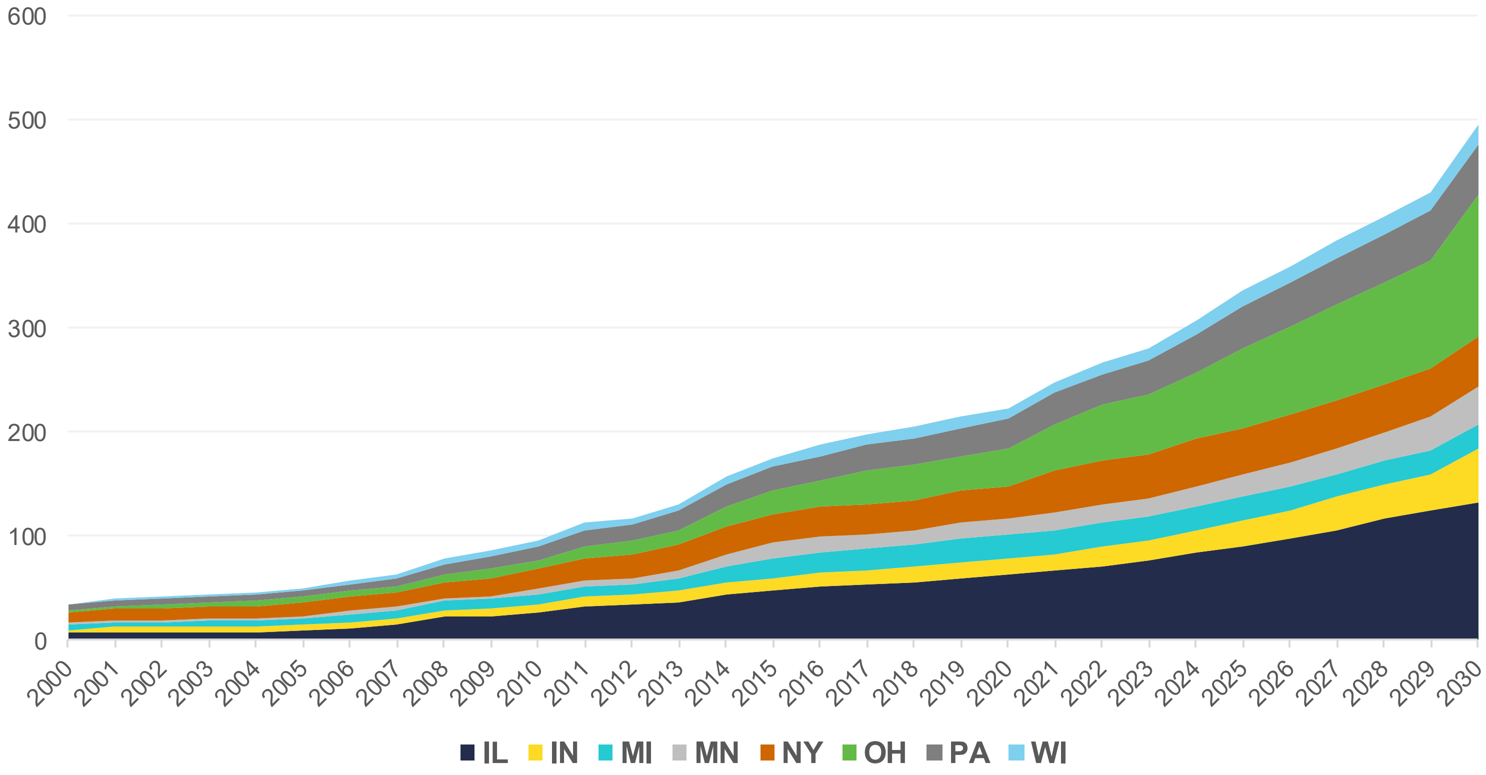
Chicago will surpass New York in data centers by 2026.

Columbus will reinforce its position as the third-largest market in the region.

Minneapolis is next, but it is comparable to other mid-size markets.

Data Centers in the Great Lakes – Cumulative Growth

How Data Centers Have Expanded



Cumulative Growth of Data Centers in the Great Lakes

- **S&P data** includes the planned data centers for the period of 2025-2029.
- Five clear growth phases:
  - 2000–2008: ~5 per year
  - 2008–2013: ~10 per year
  - 2013–2020: ~14 per year
  - 2020–2024: ~20 per year

2025–2029: ~21 per year

- Number of data centers offers incomplete picture of market change

Not all data centers are the same…

Crypto Designed primarily for cryptocurrency mining—high power use, low latency needs, often minimal redundancy	**Hyperscale** Large-scale facilities operated by or for big tech (e.g., Amazon, Google); optimized for scalability and efficiency	**Retail** Offers space, power, and services to multiple small-to-medium clients; typically high-touch service
Telco Managed by telecom providers and often integrated with network hubs and communication infrastructure	**Wholesale** Large blocks of space and power leased to a single tenant (or very few), often on long-term contracts	

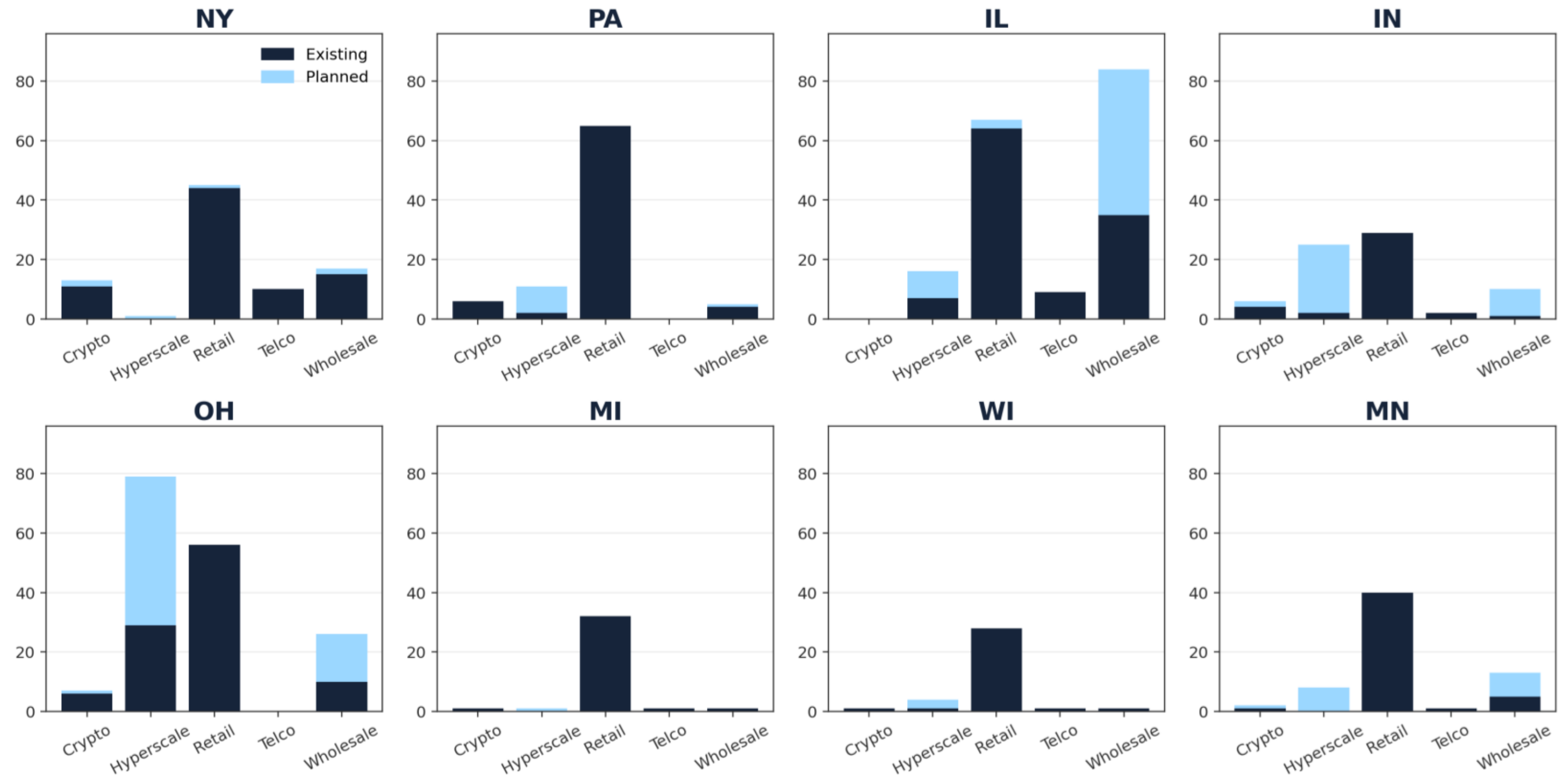
Not all data centers are the same...

Crypto 200,000 Sq ft facilities 50 MW of installed capacity Three and a half football fields	**Hyperscale** 325,000 Sq ft facilities 46 MW of installed capacity One third of the Millenium park in Downtown Chicago	**Retail** 56,000 Sq ft facilities 2 MW of installed capacity Mid-size store in a mall
Telco 20,000 Sq ft facilities <1 MW of installed capacity High-school basketball court	**Wholesale** 270,000 Sq ft facilities 13 MW of installed capacity Half-size of the Wisconsin State Capitol	

Not all data centers are the same…

Data centers in New Carlisle, Indiana (AJ Mast / The New York Times / Redux)

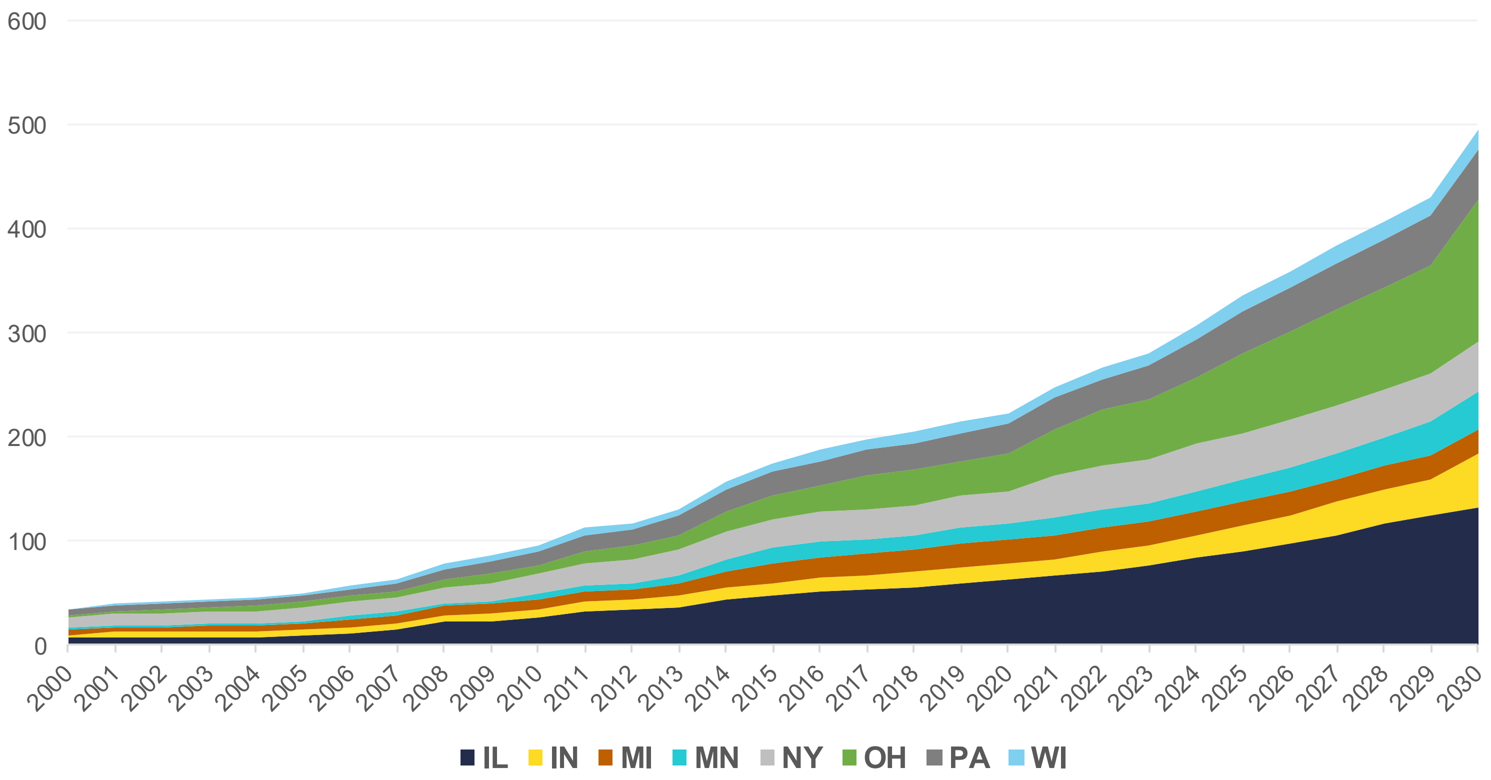
Existing vs. Planned Data Centers by Type



- Planned development is mainly focused on **hyperscale** and **wholesale** data centers
- **Retail** and **crypto** data centers show limited future growth

Data Centers in the Great Lakes – Cumulative Growth

How Data Centers Have Expanded



Cumulative growth of data centers energy requirements (GW) in the Great Lakes

Energy needs shape DCs economic and environmental footprints. Each facility type has a different energy demand

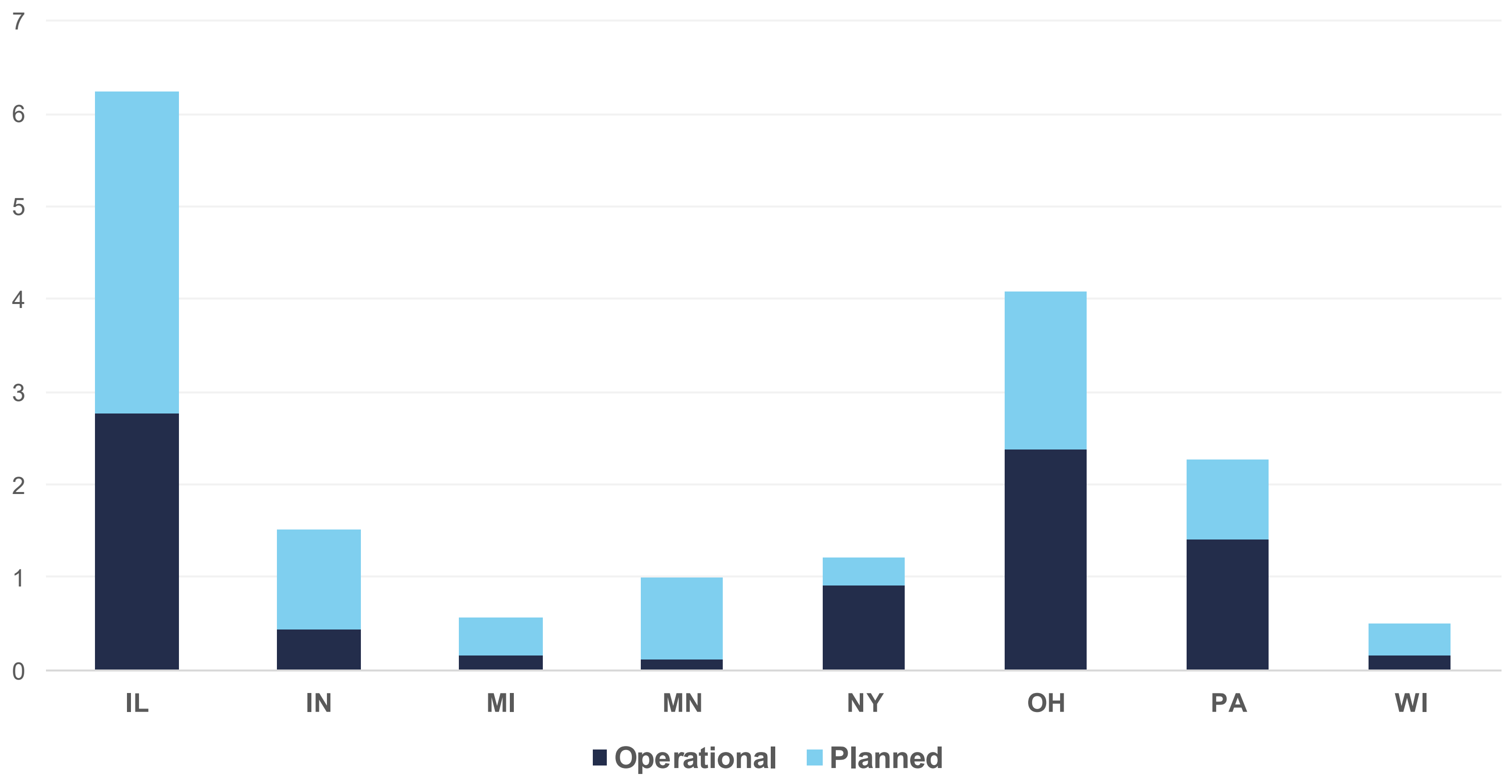
Five growth phases:

- 2000–2008: +69 MW per year
- 2008–2013: +78 MW per year
- 2013–2020: +242 MW per year
- 2020–2024: +1119 MW per year
- **2025-2029: +1311MW per year**

This represents a sharp acceleration in energy demand

Data Centers in the Great Lakes – Energy Demand

Surging Energy Demand



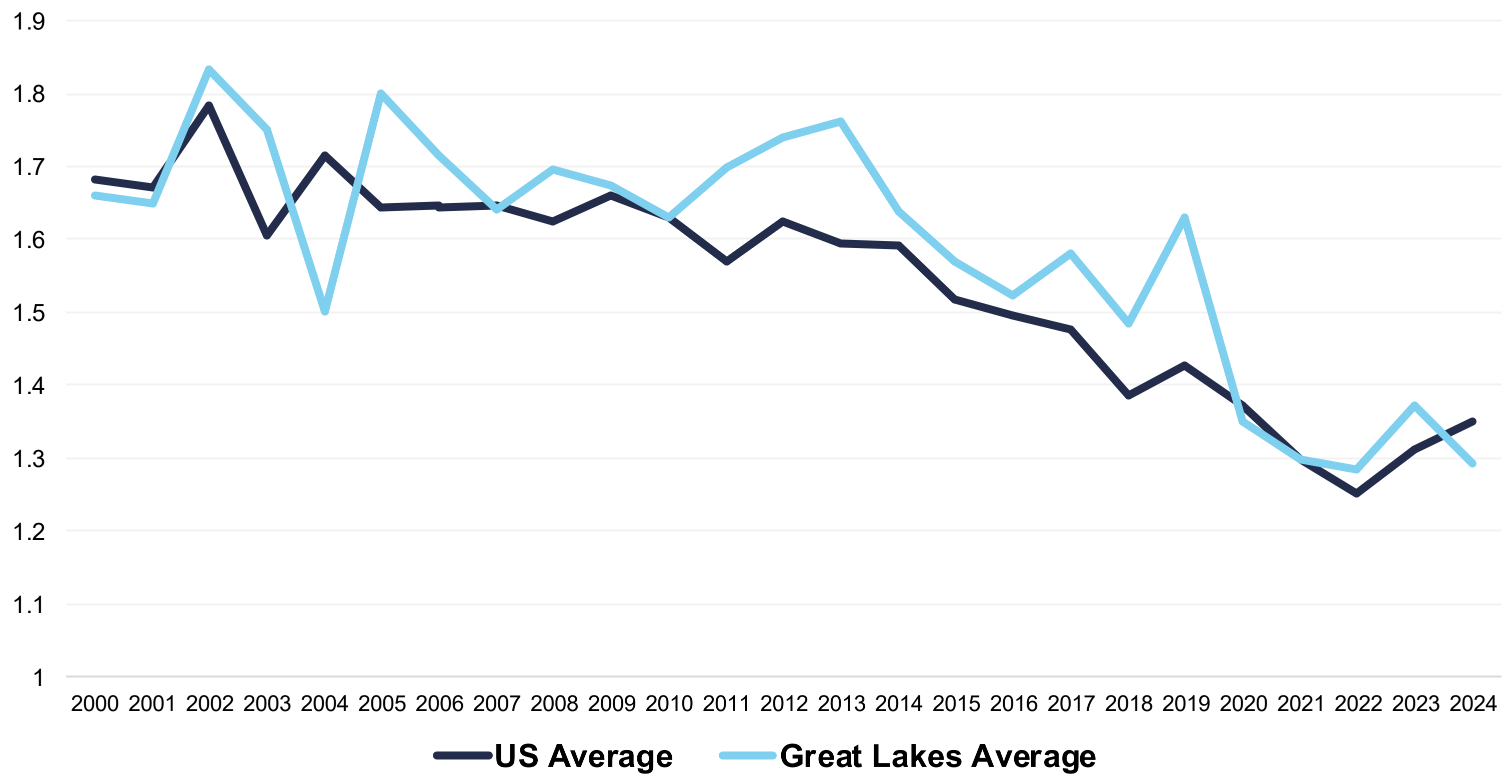
Existing and Planned UPS Power (GW) of Data Centers

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 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.

Energy Scenarios and Preliminary Results

Improving energy efficiency across time



Average Power Usage Effectiveness in the US and Great Lakes across time

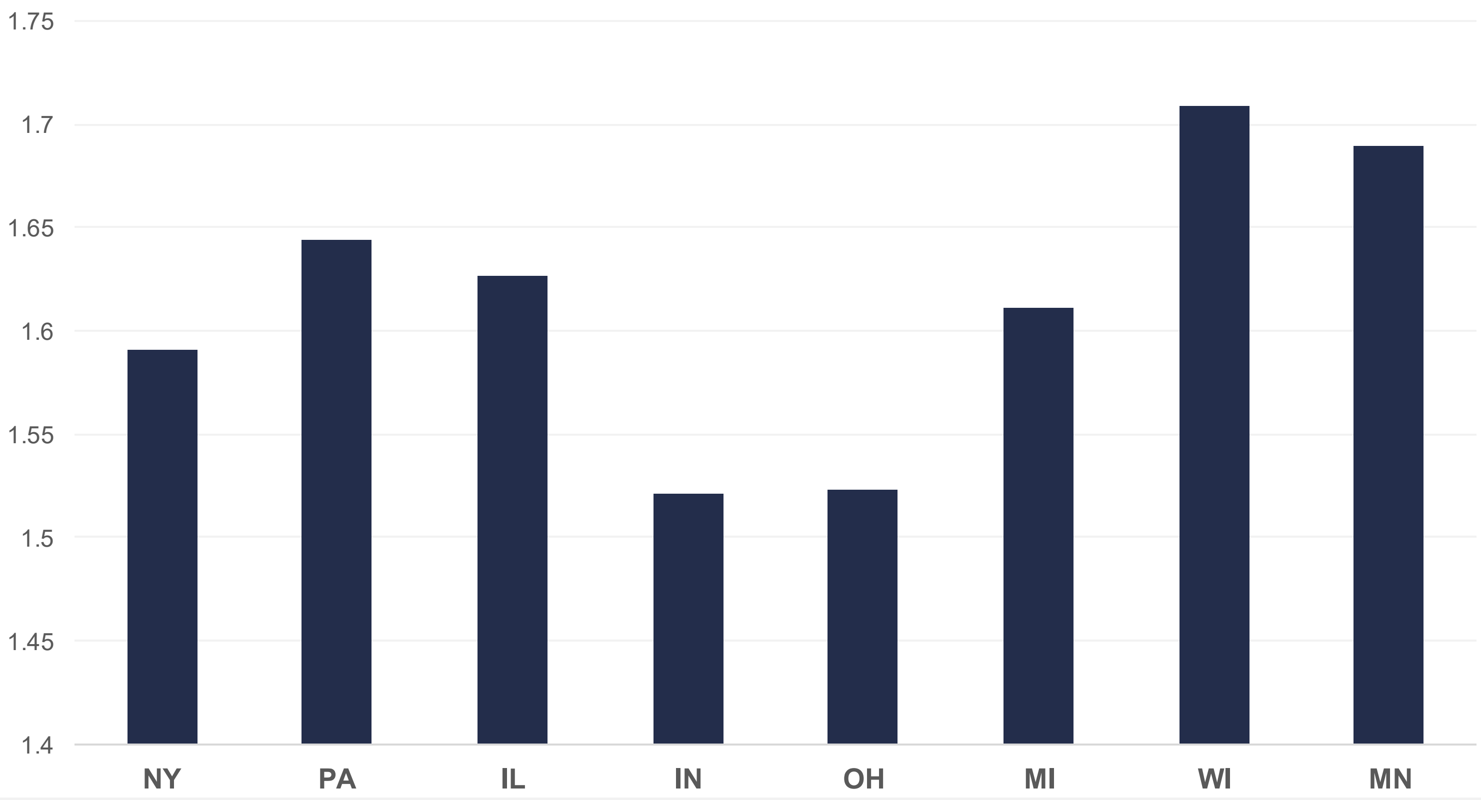
Key trend: Steady decline in average PUE

This indicates that 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.

Data Centers in the Great Lakes - Efficiency

Homogenous Energy Efficiency across States



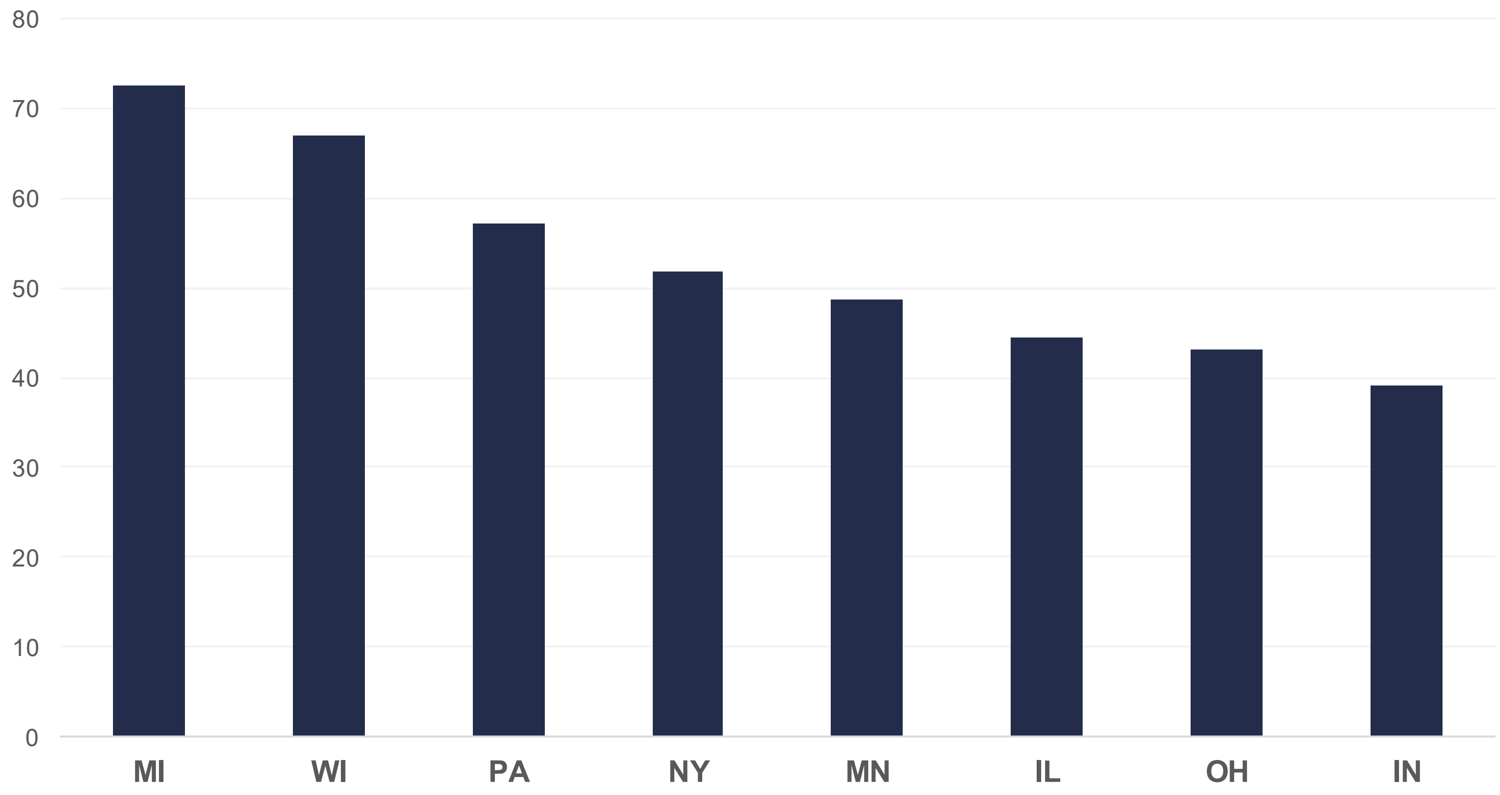
Average PUE by State

Average PUE appears relatively uniform
(typically ranging - 1.5 and 1.7).

This suggests GL data centers operate with comparable energy efficiency levels—likely due to shared industry standards and technologies.

Data Centers in the Great Lakes – Energy Demand

How Fully Utilized Are DCs



Average UPS Power Utilization (%) of Data Centers by State

- States vary in types and ages of their data centers and in how much of their **existing capacity is being used**.
- Utilization rates range widely—from 72% in Michigan to just 39% in Indiana.
- Understanding current utilization levels is essential when projecting future electricity demand and planning for infrastructure upgrades.

Moving from energy capacity to energy use

What we know…

- Total **energy capacity** and **size** of future data centers
- Total **energy demand** for data centers in Virginia (historical data)
- New data centers are not yet at capacity, but will reach their **maximum capacity more quickly than previous data centers did**
- AI training data centers are running closer to full capacity, with a **higher load factor**

Moving from energy capacity to energy use

What we know…

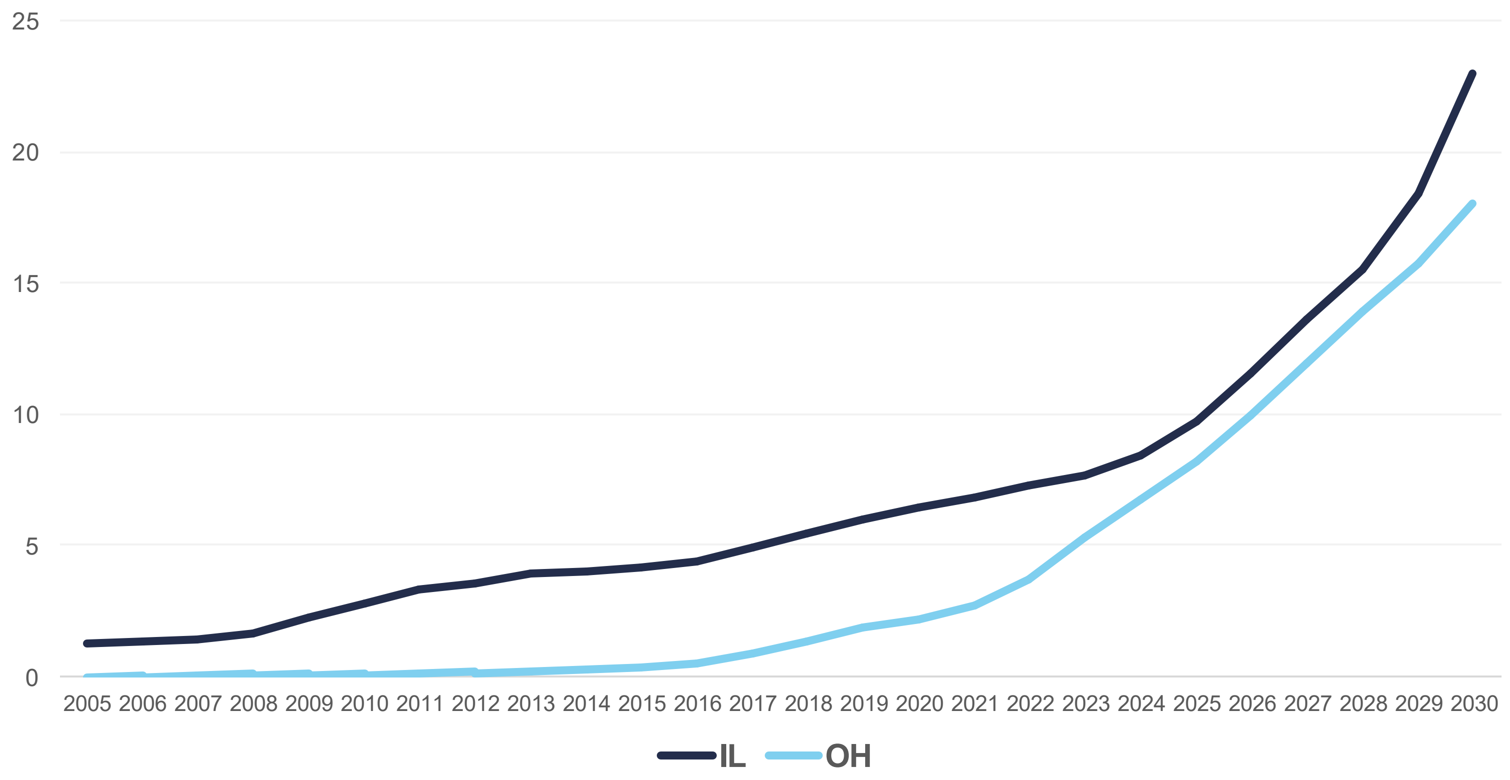
- Evolution of Power Use Effectiveness is important, but not enough to influence energy growth
- **The load factor for data centers within a region (VA as an example)**

What we don't know…

- The cooling technology of each data center
- If new technologies will emerge and substantially reduce DC energy consumption
- How the water vs. energy nexus will evolve in the future

Data Centers in the Great Lakes - Efficiency

Energy use – IL and OH



Data Center Energy Demand (TWh) – Illinois and Ohio

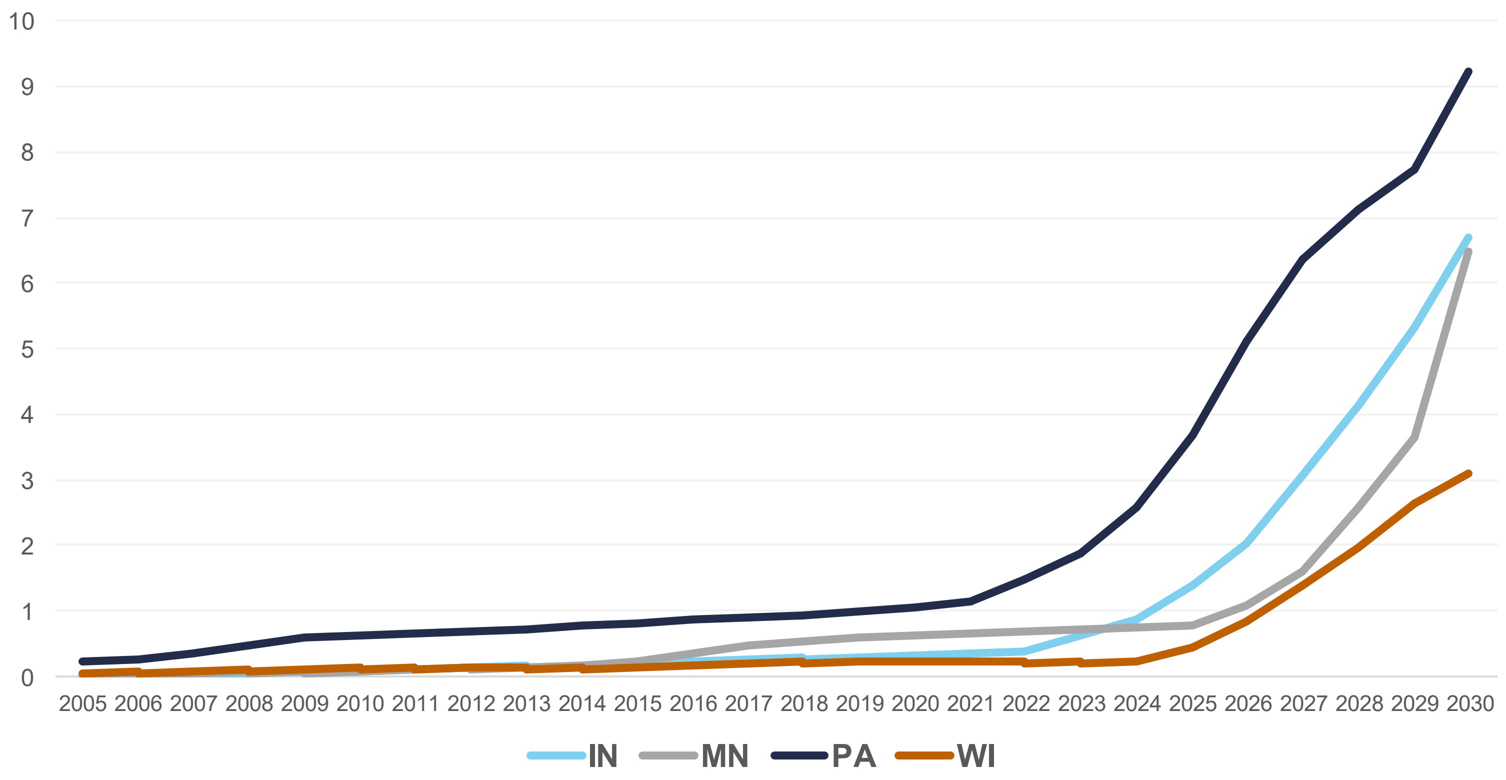
Illinois and Ohio are the most extreme cases in terms of increased energy demand.

The amount of energy data centers will use in Illinois in 2029 is equal to the output of the largest nuclear power plant.

In Ohio, the largest coal plant produces 13 TWh.

Data Centers in the Great Lakes - Efficiency

Energy use – MN, IN, PA, WI



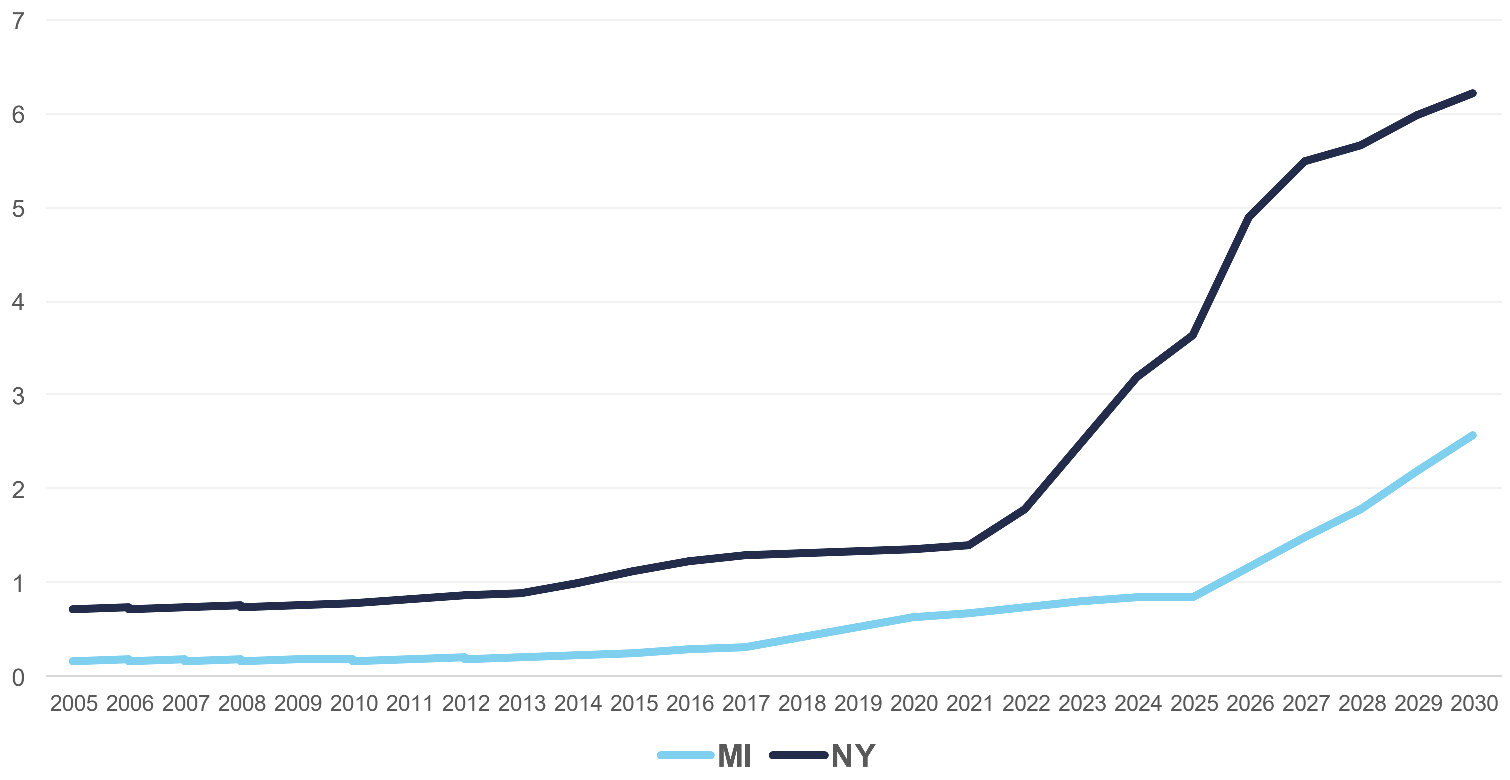
Data Center Energy Demand (TWh) – Minnesota, Indiana, Pennsylvania and Wisconsin

However, other states are also observing a sharp increase, but at lower levels.

In Indiana, the largest coal power plant produces 12 TWh per year.

In Minnesota, the largest coal power plant produced 10 TWh in 2021, but since then has been declining.

Energy use – MI, NY



Data Center Energy Demand (TWh) – New York and Michigan

Michigan and New York were underrepresented in future data center locations

Our analysis shows that these states will not experience exponential growth like other states.

While expected growth in MI is currently flat, this is expected to change as new regulations and tax exemptions are approved

Energy Forecast

Operating facilities

We use known, average rates of capacity utilization to estimate a facility's capacity

Future Facilities

We use estimates of deployment speed and the likely average capacity to calculate the likely electricity use

For consistency...

and because actual energy use at the facility level is not known, we use the same technique for estimating past energy use as we do for future use

Energy Forecast

General trend specifications

Electricity use by data centers - very low association with economic factors

Option: Not to use any external economic

predictor variables, since none show any clear connection to data center deployment.

Short run growth rates

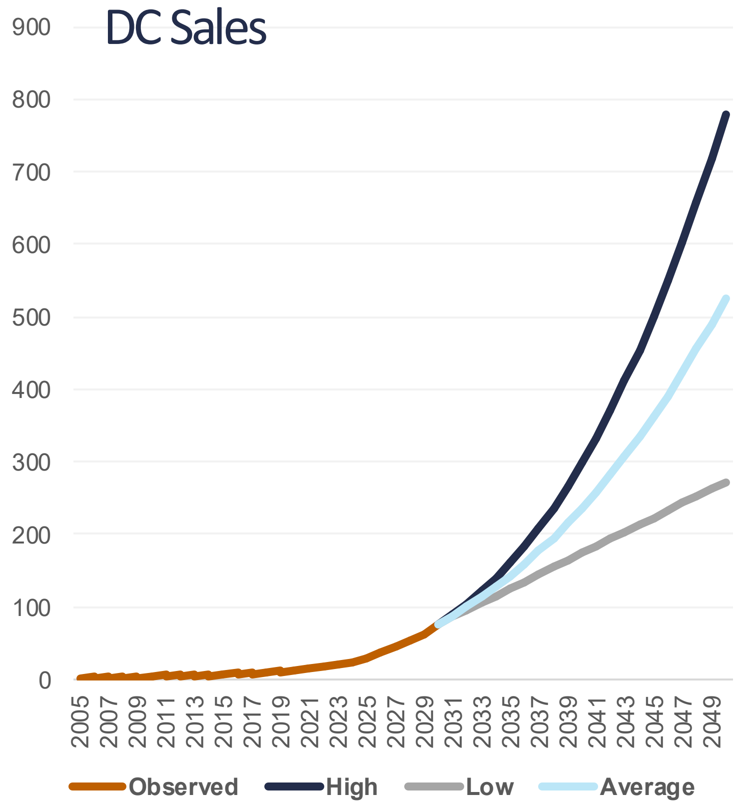
Constrained by the availability of computer chips, the availability of electricity generation and transmission capacity.

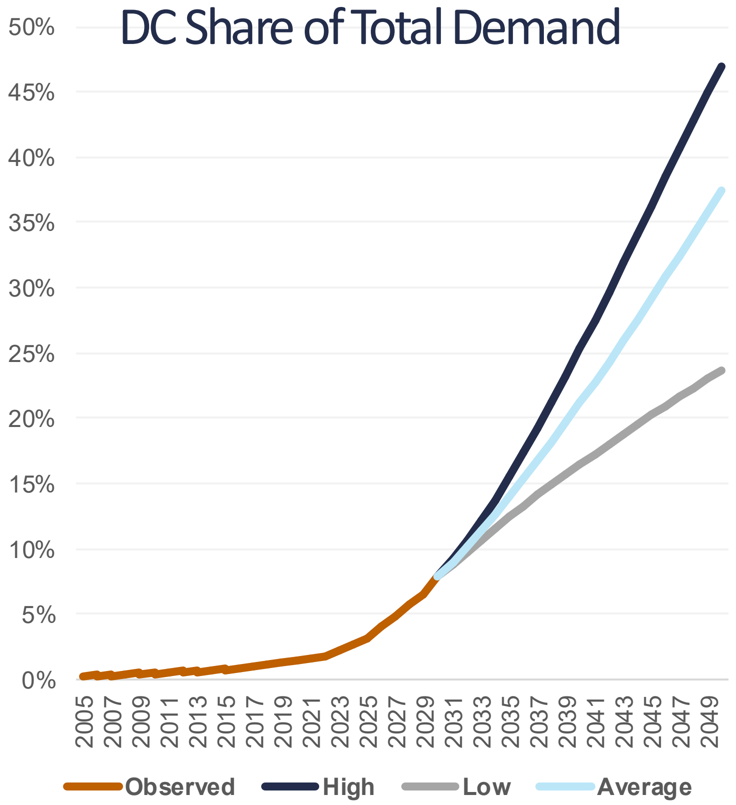
Generating distinct scenarios - time varying parameters

have relaxed the commonly applied statistical assumption that the estimated relationship between the forecast quantity and its predictor variables is constant over time.

Data Centers in the Great Lakes

Great Lakes energy forecast





GL data centers regional electricity sales (TWh), and share of total regional energy demand

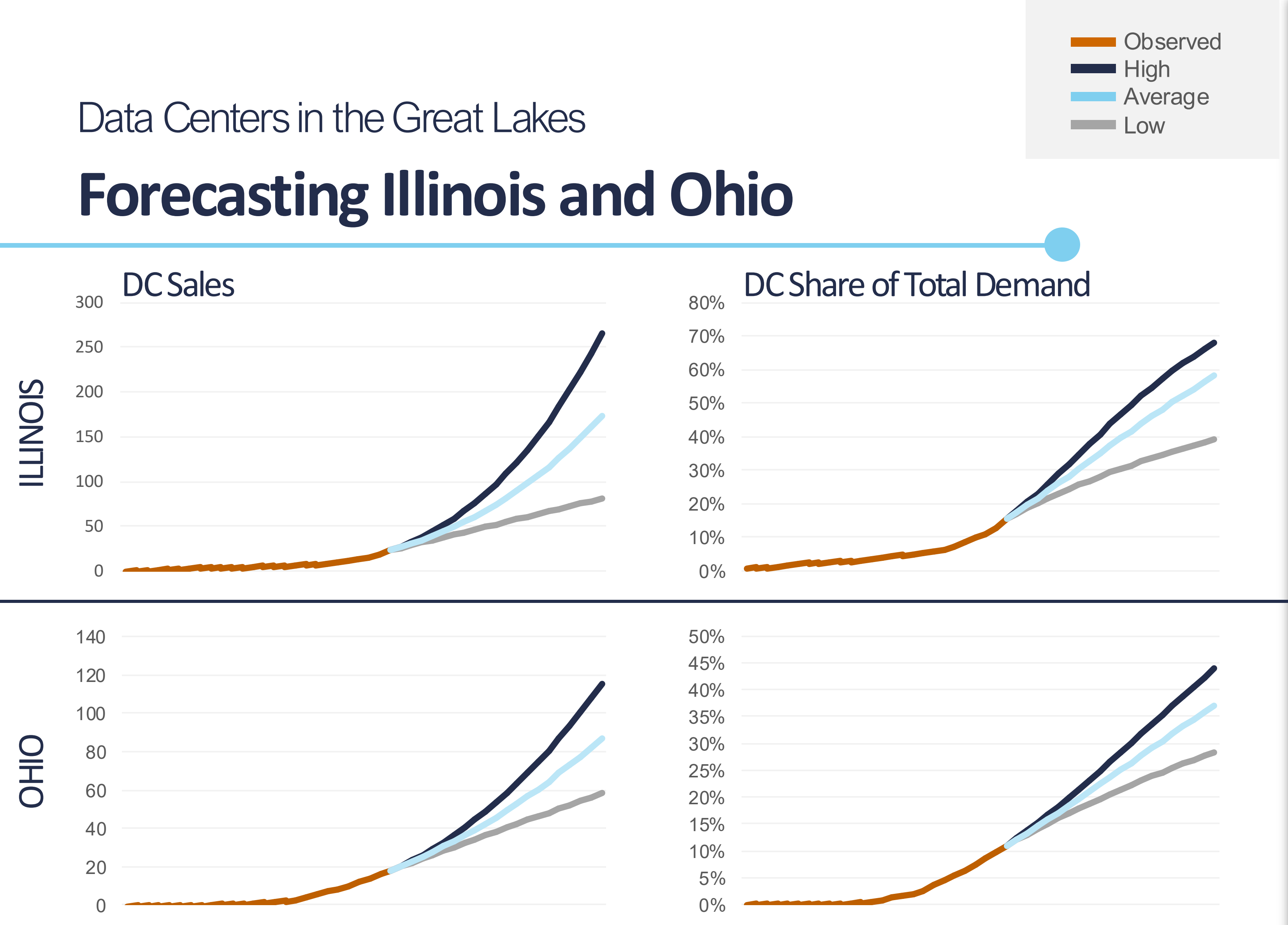
By the conservative estimate, data centers will have:

- In 2040, 17% of the all electricity sales
- In 2050, 24% of the electricity sales

- **Low scenario** Worse fit to the historical data, so it must be interpreted as a conservative estimate

- **High scenario** Best fit historical data. Seems unlikely given the pressure it would put on the grid

Forecasting Illinois and Ohio



Illinois and Ohio DC sales (TWh) and share of the state total energy demand

Illinois is the number one state in terms of TWh growth

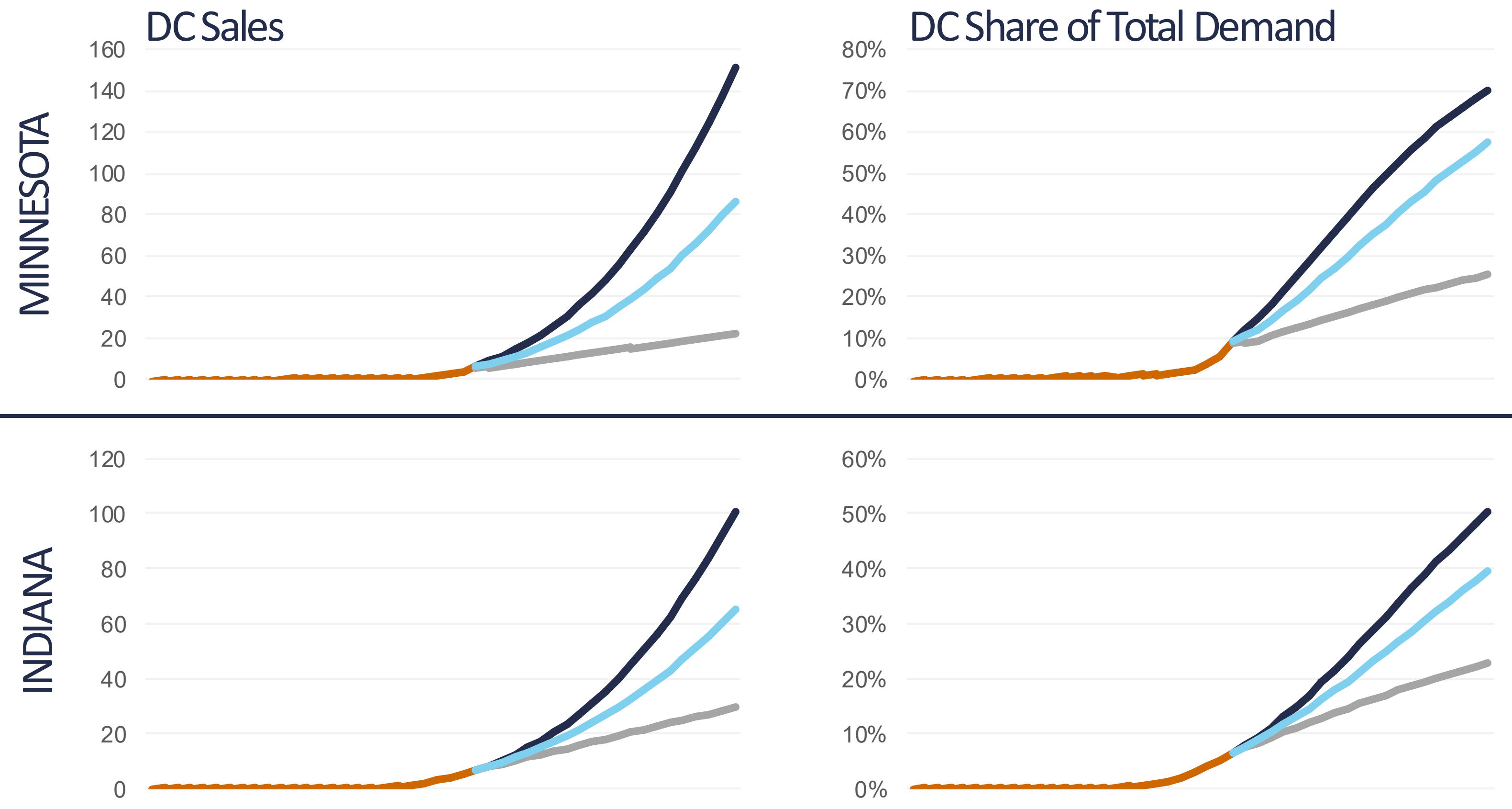
- **Low scenario**
  In the low-growth scenario DCs will represent 55 TWh and 30% of demand in 2040. In 2050, 40% of the total demand.

Ohio is the second-largest state in TWh growth, but the rate of growth is expected to slow

- **Low scenario**
  DC will represent 45 TWh and meet 20% of energy demand by 2040 and 30% by 2050

Data Centers in the Great Lakes - Efficiency

Forecasting Minnesota and Indiana



Minnesota and Indiana DC sales a (TWh) and share of the state total energy demand

Expected growth in MN highlights the need for regional planning

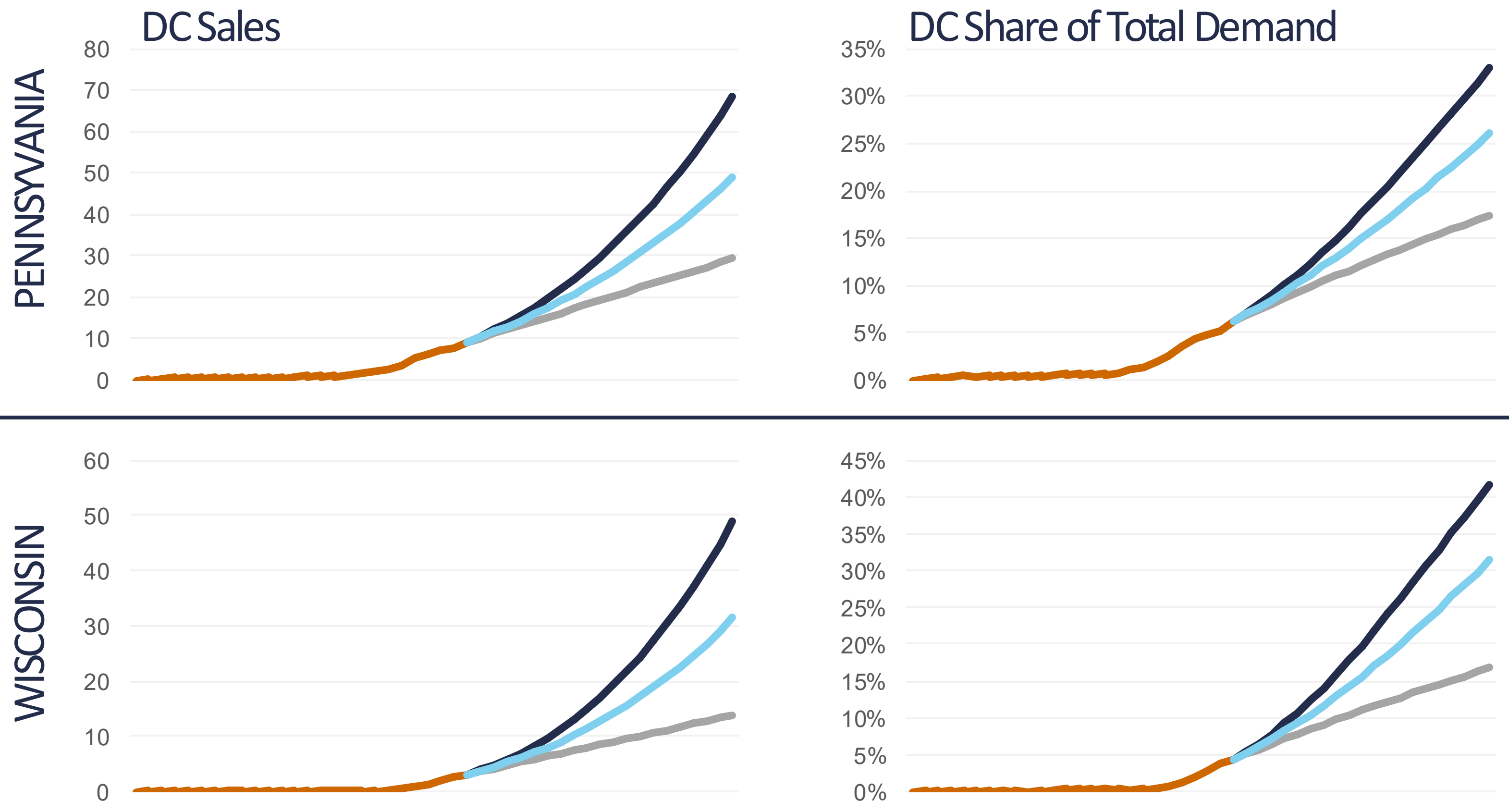
- **Average scenario:** DC will represent 40 TWh in 2040 and account for 35% of total energy. This number is expected to grow to 55% by 2050

Indiana's growth is slower, albeit current usage already exceeds MN

- **Average scenario:** By 2040, DCs represent 27 TWh and 21% of total demand

Data Centers in the Great Lakes - Efficiency

Forecasting Pennsylvania and Wisconsin



Pennsylvania and Wisconsin DC Sales (TWh) and share of the state total energy demand

Pennsylvania has more DCs, but a moderate growth curve

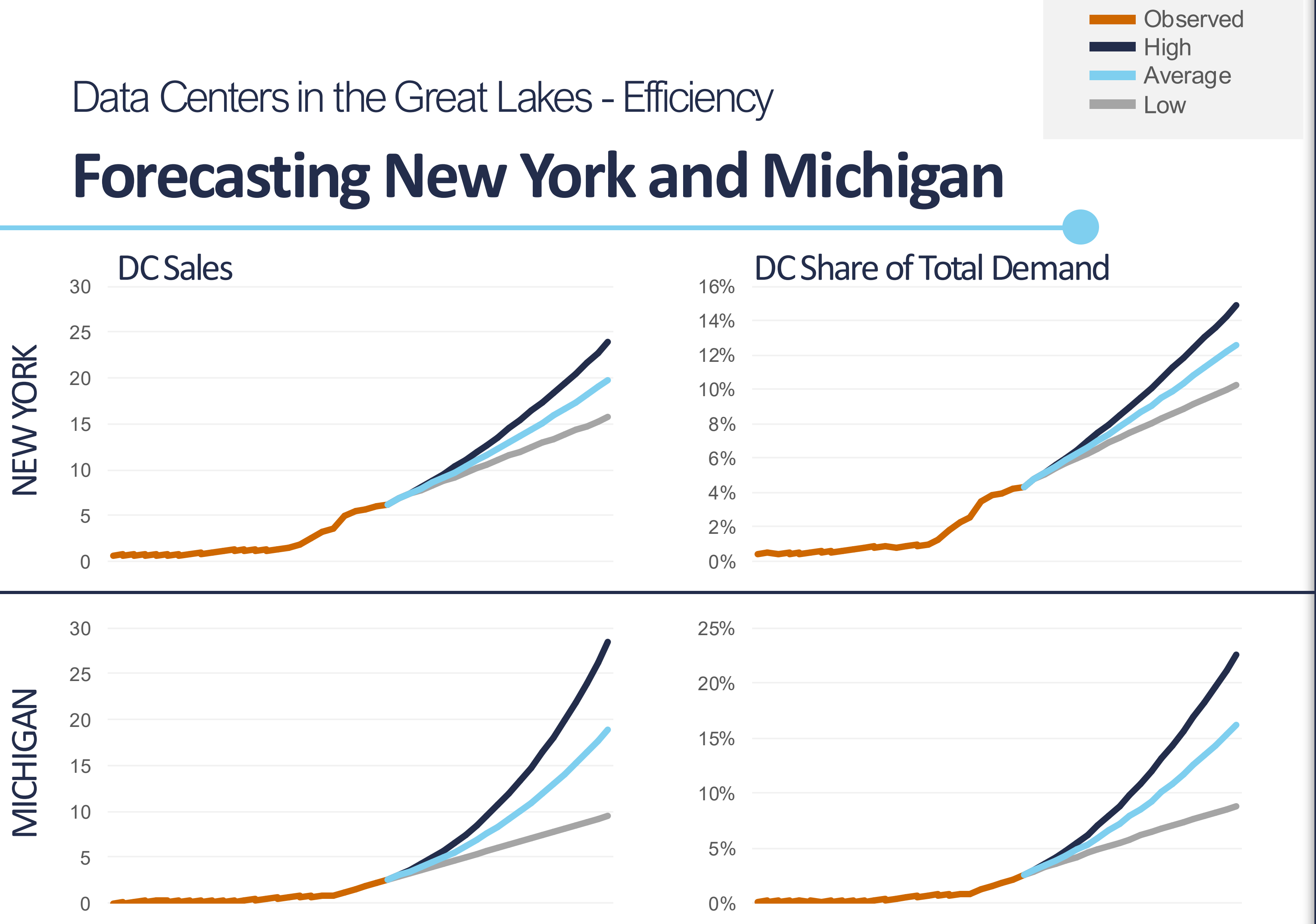
- **Average scenario**
  In 2040, data centers will use 24.5 TWh, representing 15% of total electricity demand

Wisconsin

- **Average scenario**
  DC will represent 13 TWh, or 15% of total electricity demand in the state

Data Centers in the Great Lakes - Efficiency

Forecasting New York and Michigan



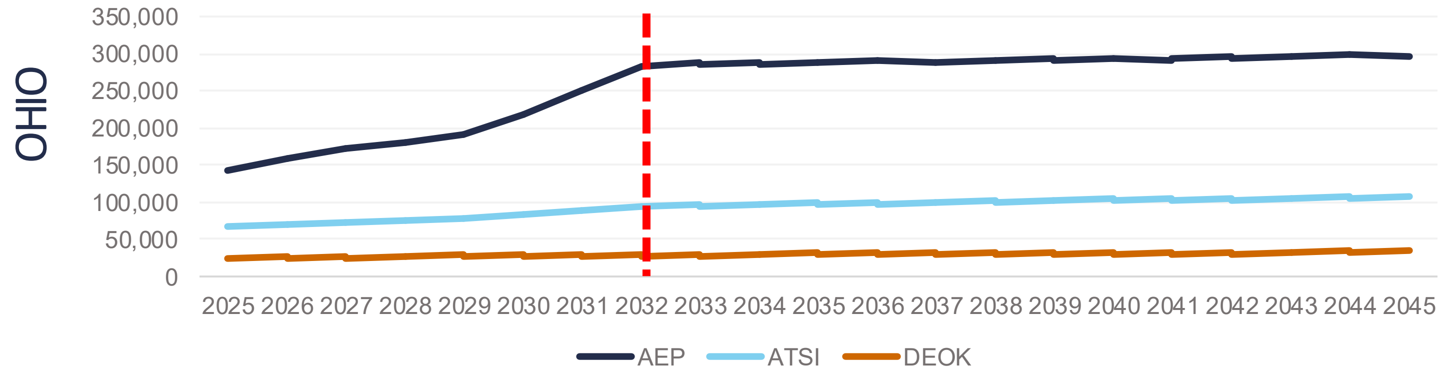
Michigan and New York DC Sales (TWh) and share of the state total energy demand

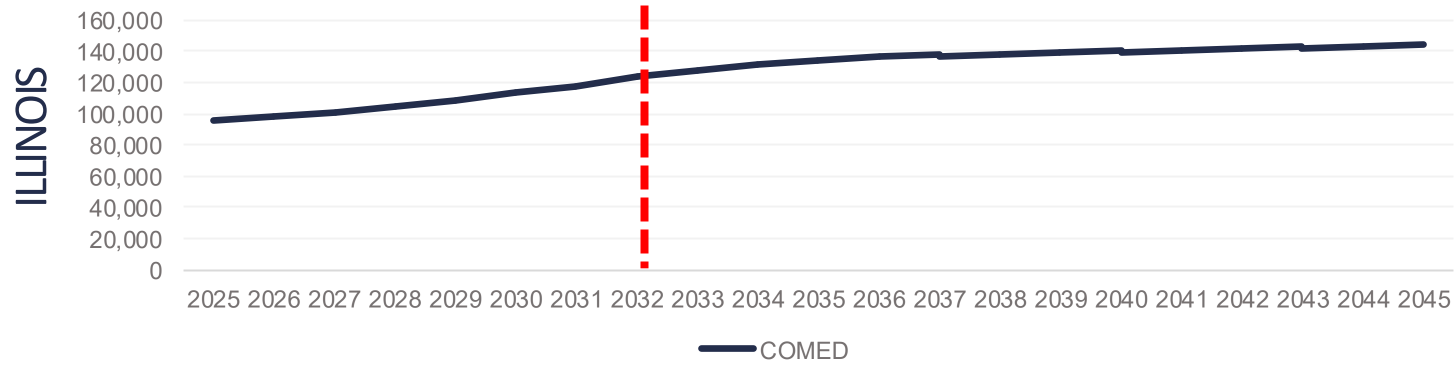
New York and Michigan's growth trajectories are less sharp than other states

- New York has the smallest relative growth, with data centers representing 8% in 2040 and 12% in 2050
- Michigan is expected to see a growth increase in the next years, reaching 8 TWh by 2040 and representing 8% of the total demand

Data Centers in the Great Lakes - Forecasting

The RTO's Forecasts





Forecasts for MISO, NYISO and PJM

- **MISO forecast**
  Anticipates a significant increase in installed energy capacity from 2024 through 2043.
- **NYISO forecast**
  Current peak usage is around 31,288 MW, but outlook varies depending on the scenario.
- **PJM forecasts**
  Substantial variation across states and utility zones, but a plateau after 2033.

Economic Impacts of Data Centers

Data Source and Methodology

Two types of economic impacts of data centers

Capital expenditures (short-term)

- Construction – approximately 20% of all capital expenditures
- IT – approximately 70% of total expenditures
- Land acquisition (not included in an economic impact analysis)

Operational expenditures (long-term)

- Inputs (electricity, cables, maintenance) and labor expenditures.
- 40% of the inputs are energy expenditures
- Labor expenditures represent 15% of the total output of a data center.

Data Source and Methodology

Other considerations

Capital Expenditures

- Construction happens locally
- IT equipment is usually bought outside the region and even outside the country
- Only 25% of the IT equipment is considered to come from the region.

Operational Expenditures

- Annual average wage in Virginia was ≈ $95k / year
- Large variation according to different types of data centers.

Data Source and Methodology

IMPLAN

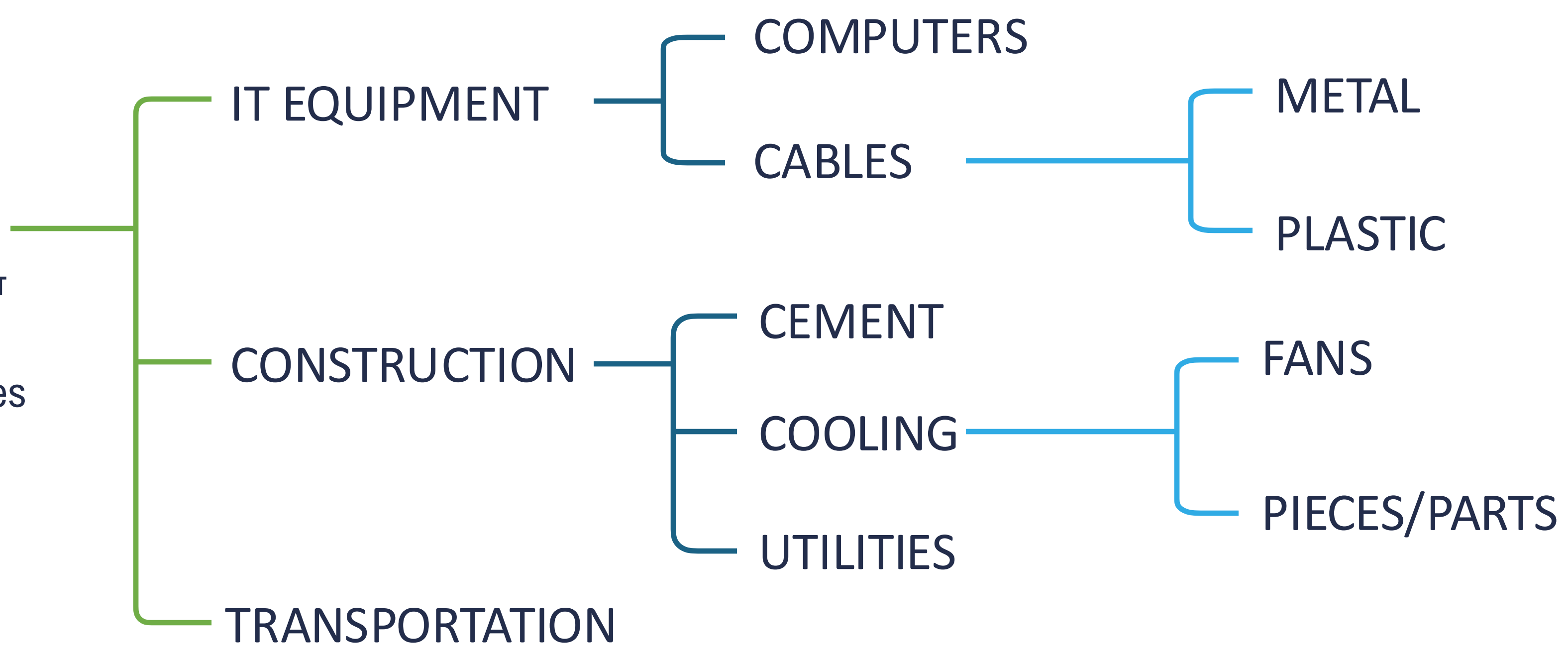
- Multi-regional input-output and state-level models to assess the economic impacts.
- Capital expenditures:
  - Current: average of 2022 to 2024.
  - Future: average of 2025 to 2029.
- Operational expenditures, according to sq ft distribution
  - Current: operational sq ft in 2024
  - Future: operational sq ft in 2024 + planned and under construction sq ft until 2029.
- Allows for the estimation of the direct, indirect, and induced effects.

Data Source and Methodology - INDIRECT

DATA CENTERS

INDIRECT EFFECTS OF DATA CENTERS AT THE REGIONAL LEVEL

The **Indirect Effect** captures the supply-chain intersectoral linkages that happen due to multiple rounds of effects.



DIRECT IMPACT

EXPENDITURES (ROUND 1)

EXPENDITURES (ROUND 2)

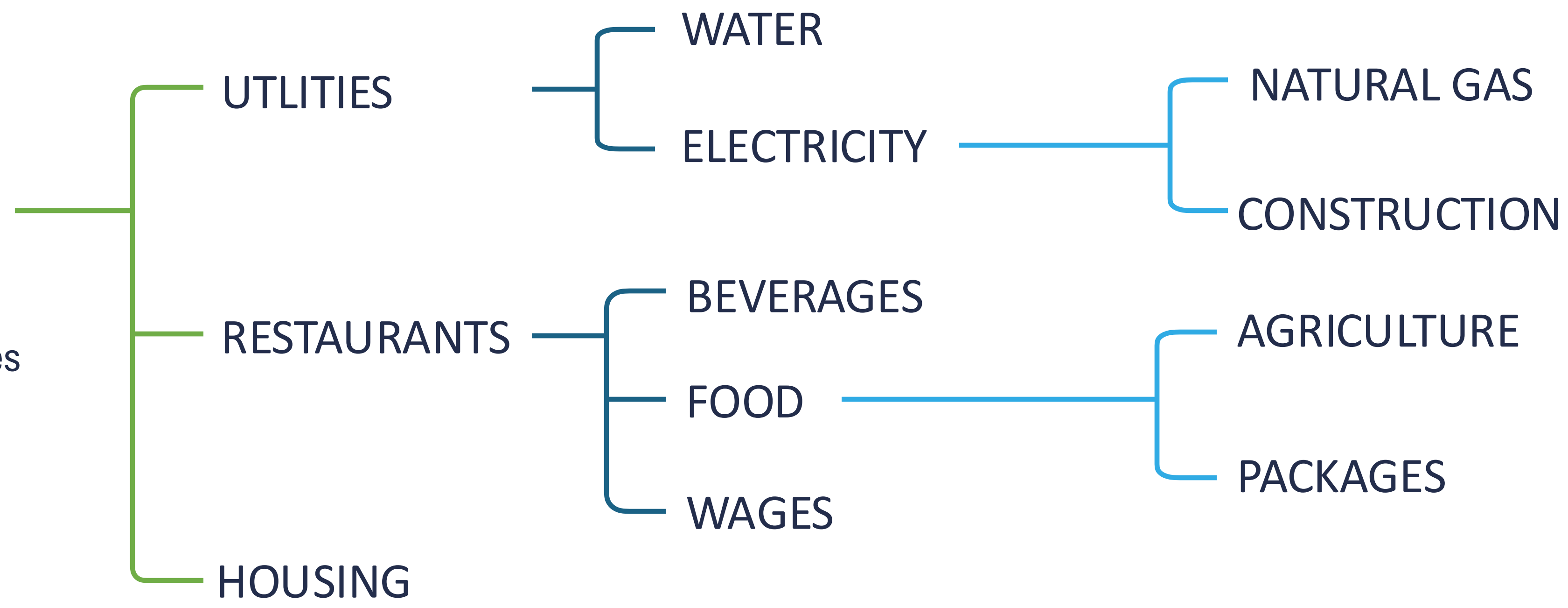
EXPENDITURES (ROUND 3)

Data Source and Methodology - INDUCED

WAGES

INDUCED EFFECTS OF DATA CENTERS AT THE REGIONAL LEVEL

The **Induced Effect** captures the effects associated with changes in household income due to increases in wages and profits.



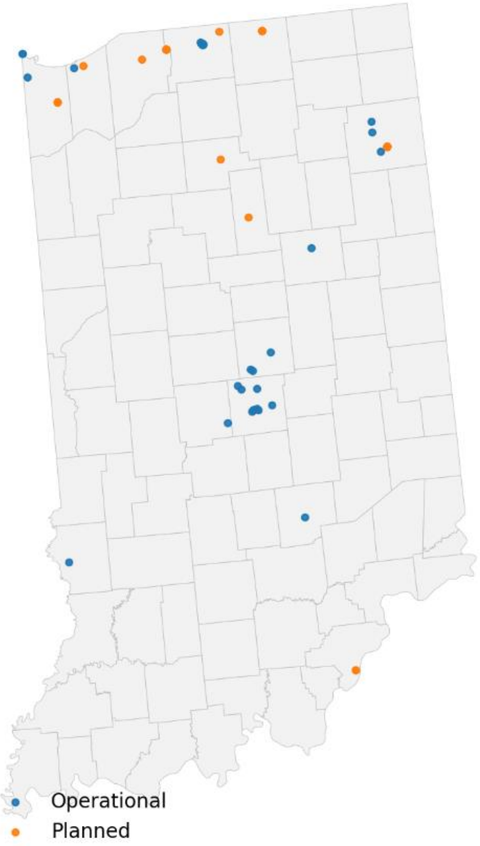
DIRECT IMPACT

EXPENDITURES (ROUND 1)

EXPENDITURES (ROUND 2)

EXPENDITURES (ROUND 3)

Data Source and Methodology – MULTI-REGIONAL



When a data center locates in Indiana

DIRECT IMPACT - The effect of locating the data center in the region

INDIRECT IMPACT – The shock in the supply chain in the region

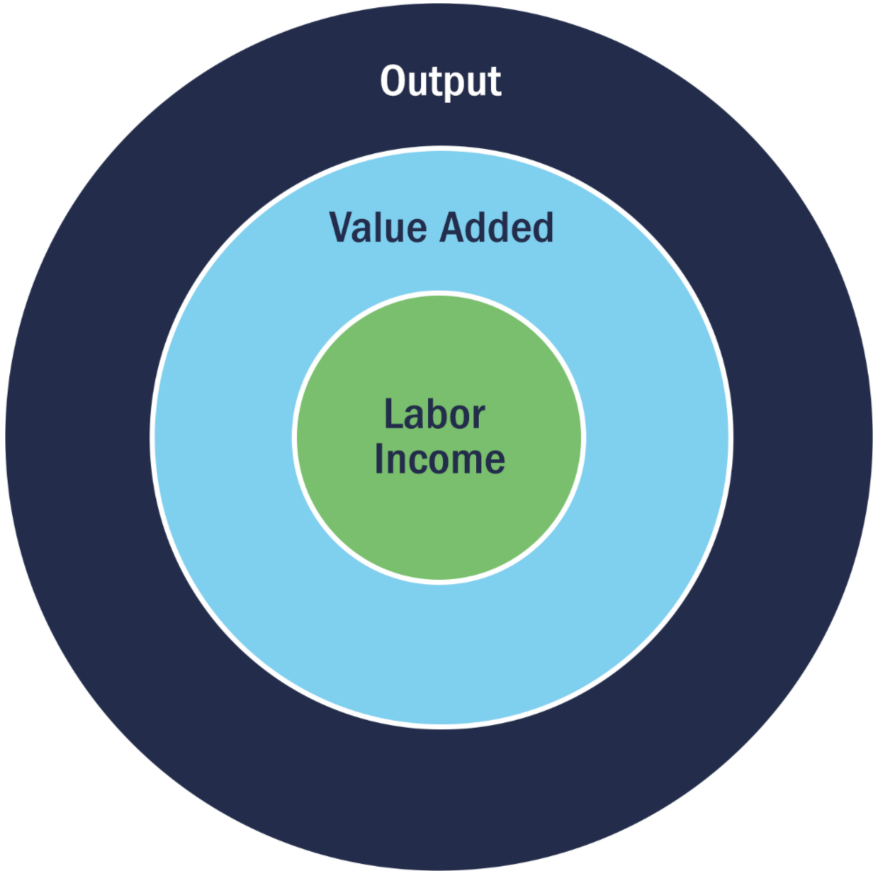
INDUCED IMPACT – The shock of the increase in income in the region

INTER-REGIONAL SHOCK - The indirect and induced effects of Indiana will also be felt in other state economies. And...

The economy of Indiana will also benefit from the indirect and induced effects associated with data centers locating in other regions.

Data Source and Methodology – ECONOMIC METRICS

- **Employment**
  Person-year of full-time and part-time employment
- **Output**
  Total revenues
- **Value-added**
  Wages + Profits + Taxes
- **Labor Income**
  Value-added component that flows to workers and business owners in the form of employee compensation and proprietary income



Results – Great Lakes

Capital Expenditures (current)				
	Employment	Labor Income (M$)	Value Added ($M)	Output ($M)
Direct	33,459	2,960	4,026	8,720
Indirect	12,012	1,093	1,914	3,732
Induced	17,959	1,144	2,121	3,384
Total	**63,430**	**5,197**	**8,062**	**15,837**

Impacts of Average Annual Capital Expenditures (2022-2024)

- **63k jobs** associated with construction per year.
- **$15.8B** is the impact of revenues associated with capital expenditures.
- **$8.1B** as the annual GDP contribution of construction.

	Annual Taxes ($M)
County	312
State	316
Federal	1,156

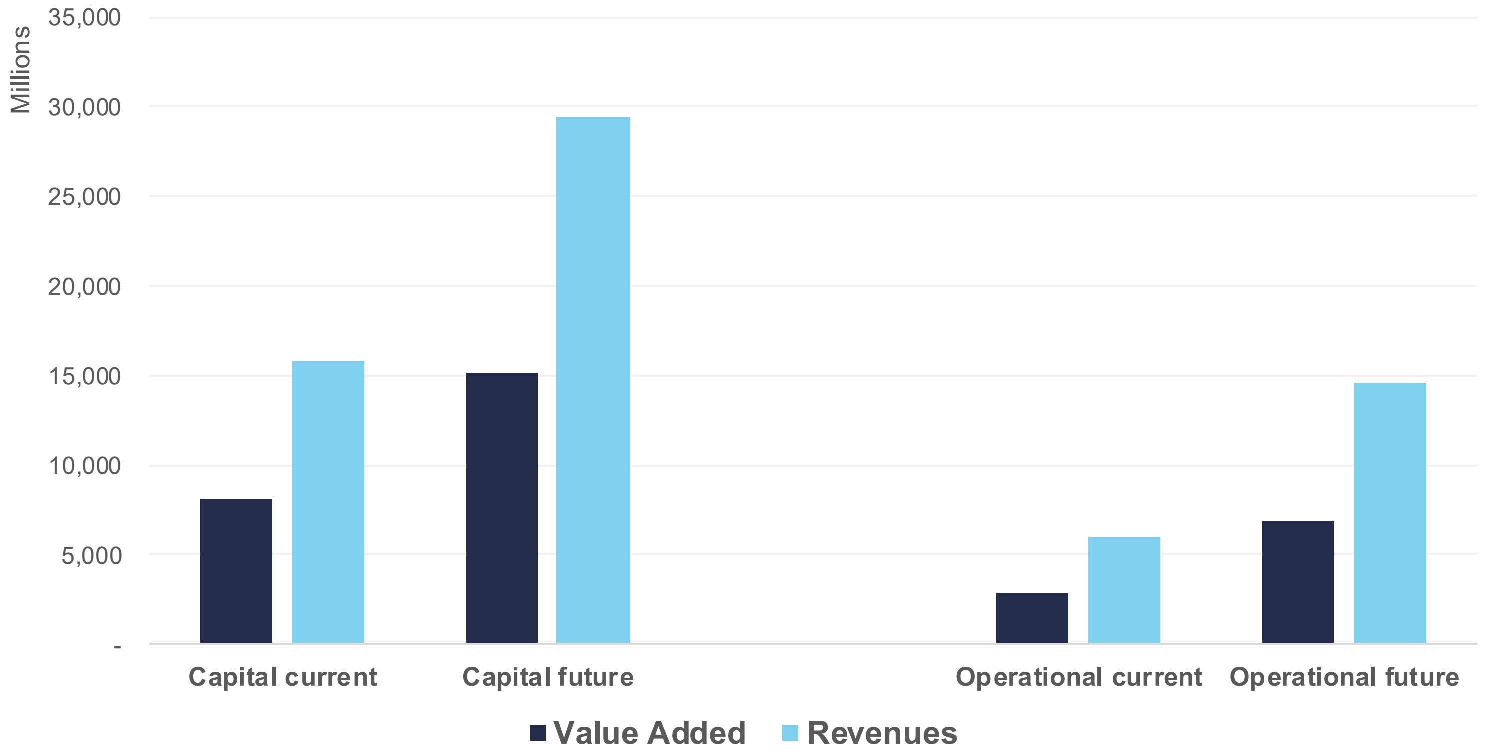
Results – Great Lakes

Operational Expenditures				
	Employment	Labor Income (M$)	Value Added ($M)	Output ($M)
Direct	4,356	407	997	2,710
Indirect	6,646	636	1,291	2,362
Induced	4,538	296	548	868
Total	**15,540**	**1,339**	**2,837**	**5,940**

Impacts of Average Annual Operational Expenditures (2024)

- **15.5K jobs** associated with data centers' operation and construction.
- **In every five jobs generated,** four are associated with construction and one with operations.
- **Approximately $300M in local and state taxes.**

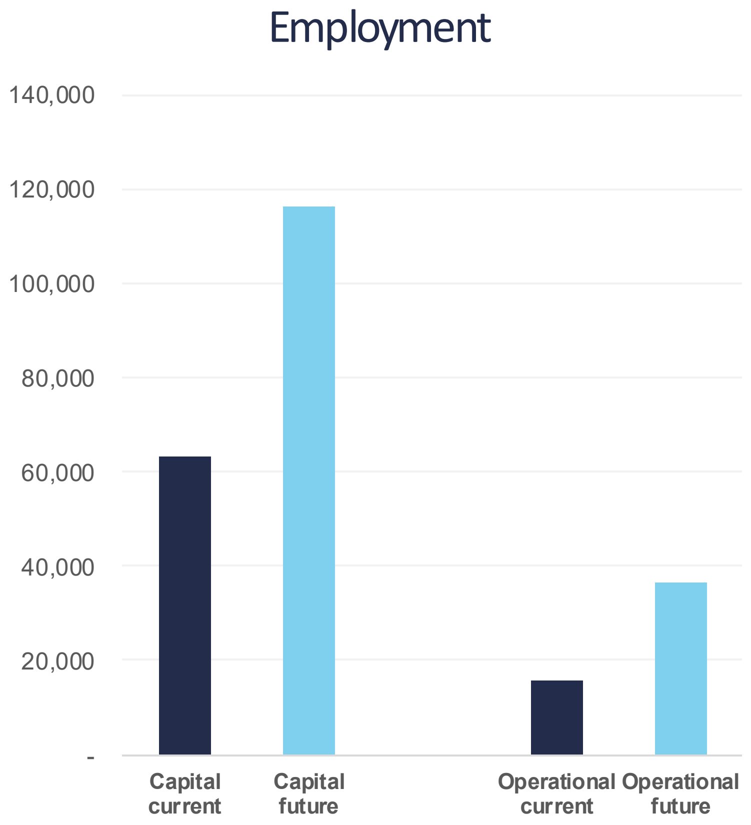
Results – Great Lakes (Current vs. Future)

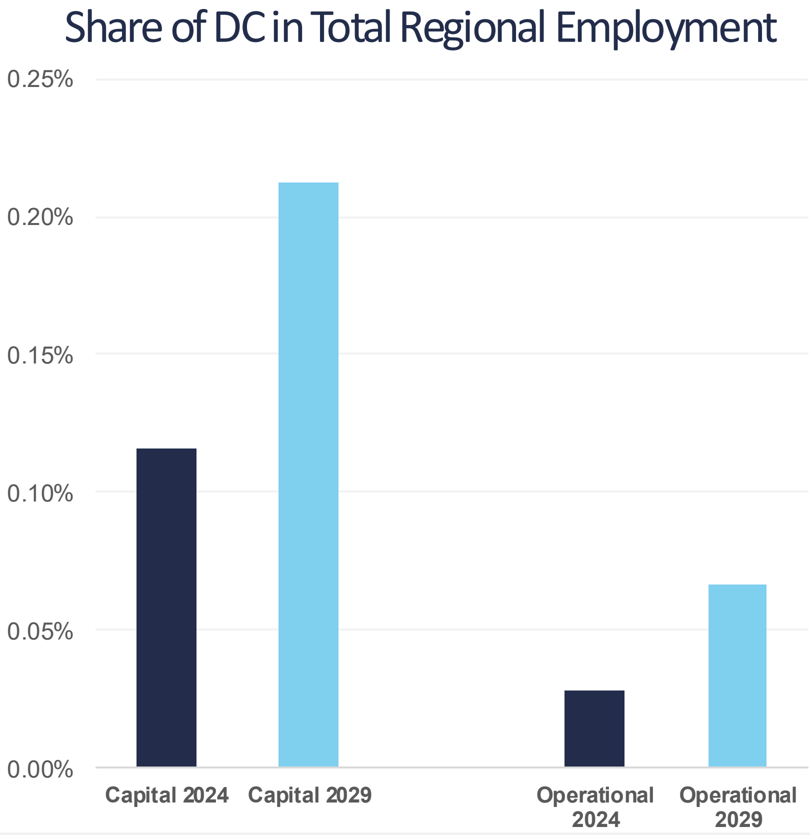


Total value-added and revenues generated in the region (current vs. future)

- Capital impacts are expected to increase 85% by 2029.
- Operational impacts are expected to grow approximately 150% by 2029.

Results – Great Lakes (Current vs. Future)

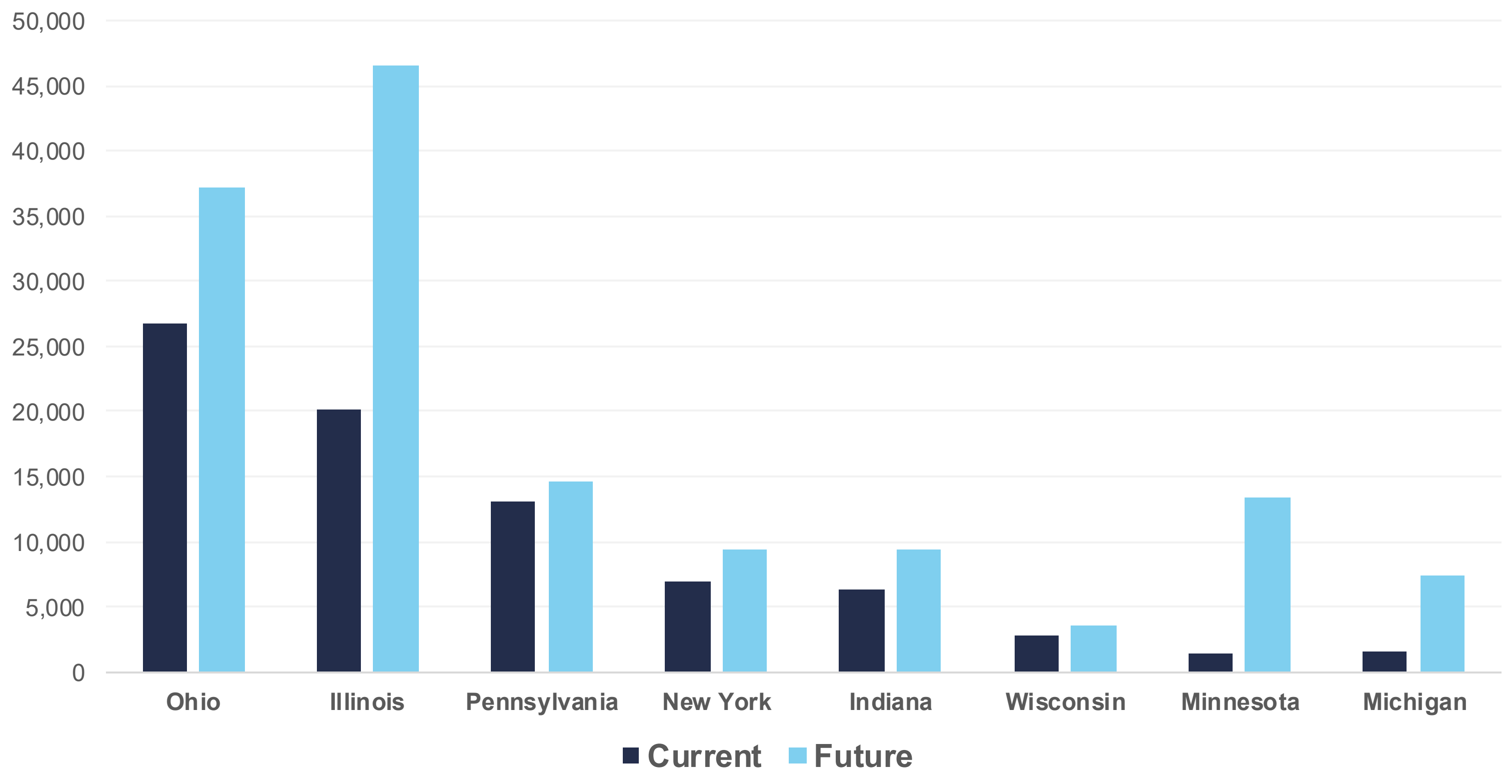




Employment and share of employment associated to data centers in the Great Lakes area

The number of jobs created will represent **less than 0.3% of the jobs in the region** (0.21% due to capital expenditures and 0.07% due to operational activity).

Total employment – State impacts



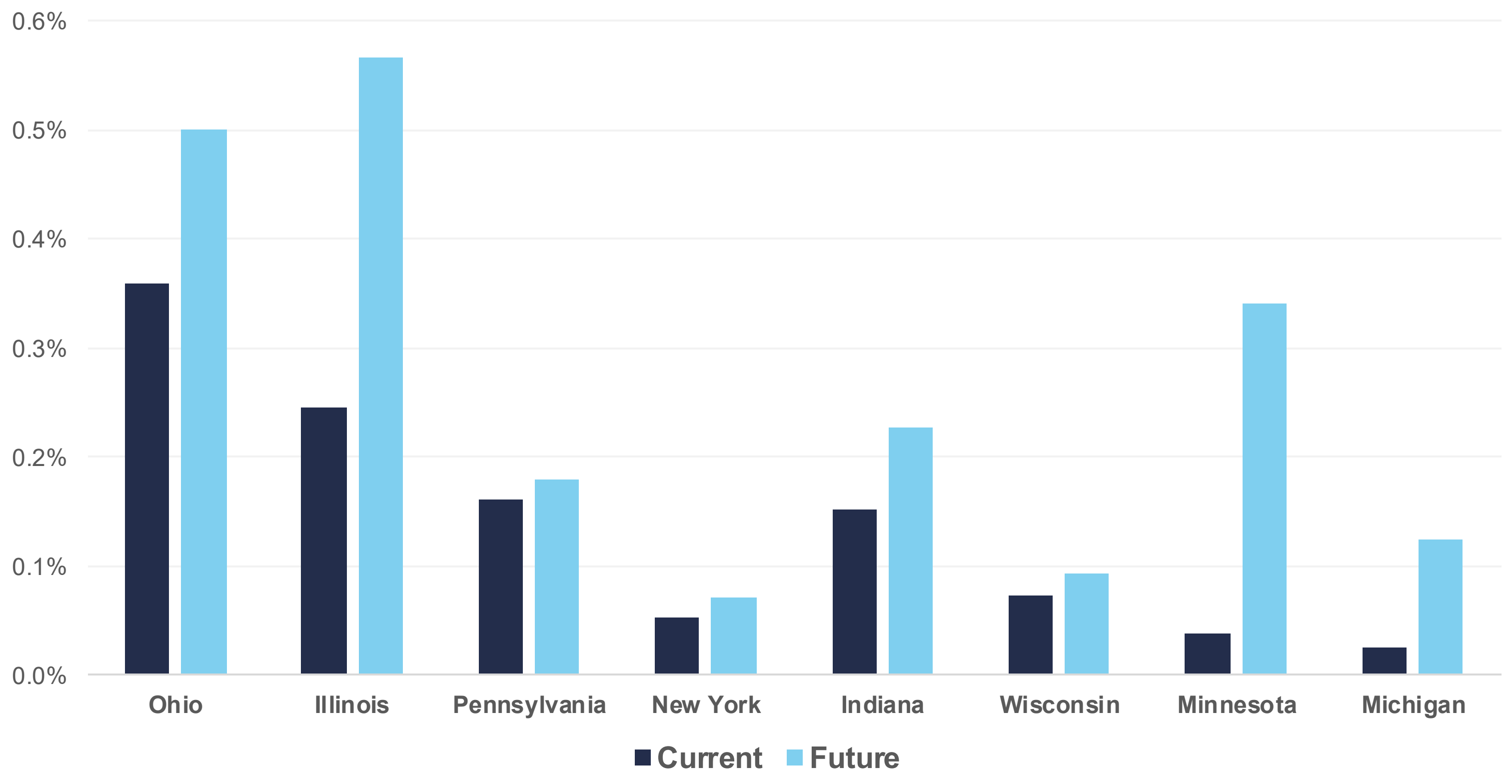
Total Employment (current vs. future)

Comparing current and future impacts, all states show an increase in employment contribution of data centers.

Impact on state employment:

- **45k jobs** in Illinois, multiplying by more than 2.5x the current footprint.
- **More than 25K** jobs in Ohio.
- **Minnesota and Michigan** will observe high relative increases when compared to other states.
- **New York, Indiana, and Wisconsin** will have fewer than 10K jobs allocated to Data Centers.

Share of employment – State impacts

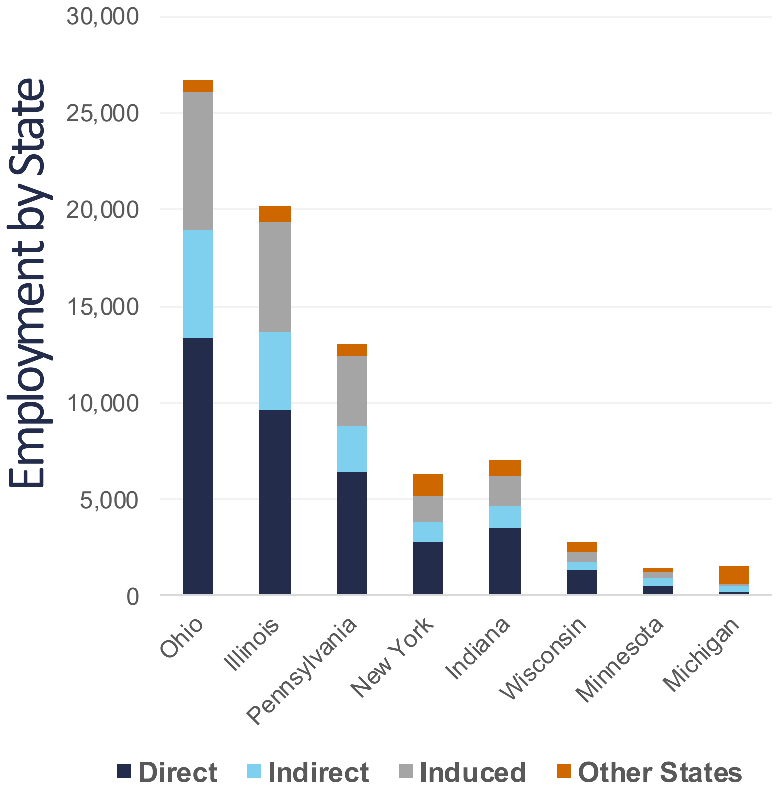


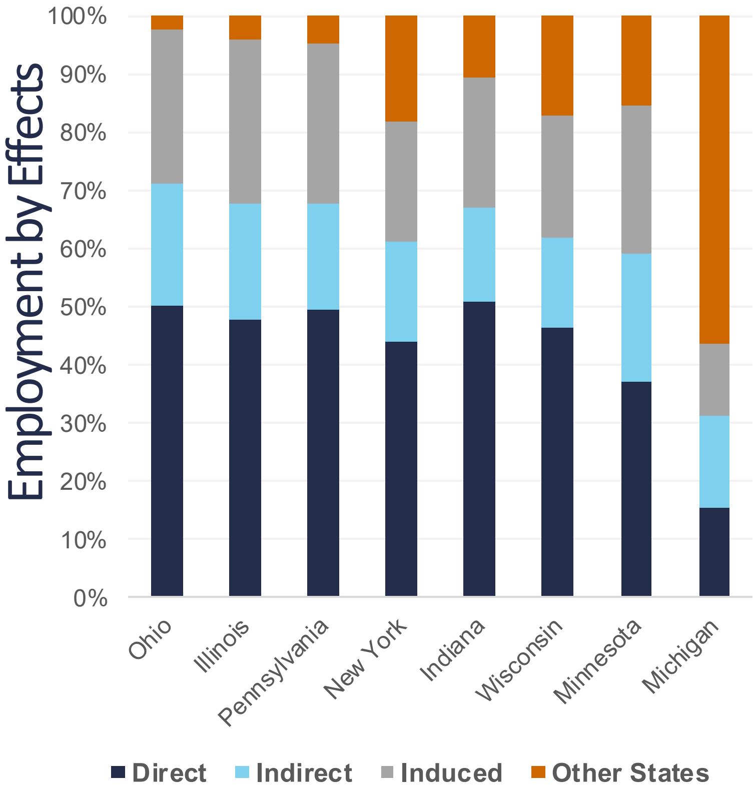
Share of the state total employment (current vs. future)

Impact on state employment continued:

- **In Illinois and Ohio,** data centers will represent more than 0.5% of the total employment (when accounting for capital and operational expenditures).
- **In Wisconsin and New York,** this value is expected to persist below 0.1% even in 2029.
- **In Minnesota,** the share of employment will increase up to 0.3% of the state economy.

Deconstructing these impacts





Total impact in employment (current) and relative decomposition

Deconstructing the four different effects that contribute to the current economic footprint:

- **The direct effects** depend on the number of data centers being built and operating
- **The indirect effects** depend on the supply chain and **the induced effects** of the income distribution
- **In Michigan and New York,** it is interesting to see the share of activity associated with the provision of inputs to other states.

Summary and Policy Impacts

Locational Aspects

Strategic Location Drivers

Most data centers are sited where there is access to high-capacity fiber-optic infrastructure (ensuring low latency and redundancy), proximity to transmission lines, and abundant water resources for cooling purposes.

Reinforcing planning is needed

The continued clustering of data centers in cities may intensify infrastructure strain (particularly water aspects), real estate competition, and affordability challenges—particularly in already high-demand markets.

Urban & Peri-Urban Dominance

The vast majority of data centers are located in urban or semi-urban zones. Rural siting remains uncommon.

Fiscal and Policy Considerations

Despite these pressures, data centers are highly capital-intensive and can contribute substantially to local tax bases. *For municipalities and states, they might represent a source of revenue, especially if structured with effective tax policies and infrastructure incentives.*

Energy Impacts and Demand Growth

Rising Demand, New Client Profile

Data centers are a fast-growing, energy-intensive customer segment. Their growth requires ***targeted grid planning*** to avoid transmission bottlenecks, strain in grid capacity, peak stress, and outages

System Stress & Cost Pressure

Without proactive investment, data center demand can strain the energy infrastructure and drive up costs—potentially leading to rate hikes that, given the nature of the electricity market, may disproportionately affect low-income

Rate Design Challenges

Existing rate structures may fail to account for the new fixed and variable costs associated with serving data centers. Utilities must ensure that cost-recovery mechanisms are equitable, avoiding scenarios in which current customers subsidize infrastructure expansion for future large-scale users, especially with potential future uncertainty associated to these clients.

Sustainability Risks

If demand outpaces clean energy deployment, this may delay the retirements of fossil plants and compromise emissions-reduction goals, challenging broader climate commitments.

Economic Challenges

Job Creation Is Limited & Front-Loaded

Most employment occurs during the construction phase and is not negligible. Operational jobs are fewer.

Fiscal Revenues Are at Risk

The primary local benefit is often state and local tax revenue. However, aggressive tax-exemption strategies risk triggering a “race to the bottom” and can erode the most relevant local benefits that data centers can bring to a community.

Benefits Are Geographically Dispersed

While capital-intensive, data centers often create few local jobs. Instead, economic gains might accrue to states and regions supplying machinery and IT equipment for construction, or to those more deeply connected to the tech industry.

Balanced Incentives Are Needed

Part of the economic development strategies of localities and states around the country are focused on the artificial intelligence industry. Retaining local tax contributions is critical to offsetting infrastructure burdens and resource demands. Incentive design must be transparent, equitable, and sustainable.

Other Questions Remain Unanswered

What are the multi-level water impacts?

Data centers may directly withdraw water for cooling (Scope I) or indirectly drive water use through power generation (Scope II). States need to assess these impacts to clearly understand the effects of different cooling systems and to develop better policy frameworks for DCs.

What guidelines are in place to ensure data transparency and risk planning?

Effective infrastructure and environmental planning relies on good public data on energy use, water consumption, tax subsidies, and job creation. Mandatory reporting is essential for accountability and informed policymaking.

Is growth outpacing need?

Rapid expansion fueled by AI and cloud investments raises concerns of overcapacity, potential stranded assets, and infrastructure mismatches. Proactive oversight is needed to prevent volatility and inefficiencies.

Other Questions Remain Unanswered

How will we safeguard air and water resources?

Policy makers need top consider the need to mitigate emissions from backup generators and regulate large water withdrawals, particularly in ecologically sensitive or water-stressed areas.

How do we ensure that incentives align with outcomes?

Tax breaks should be tied to measurable performance—e.g., energy efficiency, emissions control, water conservation, and reliability—to ensure public benefit and grid resilience.

Q&A

Thank you