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Data Center Development & The Need for Power

Oct. 21, 2025

W&J Center for Energy Policy and Management

Is the data center boom:

A race?  Is there a prize for second place?

A war?  What is victory?

A bubble?  What happens if it bursts?

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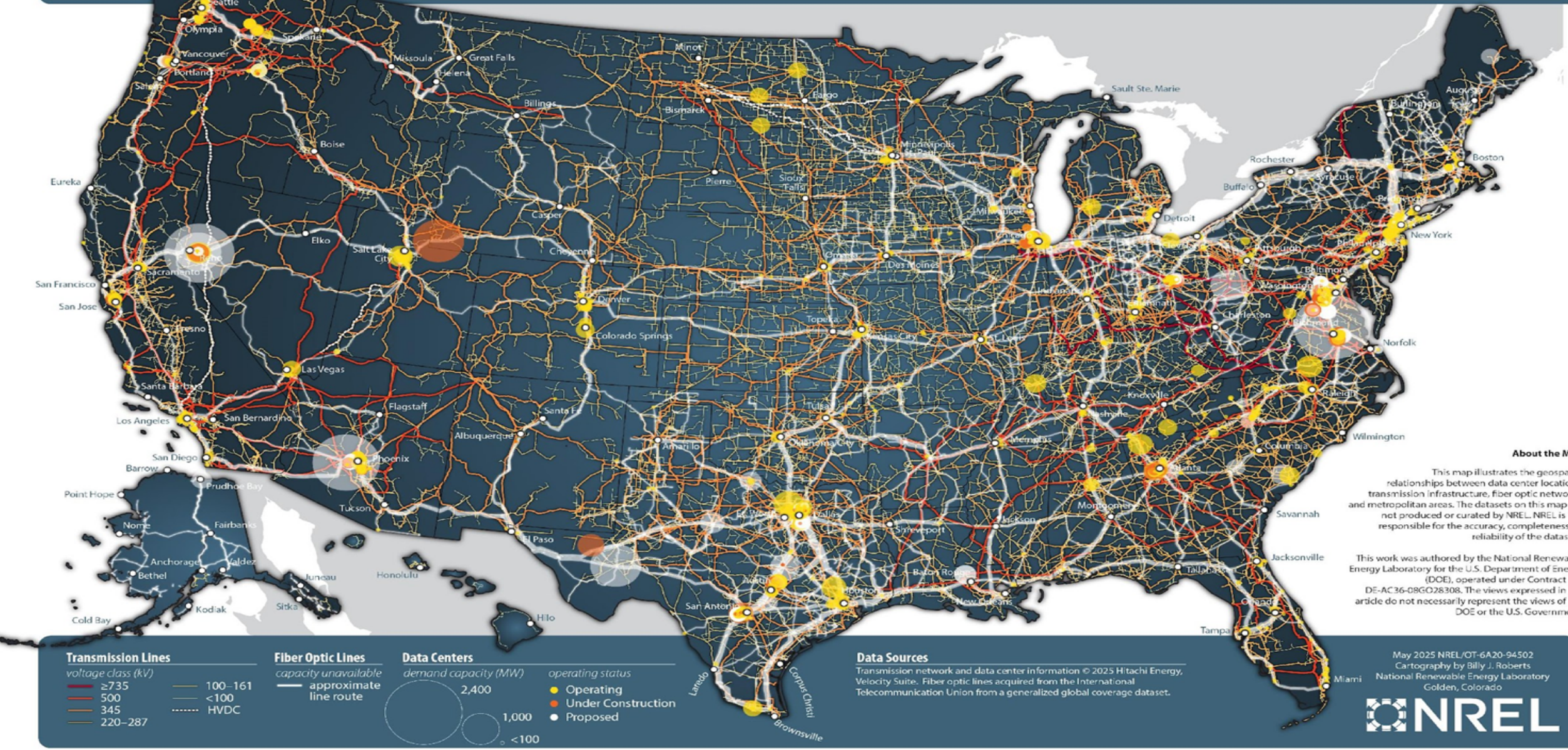
Step Back
The Taxonomy of Data Centers and Energy Demand

Type	Use and Description	Energy Profile
Hyperscale	High-density computing, built by large tech companies, for global scale; ten of thousands to millions of servers	100 MW to 1+ GW
AI / ML Learning	Specialized facilities for training inference models (large language models and machine learning); GPU heavy	100 MW to 1+ GW; varying load depending on training intensity (bursts of highly intensive demand)
Cloud	On-demand computing, storage and networking, database hosting (Azure, AWS, Oracle)	50-100 MW
Colocation	Multiple enterprises rent space and power for their servers; operated by third-party provider	50-100 MW
Edge	Distributed facilities to support Internet of Things / 5G telecoms, usually near industry and urban areas	500 KW–1 MW
Enterprise	On-premise, for internal IT needs	<10 MW

Data Center Infrastructure in the United States, 2025



About the Map

This map illustrates the geospatial relationships between data center locations, transmission infrastructure, fiber optic networks, and metropolitan areas. The datasets on this map are not produced or curated by NREL. NREL is not responsible for the accuracy, completeness, or reliability of the datasets.

This work was authored by the National Renewable Energy Laboratory for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government.

Transmission Lines

voltage class (kV)

- ≥735
- 500
- 345
- 220–287
- 100–161
- <100
- HVDC

Fiber Optic Lines

capacity unavailable

- approximate line route

Data Centers

demand capacity (MW)

2,400
1,000
<100

operating status

- Operating
- Under Construction
- Proposed

Data Sources

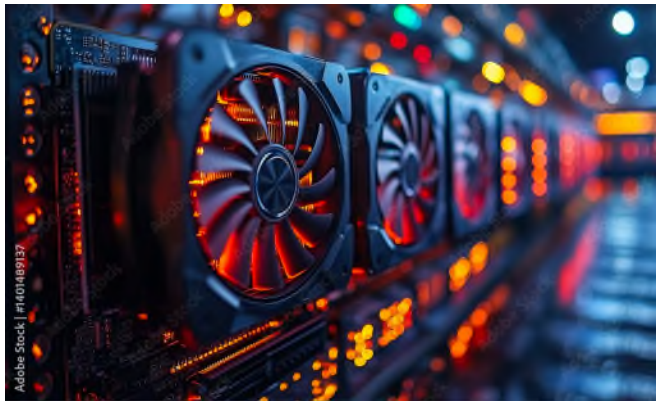
Transmission network and data center information © 2025 Hitachi Energy, Velocity Suite. Fiber optic lines acquired from the International Telecommunication Union from a generalized global coverage dataset.

May 2025 NREL/OT-6A20-94502
Cartography by Billy J. Roberts
National Renewable Energy Laboratory
Golden, Colorado

NREL

Inside the Data Center
Heating & Cooling

System	Percentage of Electricity Load	Additional Notes
IT Hardware (chips and servers)	40-60%	Options: • Grid connected • Uninterruptible Power Supply (batteries and flywheels) • On-site Generation (gas, solar, geothermal, nuclear) • Backup Generation (diesel, fuel cells, solar + storage)
Cooling	30-40%	Options: • Air-cooling – simple, but poor efficiency at high-intensity • Direct-to-chip liquid cooling – complex system design • Immersion Cooling – very efficient, requires complex system designs and special hardware • Hybrid Cooling
Facility Operations (lighting, security, office space)	10-30%	



Source: Electricity Demand and Grid Impacts of AI Data Centers: Challenges and Prospects, by Chen, Wang, Colacelli, Lee and Xie

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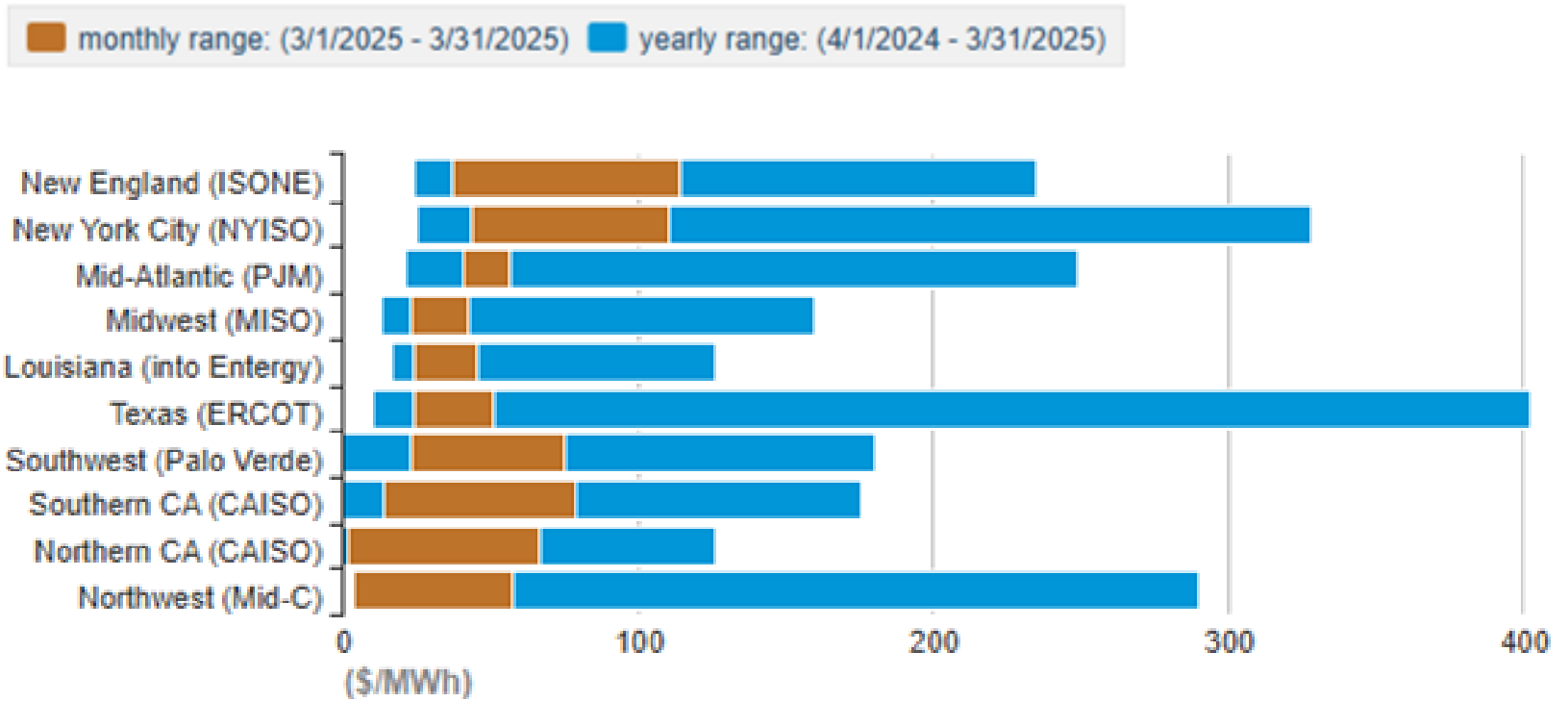
Pennsylvania isn't the least expensive. . .

Monthly and annual range of wholesale electricity prices for selected regional trading hubs
March 2025



Top Metro Growth Markets
enter Trends Report
Atlanta
Northern Virginia
Phoenix
Hillsboro, OR
Chicago

Source: U.S. Energy Information Administration based on SNL Energy; CBRE North America

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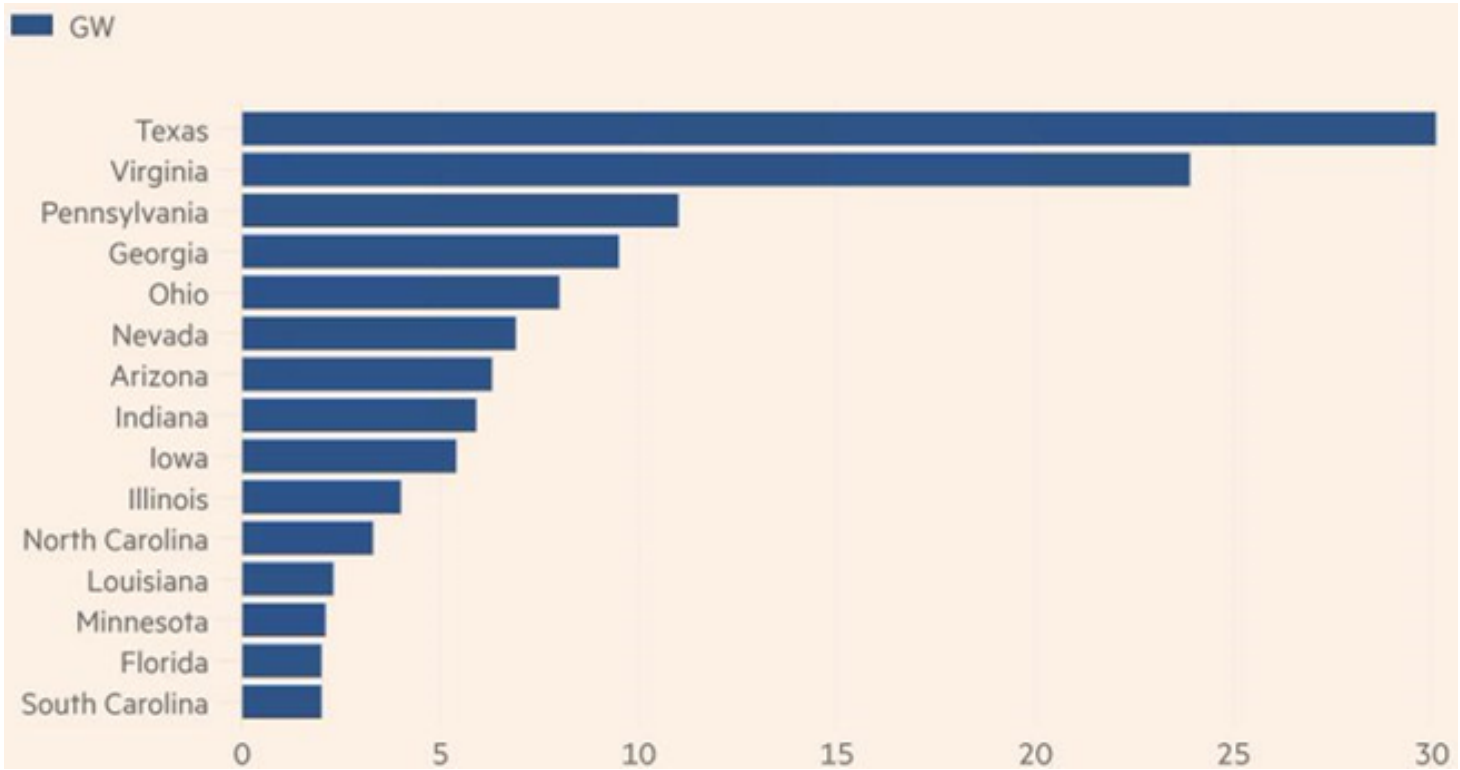
. . . yet has garnered strong interest

Data center capacity announced since January 1, 2023



"While Wood Mackenzie is tracking 134GW of proposed data centres across the US, interconnection requests far exceed this, due to developers hoarding spots in multiple queues, hoping one of them will pay off. Developers are looking outside of hubs such as Virginia and Texas at states including Pennsylvania, Ohio, Indiana and Iowa, where they are banking that connection times will be faster."

– Can the U.S. power grid keep up with the AI data centre boom?, *Financial Times,* June 19, 2025

Source: Wood Mackenzie

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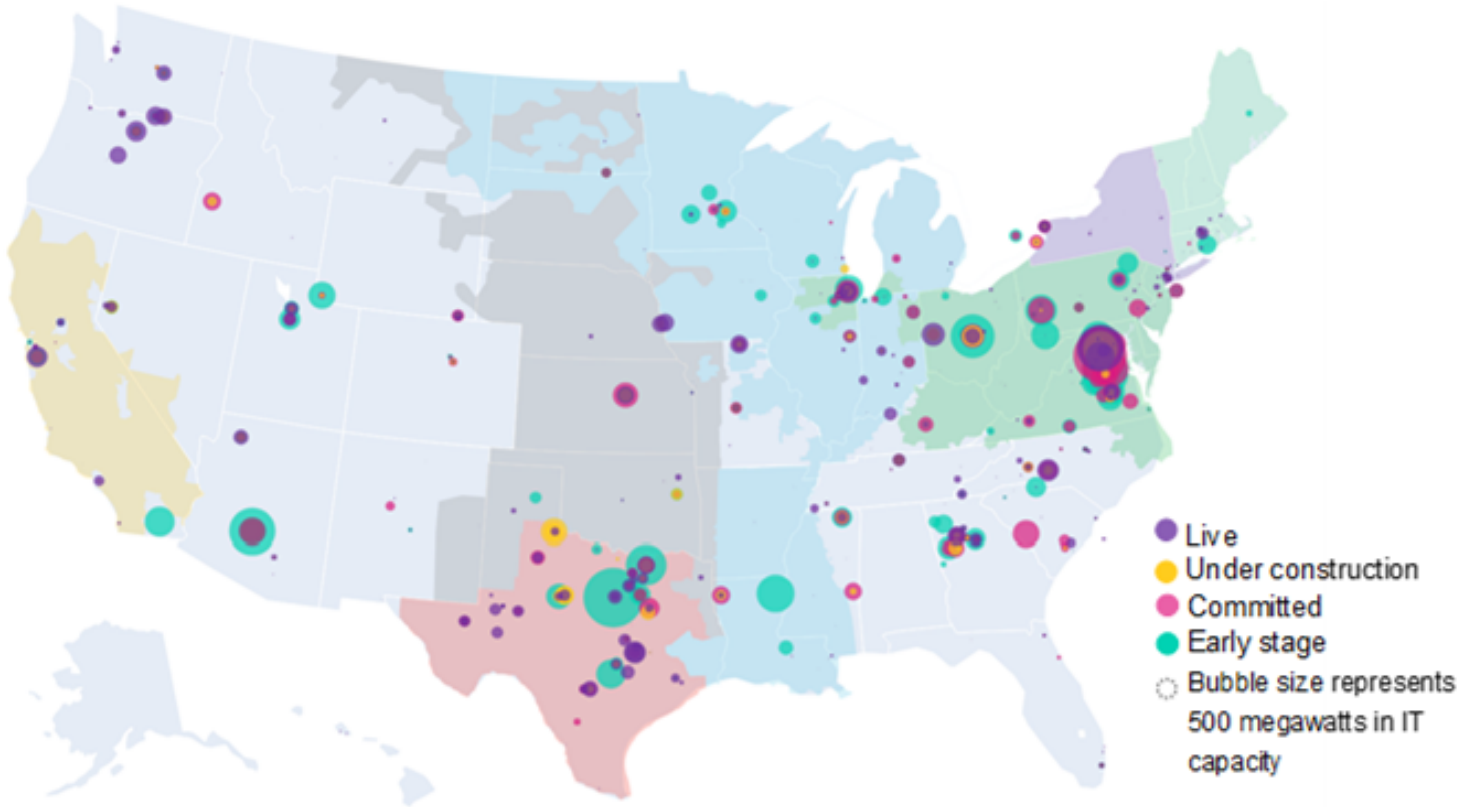
Speed to market with power wins the day

Pipeline of data centers in IT load



"Regionally, PJM remains the largest U.S. data-center market through 2035, followed by Ercot and the Southeast. For companies developing advanced AI models, quickly securing data-center capacity is critical – any delay risks falling behind competitively. Site selection has thus become more opportunistic, favoring locations with available grid capacity, expedited interconnection, tax incentives and land. This is shifting some developments away from traditional hubs in Virginia, Oregon, Texas, Ohio and California."

– *Bloomberg NEF*, Power for AI Easier Said Than Built, April 2025

Sources: DC Byte, BloombergNEF
Note: IT stands for information technology; IT load refers to the amount of power a data center uses for compute, network, and storage

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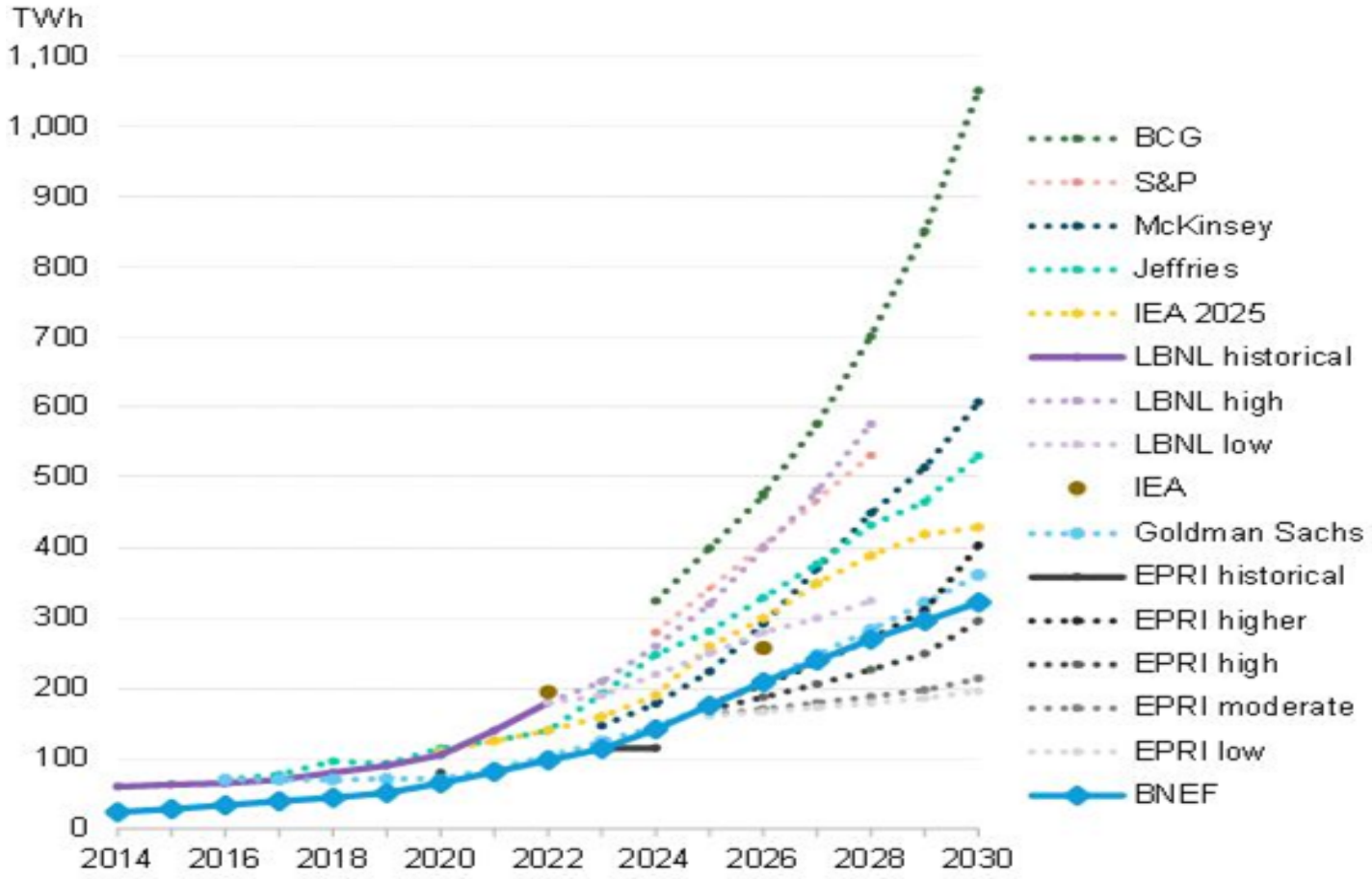
Power demand for data center growth accelerates – But by how much?

Comparison of U.S. data center energy demand forecast



Sources: BloombergNEF, Lawrence Berkeley National Lab, International Energy Agency (IEA) 2024, Boston Consulting Group, Electric Power Research Institute, Jefferies, Goldman Sachs, McKinsey, S&P, IEA 2025

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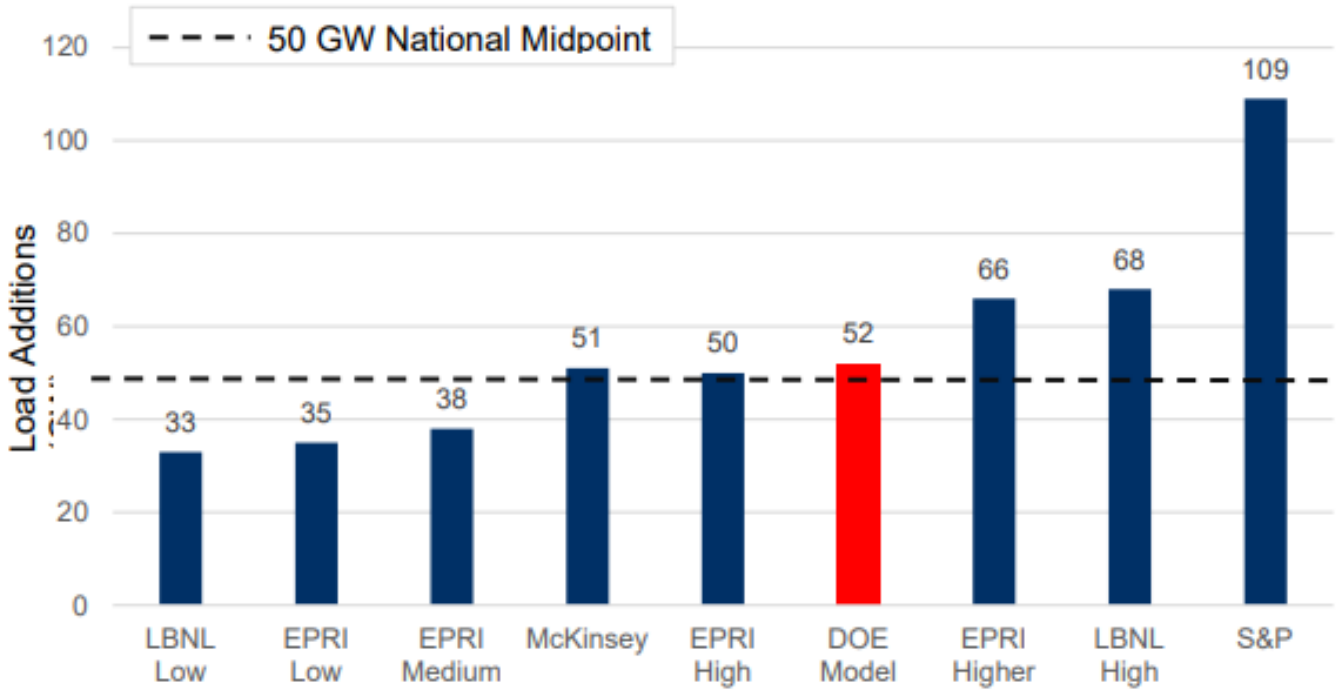

*"These projections show wide variation . . . [and, due to] differences in hardware intensity, thermal management, siting assumptions and behind-the-meter generation, the modeling team adopted a national midpoint assumption of approximately **50 GW by 2030**…Peak load is projected to increase 2.3% per year."*

Sources: US Department of Energy Report on Strengthening U.S. Grid Reliability and Security, 2025

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Policy responses from key regulators and institutions

"The **current conditions** in the [PJM] capacity market are **almost entirely the result of large load additions from data centers**, both actual historical and forecast."

– PJM Independent Market Monitor Joseph Bowring, who suggested at a June 2025 FERC technical conference to require data centers to procure their own generation

"These large load users are forecast to place significant new demand on the electric grid […] These **new customers represent a tremendous opportunity for the state** in terms of jobs, economic growth, technological advancement, and rate stability, in addition to bolstering our national security."

– PA PUC Chairman Steve DeFrank, Motion of *En Banc Hearing* re Interconnection and Tariffs for Large Load Customers

Nearly 100 GW of large new loads could be integrated with minimal impact, Duke University "Rethinking Load Growth Paper, Feb. 2025

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Policy responses in motion from PA Legislature

Enabling New Development	New Requirements on Data Centers
Sen. Rothman (R) – Commonwealth Opportunity Zones regulatory sandboxes	Rep. Rob Matzie (D): Ratemaking framework, green energy requirements based on Indiana and Georgia
Reps. Mullins (D), Nelson and Barton (R) / Sen. Bartolotta (R) – Accelerated data center permitting	Sens. Brown and Argall (R) – Requires "will-serve letters from utilities, and additional meetings and information sharing to local officials
Reps. Scialabba, Leadbeter and D'Orsie (R): Keystone AI Innovation package	Rep. Steele (D) – Requires energy efficiency targets for sales tax exemption eligibility Rep. Fiedler (D) – Requires prevailing wages to be paid for sales tax exemption eligibility
Sen. Yaw (R) and Miller (D) – Load Forecasting Oversight	Rep. Webster (D) – Requires water consumption reporting
Rep. Steele (D) – POWER Siting Board (*for certain energy projects)	Reps. Mullins and Donahue (D) – Water and power consumption reporting
	Reps. Donahue and Mullins (D) – Establishes minimum zoning criteria for sound, setbacks, design standards
	Rep. Sappey (D) – Emergency response standards

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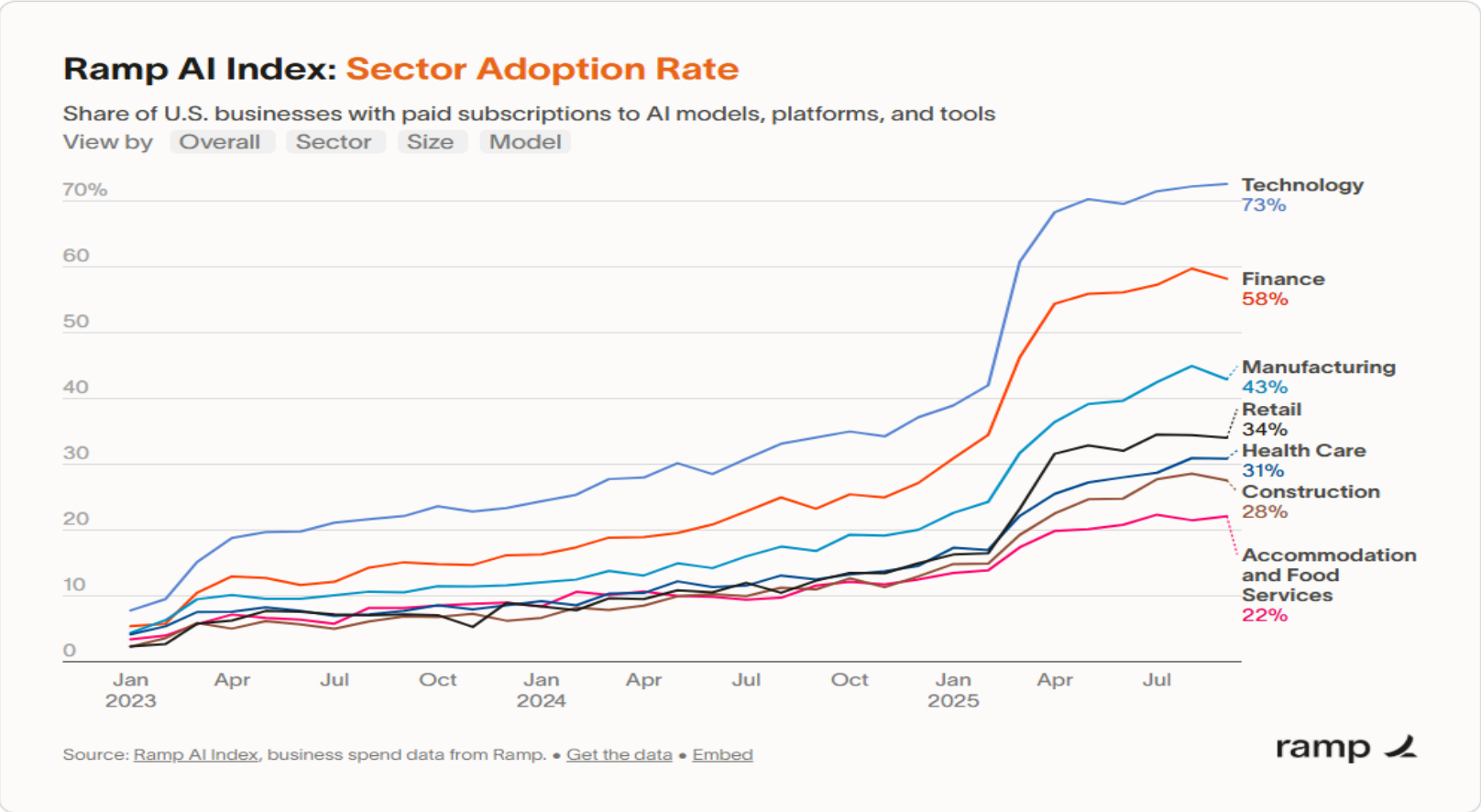
Ramp AI Index and Census Data: Sector Adoption Rate Peak or Plateau?

Share of U.S. businesses with paid subscriptions to AI models, platforms, and tools



Excluded from the chart, as of Sept. 2025, adoption rates were:

- **Professional services 58%**
- **Utilities 44%**
- **Mining, oil and gas 32%**
- **Public administration 25%**

Ramp estimates **44% of all US Businesses** and **9% of US Government** agencies have a paid AI subscription

Source: Ramp AI Adoption Index, U.S. Census Business Trends and Outlook Survey

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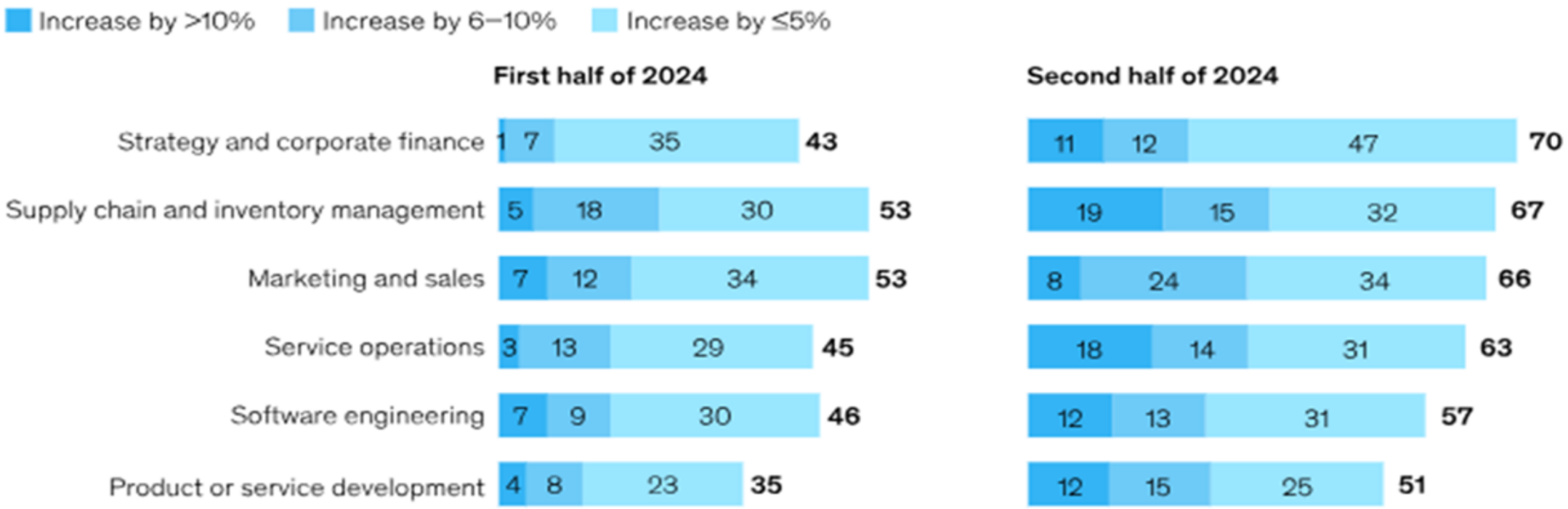
Organizations increasingly see gen AI's effects on revenues in the business units using the technology

Revenue increase within business units from gen AI use, past 12 months, by function,
% of respondents



Source: McKinsey State of AI

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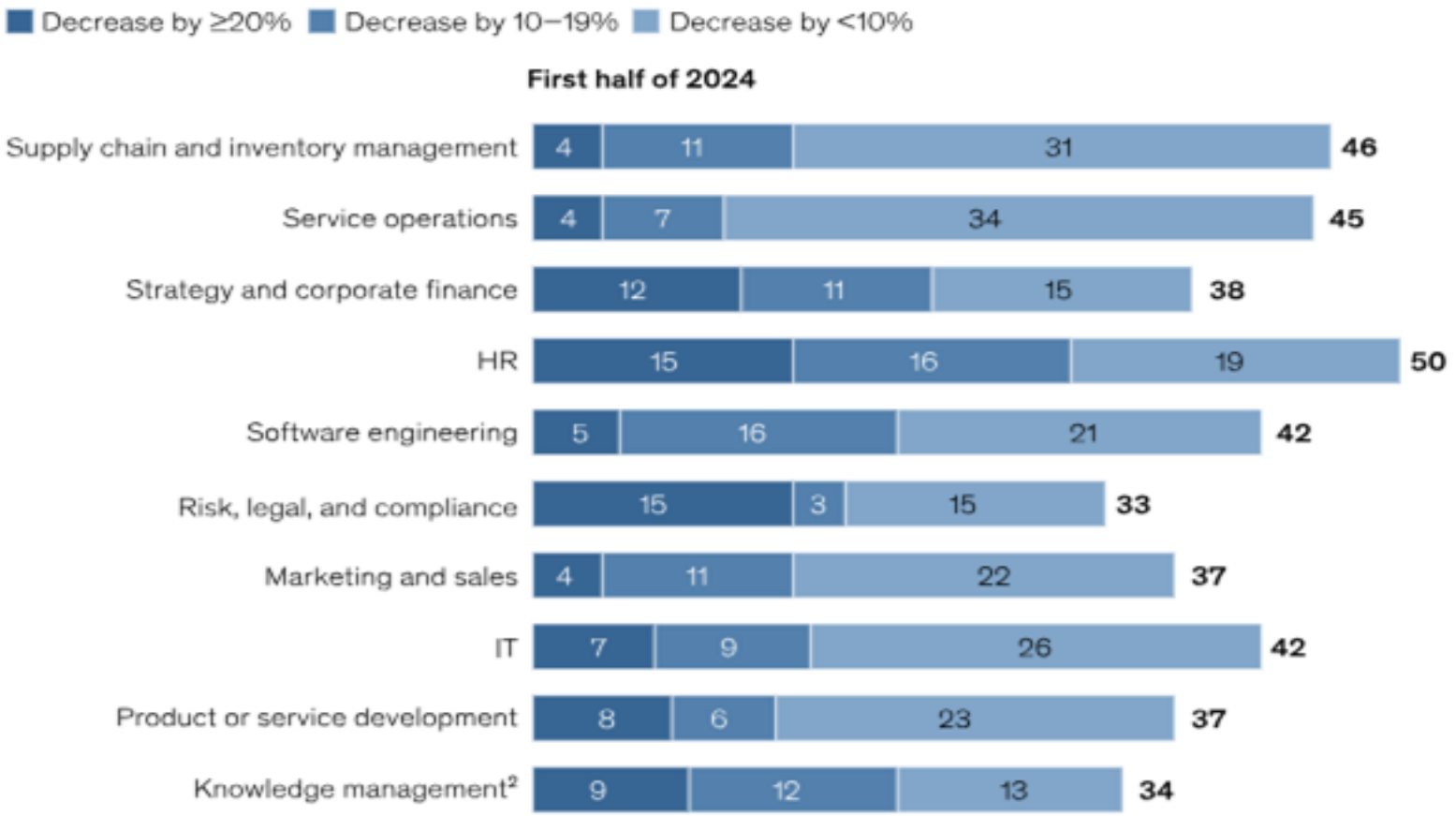
Respondents increasingly report cost reductions from gen AI within business units using the technology

Cost decrease within business units from gen AI use, past 12 months, by function, % of respondents



Source: McKinsey State of AI

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Team Pennsylvania's Energy, Data Center, & Artificial Intelligence Roadmap

TEAM PENNSYLVANIA

About Us

- **501(c)(3) nonprofit, nonpartisan** organization founded in 1997
- Statewide, public-private partnership **co-chaired by the Governor** and a PA **private sector leader**
  - Public Sector
    - Agency secretaries from the Departments of Agriculture, Community & Economic Development, Education, and Labor & Industry
    - Legislators from all four caucuses
  - Private Sector
    - Business and industry
    - Labor
    - Academia
    - Nonprofit c-suite executives

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Core Purpose

Working together
for all Pennsylvanians
in public-private partnership,
we accelerate
the commonwealth's long-term
economic future.

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This Roadmap *Is*

- **An actionable strategic planning document** rooted in current conditions, future trends, and measurable outcomes
- **A living framework** that adapts for discussion, strategy, and investment
- **A tool for coordination**, aligning public and private sector efforts to move in the same direction
- **Nonpartisan**, filtered through Team Pennsylvania's 4 goals
- **Inclusive of AI** → Not just an energy/data center conversation

This Roadmap *Is Not*

- A static report or academic study
- Just a list of technologies or ideas without prioritization
- A political statement or an inflexible mandate
- A detailed project plan, though it should inform those that follow
- A data center siting strategy
- Energy demand projections or forecasts

Pennsylvania's Unique Opportunity to Lead in Energy Transformation and Data Center Expansion in the AI Age

Vision for Pennsylvania

Pennsylvania will take bold action and work together, across sectors, to turn rapid technological change into lasting economic growth for communities across the state.

Vision for the Roadmap

This roadmap positions Pennsylvania to lead in the age of artificial intelligence. Artificial intelligence and the systems behind it are transforming how we work, live, and grow our economy. With bold goals and flexible strategies, we can shape these forces to benefit every region of the state.

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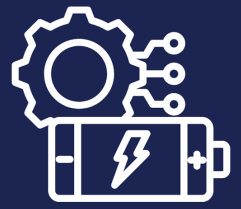
Six goals to be achieved by 2035:

#1



LEAD THE NATION IN AI-APPLIED AND NEXT-GENERATION ENERGY SYSTEM TRANSFORMATION,

ensuring that AI not only consumes energy, but also advances how it's generated, stored, and distributed

#2

LEAD THE NATION IN AI AND NEXT-GENERATION TECHNOLOGY COMMERCIALIZATION

from higher education R&D, private-sector innovators, startups, and scale-ups

#3

DEPLOY SCALABLE, FIRM ENERGY GENERATION — TARGET OF 10-12 GW—

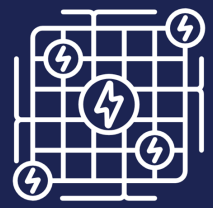
to support emerging industrial and compute infrastructure

#4

ESTABLISH 3–5 INNOVATION CORRIDORS

across Pennsylvania's rural and urban landscape anchored by energy-enabled, AI-powered development

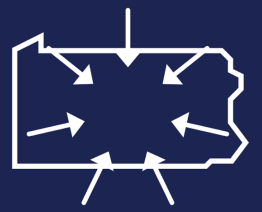
#5



MODERNIZE GRID INFRASTRUCTURE AND PERMITTING

to meet the demands of next-generation data and energy needs

#6



SET A STRATEGIC TARGET FOR PENNSYLVANIA-BASED SOURCING TO REACH 20% OF TOTAL SPEND

in AI-powered data center and grid infrastructure projects by 2035

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National and Pennsylvania Context

National and Global Dynamics

NATIONAL AND GLOBAL POLICY SHIFTS

Federal legislation, international agreements

GLOBAL ENERGY AND TECHNOLOGY MARKETS

Pricing, supply chains, trade policies

INFRASTRUCTURE SYSTEMS AT SCALE

Interstate transmission, broadband backbones

GEOPOLITICAL DYNAMICS

International competition and security issues

Pennsylvania Levers

PERMITTING AND REGULATORY PROCESSES

Streamlining approvals to accelerate projects

CROSS-SECTOR COORDINATION

Aligning business, government, labor, and academia

TALENT STRATEGY

Aligning training programs with emerging industry needs

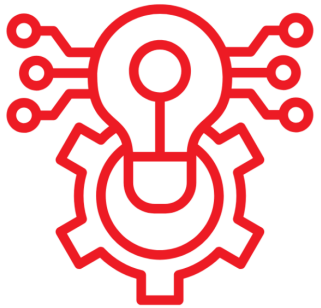
STATE-LEVEL INCENTIVES AND PROGRAMS

Shaping funding, tax credits, or pilot initiatives

Long-Term Strategies (2025–2035)

Three mutually reinforcing priorities anchor Pennsylvania's long-term strategies to 2035:

Scale Commercialization and Technology Leadership



Modernize Energy Systems for Compute Resilience

Build and Sustain Talent Pipelines

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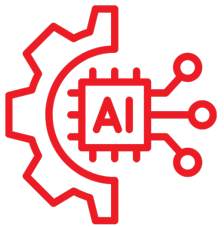
Near-Term Actions (2025–2027)

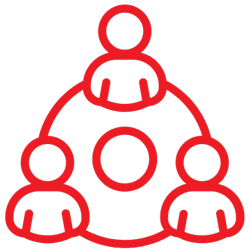
To establish Pennsylvania's early leadership in the energy-data-AI economy, near-term actions must remove immediate barriers, signal serious intent to investors and developers, and set the stage for longer-term transformation.

Accelerate Permitting and Site Readiness

Incentivize Strategic Energy and Industrial Co-Location



Scale AI in Manufacturing



Create Collaborative Environment Encouraging Shared Resources

Expand Shared Knowledge Base Between State and Local Entities

Strengthen Talent Strategy

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Roles and Enablers

What: Policy, Governance, and Legal Reform

Who: Federal, State, and Local Government, Courts, Advocacy Groups

What: Regional Impacts Across Rural, Urban, and Suburban Landscapes

Who: Local/Regional Planning, Zoning, Economic Development, Community Members, Public Sector

What: Technology and AI-Driven Innovation

Who: Private Sector, Federal Labs, Academia

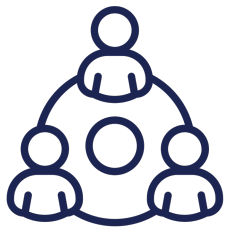
What: Workforce

Who: Education, Workforce Development Boards, Private Sector, Trades

Team Pennsylvania Foundation Commitments

What's Next: Activate Key Initiatives

- Advancing an **AI Scaling initiative** for small and medium sized manufacturers
- Conducting a statewide **AI/Robotics value chain analysis**
- Launching a **nuclear initiative** geared toward harnessing the full potential of advanced nuclear energy technologies and powering data centers



Engage More Partners

Listen, Learn, and Adapt

Measure What Matters

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Participating Task Force Organizations

The Pennsylvania Energy, Data Centers, Artificial Intelligence Roadmap is the result of collaboration, and while the strategies and considerations reflect the broadest possible set of views, they do not imply a full endorsement by every participant of the Task Force.

View the full list of participating organizations here:

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To View the Full Roadmap:

Or Visit: https://teampa.com/energy/edcai-roadmap/

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Accelerating Economic Growth Through Public-Private Partnership

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