Electricity Demand Growth and Data Centers: A Guide for the Perplexed

Jonathan Koomey, Ph.D.

Koomey Analytics

http://www.koomey.com, jon@koomey.com

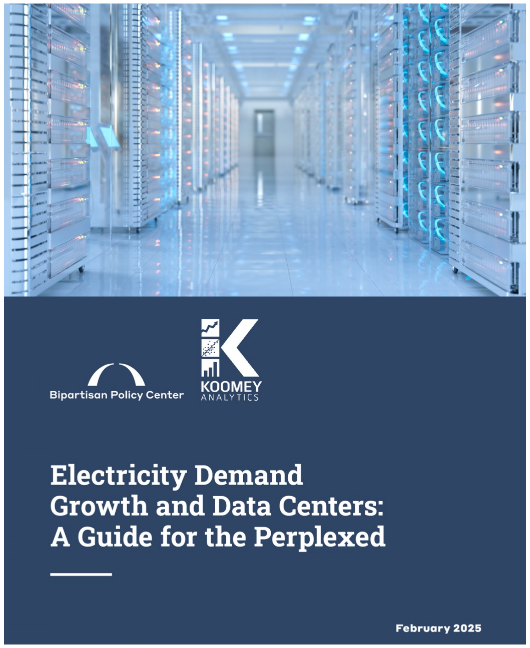
Presented at the Ohio Manufacturers Association Annual Conference

Columbus, OH

August 27, 2026

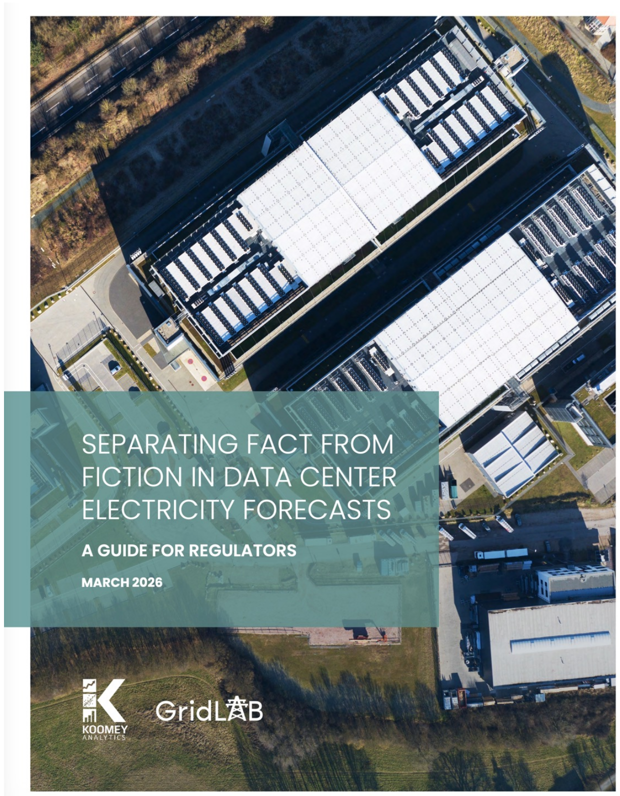
Copyright Jonathan G. Koomey 2026

Summary report out Feb 2025:



- Koomey, Jonathan, Zachary Schmidt, and Tanya Das. 2025. *Electricity Demand Growth and Data Centers: A Guide for the Perplexed*. Washington, DC: Bipartisan Policy Center. February. [https://bipartisanpolicy.org/report/electricity-demand-growth-and-data-centers/]

Related report out March 2026:



- Koomey, Jonathan, Zachary Schmidt, Priya Sreedharan, Nikhil Kumar, and Taylor McNair. 2026. *Separating fact from fiction in data center electricity forecasts: A guide for regulators*. Bay Area, California: A joint report by Koomey Analytics and Gridlab. March. [https://gridlab.org/portfolio-item/data-center-load-forecast-report/]

Copyright Jonathan G. Koomey 2026

Media convey a sense of alarm

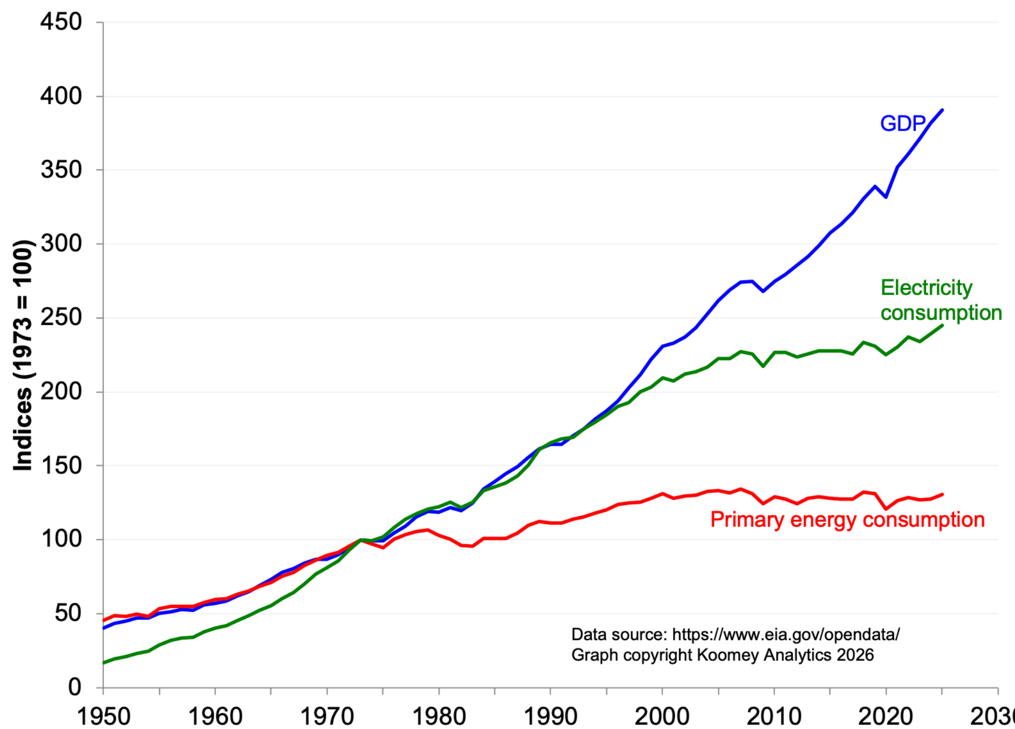
- The Washington Post: “Amid explosive demand, America is running out of power”
- The New York Times: “A new surge in power use is threatening US. climate goals”
- The Financial Times: “Booming AI demand threatens global electricity supply”
- Forbes: “ChatGPT And Generative AI Innovations Are Creating Sustainability Havoc”
- MIT Press: “The Staggering Ecological Impacts of Computation and the Cloud”

We’ve seen this show before

- There’s a well documented tendency to exaggerate IT’s electricity use and environmental effects (Koomey and Masanet 2021).
- Brandolini’s law applies
  - Polite paraphrase: “It’s 10X easier to create nonsense than to refute nonsense”
  - People doing careful work are always playing catch up
- Prior cycles are instructive
  - ”Internet data flows 2X every 100 days”. Nope, 2X every year (Koomey 2003)
  - “Dig more coal, the PCs are coming”, Forbes 1999. All nonsense.
    - The internet claimed to use 8% of US electricity (Nope, 1%). All computers 13% (Nope, 3%), growing to 50% in 10-20 years (Nope, not possible). Koomey et al. (2002).
    - Claim that IT caused the California power crisis (nope, it was Enron et al.)
    - Claim that wireless PalmPilot uses as much electricity as a fridge (2000x overestimate, Koomey et al. 2004).
  - ”The cloud begins with coal”, 2013. Same author, same story. All nonsense.

Copyright Jonathan G. Koomey 2026

Is total annual US electricity use growing?



All-sector electricity consumption up 2.1% from 2023 to 2024 and up 2.4% from 2024 to 2025.

Average annual rate of change 2005 to 2023 = 0.3%/year

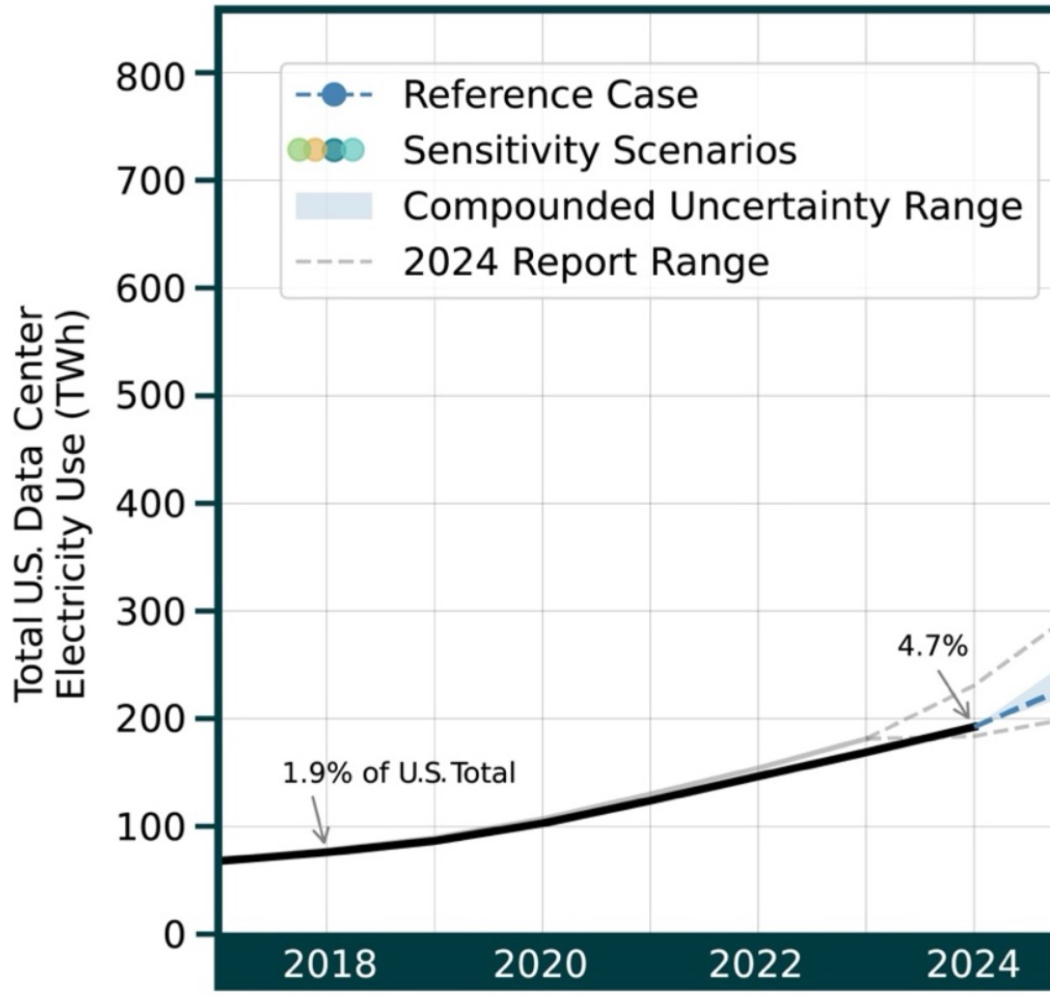
Zero growth 2018 to 2023.

Source: https://www.eia.gov/opendata/

Copyright Jonathan G. Koomey 2026

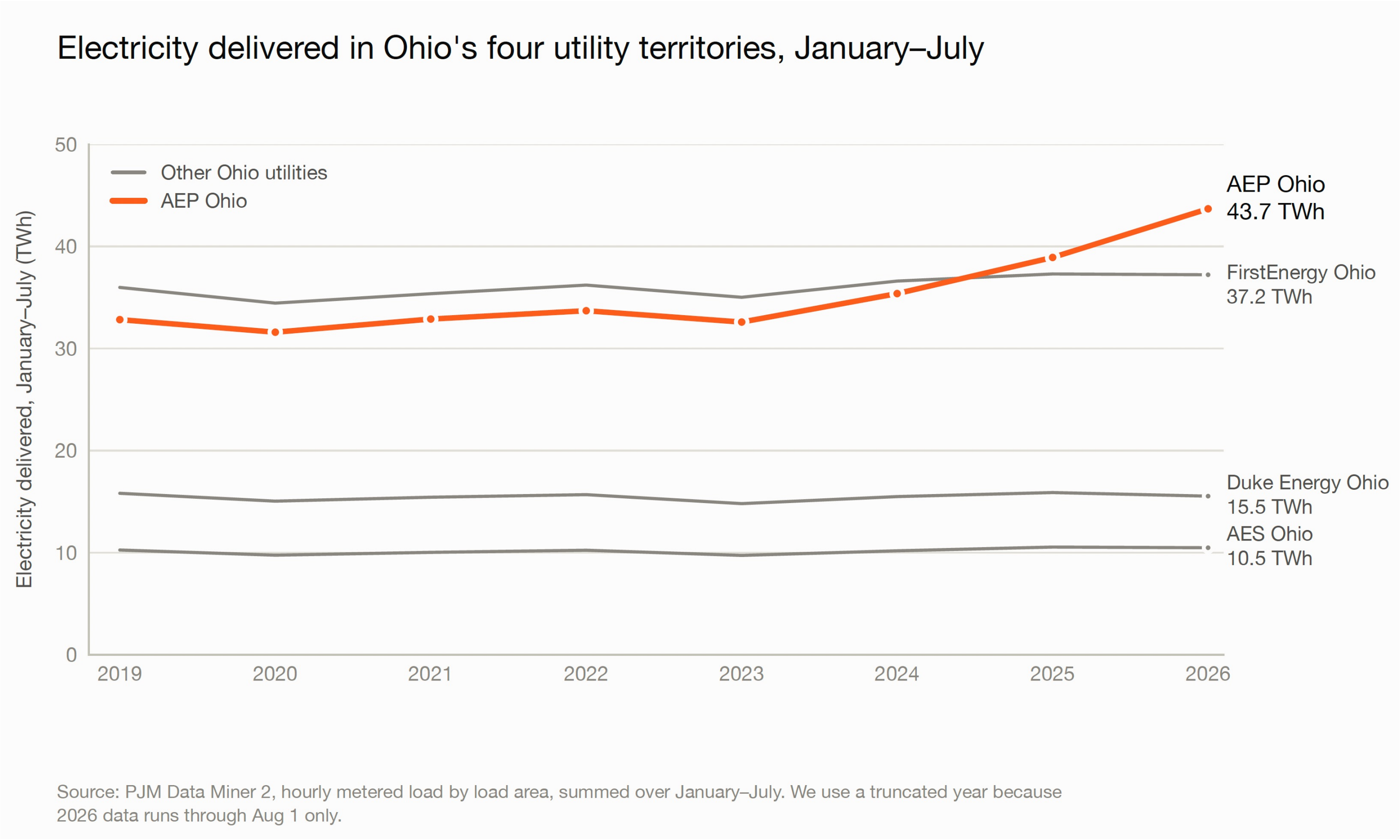
US compute data center electricity use is growing

Source: Smith et al. 2026. Estimate for 2023 was 4.4% of US electricity use (Shehabi et al. 2024)



Copyright Jonathan G. Koomey 2026

Demand growth isn't happening everywhere

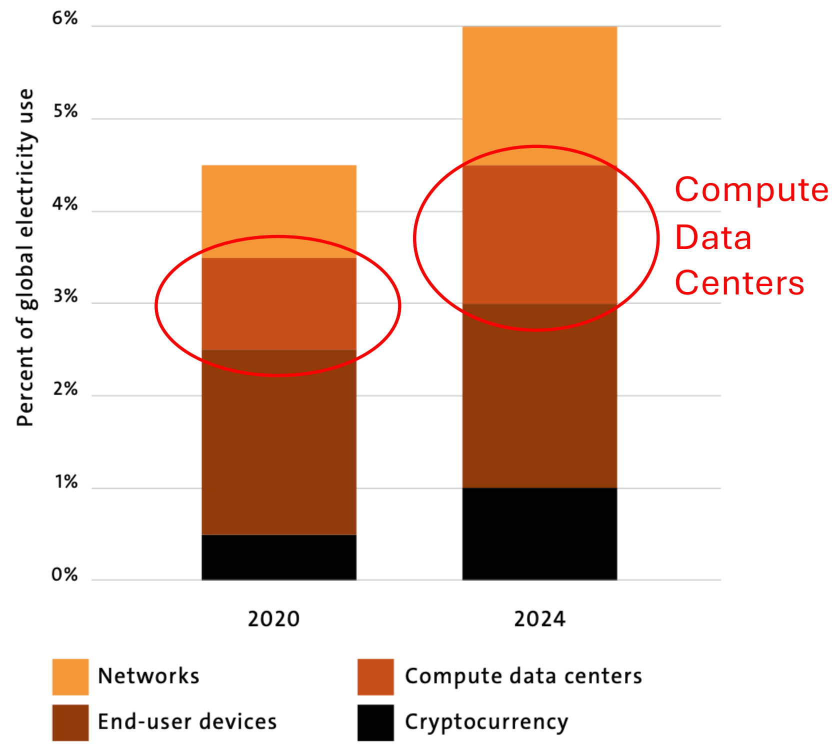


Copyright Jonathan G. Koomey 2026

Important global context: % of electricity for all ICT

Source: Koomey and Masanet 2026
NB. US electricity use for compute data centers (4.7%) is 3X higher than global total (1.5%) from IEA 2026.

***Figure 2:** Approximate fractions of total global electricity use represented by different types of computing and network equipment in 2020 and 2024*



Sources: Compute data centers and networks in 2020: Malmodin et al..[9] Compute data centers in 2024: IEA[4]. Networks in 2024 assumed to match compute data center total from IEA (1.5%). End-user devices in 2020 from Malmodin et al.,[9] with percentage assumed constant to 2024. Cryptocurrency (Bitcoin) totals from Cambridge Bitcoin Energy Consumption Index (https://ccaf.io/cbnsi/cbeci) divided by electricity consumption totals from IEA.[10]

Copyright Jonathan G. Koomey 2026

Reminder: Growth in data use, data transfers, or computations, or investments doesn't necessarily imply growth in computing electricity use

Copyright Jonathan G. Koomey 2026

Two opposing factors

- Energy use per year is a function of computations per year and electricity use per computation

$$\frac{\text{Total Energy (kWh)}}{\text{Year}} = \frac{\text{Computations}}{\text{Year}} \times \frac{\text{kWh}}{\text{Computation}}$$

- Equivalently:

$$\frac{\text{Total Energy (kWh)}}{\text{Year}} = \frac{\frac{\text{Computations}}{\text{Year}}}{\frac{\text{Computations}}{\text{kWh}}} = \frac{\text{Service demand}}{\text{Energy efficiency}}$$

- **Implications**: If service demand (computations/Year) goes up faster than efficiency (computations/kWh), then total kWh goes up (but people often underestimate improvements in computations/kWh).
- Also, changes in efficiency and service demand are **Deeply Uncertain.** Efficiency can improve very rapidly, especially after the initial growth stages in service demand. New services can add to service demand but can also displace existing services. New services may not materialize as fast as people initially think.

Copyright Jonathan G. Koomey 2026

US compute data center electricity use is projected to grow even more

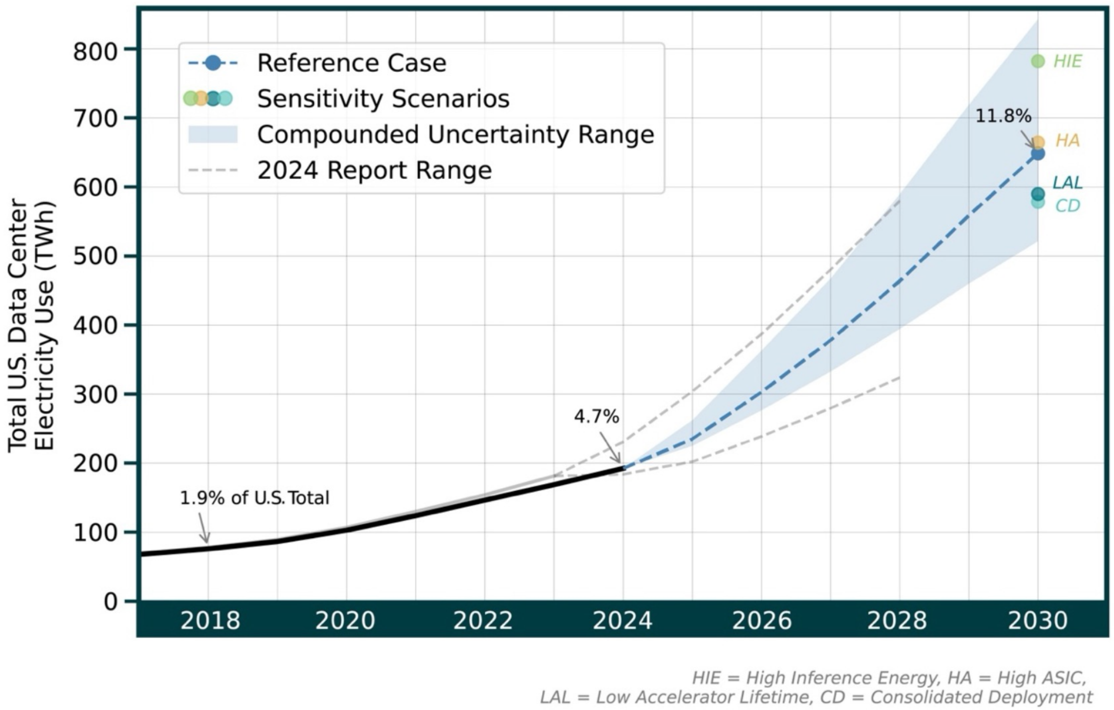
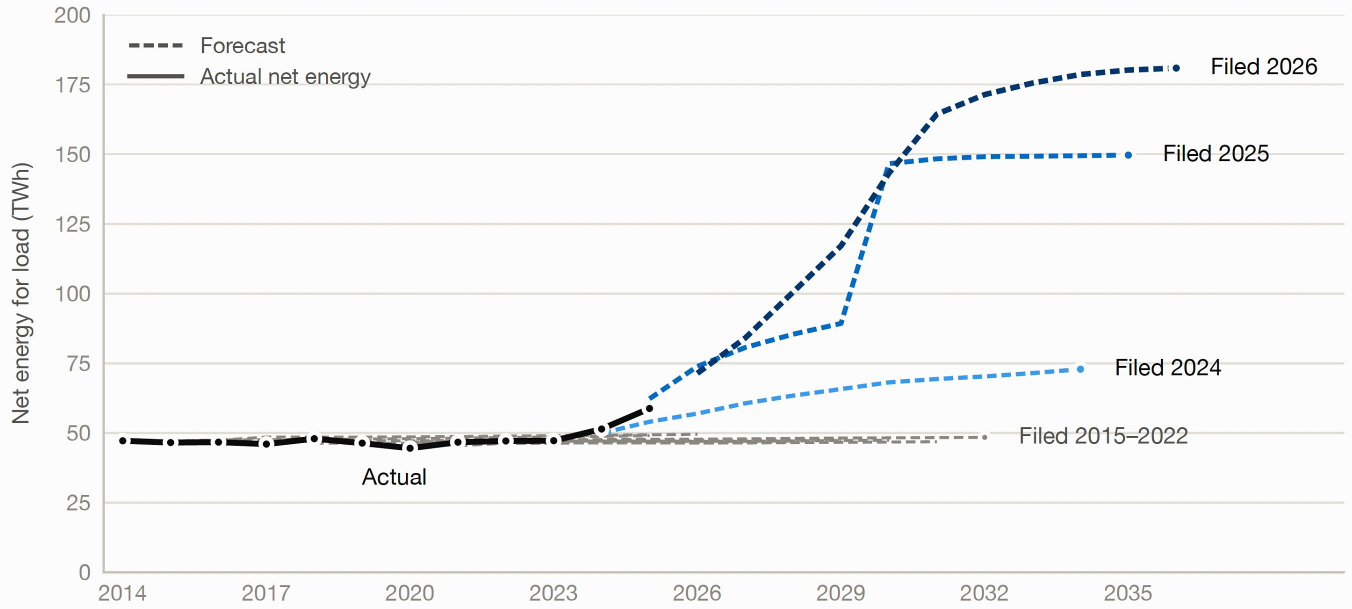


Figure 1. Total U.S. data center electricity use from 2017 through 2030

Source: Smith et al. 2026. Estimate for 2023 was 4.4% of US electricity use (Shehabi et al. 2024)

Expected load growth up for AEP Ohio

Annual net energy for load in AEP Ohio's Ohio service area, forecast and actual



Source: PUCO Form FE-D1 (Electric Utility Ohio Service Area Energy Consumption Forecast), column 8 (net energy for load), in AEP Ohio's Long-Term Forecast Reports to the Ohio Power Siting Board

Copyright Jonathan G. Koomey 2026

Conventional wisdom electricity forecasts for the US assume that benefits from AI compute will continue to accrue from scaling AI models (bigger models, bigger datasets). Will they?

Copyright Jonathan G. Koomey 2026

Because of emerging trends, the conventional wisdom is likely to be at the high end of the scenario range, in my judgement

Copyright Jonathan G. Koomey 2026

Emerging trends and constraints

- Service demand
  - People love free stuff!: Now price of AI services << cost of delivering them, but that is changing
  - Increasing user resistance to AI (accuracy, copyright, environment, local politics)
  - Agentic AI driving service demand (and costs) up
- Supply of AI computing
  - Running out of good data (historical data mostly ingested already, increasing AI-driven “data corruption”, and malicious or unintentional spreading of false information)
  - Power supply constraints (e.g. lead time for generation equipment)
  - Removal of local subsidies
  - Local and state regulations constraining deployment
  - Insufficient financial returns on deployed capital (maybe)
- Efficiency and redefining the task
  - Other ways to deliver AI training compute
    - Smaller models and datasets (e.g. DeepSeek, Z.ai)
    - Special purpose computing devices
    - Lower precision computation
  - Shift in service demand more to inference compute close to end users (e.g. Apple neural engine)

Copyright Jonathan G. Koomey 2026

What's next for data centers?

- Nobody has any idea of how much direct electricity use and emissions will go up because of AI deployments in the medium term, though the near term will see impressive growth in that segment of data center workloads
  - Tension: The AI deployments people are most excited about are the ones with the highest cost, electricity use, and emissions, but also with the most uncertain business prospects
- Important to consider a wide range of scenarios (including declines in direct AI electricity use in the medium to longer term).
- Naïve extrapolations based on short-term trends are a recipe for disaster, as they have been in the past.

Copyright Jonathan G. Koomey 2026

New approaches to demand forecasting needed

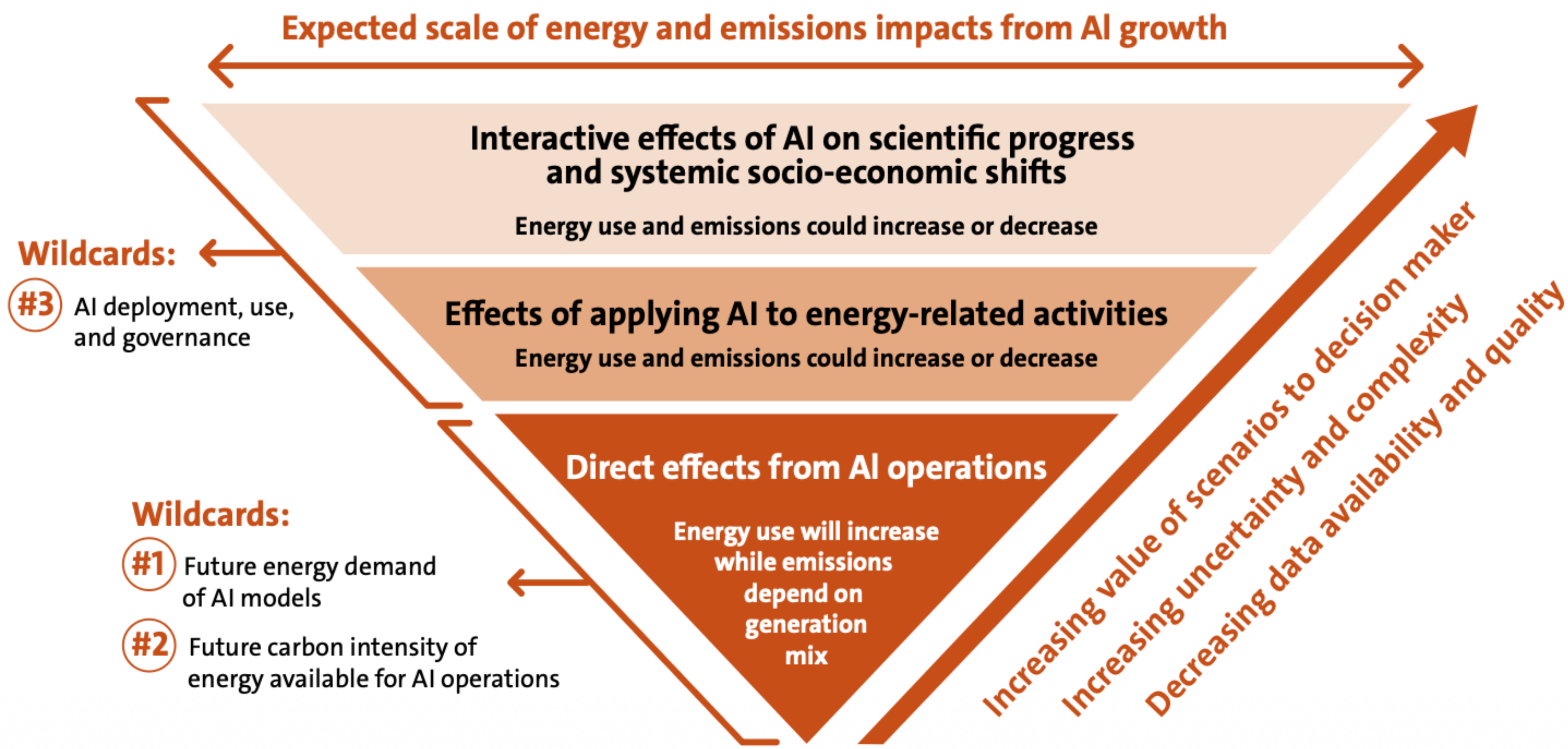
- Both utilities and tech companies have incentives to exaggerate potential demand growth
  - Utilities get paid for additional sales and investments
  - Asymmetric risk: outages in case of higher demand are more dangerous than risk of additional ratepayer costs if demand doesn't materialize
  - Tech companies want to make sure electric capacity will be available if they choose to create new data centers
- Tech companies and project developers "shop around" for best sites, but many utilities take such inquiries as legitimate requests for additional demand (double counting likely)
- Utility forecasts often take technology industry projections of AI and data center service demand at face value, instead of critically evaluating them
- The need has never been greater for a wide range of electricity use scenarios to capture uncertainty in efficiency and service demand trends

Copyright Jonathan G. Koomey 2026

"We think these interconnect queues … may be overstated anywhere from three to five times what might actually materialize either in regulated markets or competitive markets."
–James Burke, CEO of Vistra Energy

Copyright Jonathan G. Koomey 2026

System effects of AI on energy and emissions subject to deep uncertainty



Source: Koomey and Masanet 2026

Summary

- Actual data shows no rapid increases in total US electricity use from 2018 to 2023, with modest growth 2023 to 2024 (2.1%) and 2024 to 2025 (2.4%)
- Some data indicates growth locally for some utilities in some states (VA, TX, GA, CA, OH)
- Forecasts reflect utility *expectations* of large load growth from data centers/AI, but don't necessarily reflect what will actually happen
- Forecasts are based on assumptions that are not always verifiable
- Often only people with local and topic knowledge can critique utility forecasts
- Nobody has any idea of what AI electricity use will be even a few years hence
    - Deep uncertainty in service demand and efficiency trends prevails

Copyright Jonathan G. Koomey 2026

References (1)

- Avelar, Victor, Patrick Donovan, Paul Lin, Wendy Torell, and Maria A. Torres Arango. 2023. *The AI Disruption: Challenges and Guidance for Data Center Design*. Schneider Electric. White Paper 110, version 1.1, SPD_WP110_EN. September 7. [https://www.se.com/eg/en/download/document/SPD_WP110_EN/]
- Bangalore, Srini, Arjita Bhan, Andrea Del Miglio, Pankaj Sachdeva, Vijay Sarma, Raman Sharma, and Bhargs Srivathsan. 2023. *Investing in the rising data center economy*. San Francisco Bay Area, CA: McKinsey & Company, Technology, Media, & Telecommunications Practice. January. [https://www.mckinsey.com/~/media/mckinsey/industries/technology%20media%20and%20telecommunications/high%20tech/our%20insights/investing%20in%20the%20rising%20data%20center%20economy/investing-in-the-rising-data-center-economy_final.pdf]
- Bloomberg. 2024. "AI is already wreaking havoc on global power systems." June 21. [https://www.bloomberg.com/graphics/2024-ai-data-centers-power-grids/]
- Brown, Jeff. 2024. *Data Center Electricity Consumption is About to Quadruple*. Dover, DE: Brownridge Research. June 3. [https://www.brownridge.com/data-center-electricity-consumption-is-about-to-quadruple/]
- Davenport, Carly, Brian Singer, Neil Mehta, Brian Lee, and John Mackay. 2024. *Generational Growth: AI, data centers and the coming US power demand surge*. New York, NY: Goldman Sachs Equity Research. April 28. [https://www.goldmansachs.com/intelligence/pages/gs-research/generational-growth-ai-data-centers-and-the-coming-us-power-surge/report.pdf]
- EPRI. 2024. *Power intelligence: Analyzing artificial intelligence and data center energy consumption*. Palo Alto, CA: Electric Power Research Institute. May. [https://www.epri.com/research/products/000000003002028905]
- Huber, Peter, and Mark P. Mills. 1999. "Dig more coal—the PCs are coming." In *Forbes*. May 31. pp. 70–72. [http://www.forbes.com/global/1999/0531/0211100a.html]
- IEA. 2024a. *Electricity 2024: Analysis and forecast to 2026*. Paris, France: International Energy Agency. January. [https://www.iea.org/reports/electricity-2024]
- IEA. 2024b. *World Energy Outlook 2024*. Paris, France: International Energy Agency, Organization for Economic Cooperation and Development (OECD). October. [https://www.iea.org/reports/world-energy-outlook-2024]
- IEA. 2025. *World Energy Outlook Special Report: Energy and AI*. Paris, France: International Energy Agency, Organization for Economic Cooperation and Development (OECD). April. [https://www.iea.org/reports/energy-and-ai]
- IEA. 2026. *Key questions on energy and AI*. Paris, France: International Energy Agency, Organization for Economic Cooperation and Development (OECD). April 16. [https://www.iea.org/reports/key-questions-on-energy-and-ai]
- iMasons. 2024. *State of the digital infrastructure industry: Annual report*. Infrastructure Masons. [https://imasons.org/blog/state-of-the-digital-infrastructure-industry-report-2024/]
- Koomey, Jonathan, Chris Calwell, Skip Laitner, Jane Thornton, Richard E. Brown, Joe Eto, Carrie Webber, and Cathy Cullicott. 2002. "Sorry, wrong number: The use and misuse of numerical facts in analysis and media reporting of energy issues." In *Annual Review of Energy and the Environment 2002*. Edited by R. H. Socolow, D. Anderson and J. Harte. Palo Alto, CA: Annual Reviews, Inc. (also LBNL-50499). pp. 119–158. [http://www.annualreviews.org/doi/abs/10.1146/annurev.energy.27.122001.083458]
- Koomey, Jonathan. 2003. "Sorry, Wrong Number: Separating Fact from Fiction in the Information Age." In *IEEE Spectrum*. June. pp. 11–12. [http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1203076&tag=1]
- Koomey, Jonathan, Huimin Chong, Woonsien Loh, Bruce Nordman, and Michele Blazek. 2004. "Network electricity use associated with wireless personal digital assistants." *The ASCE Journal of Infrastructure Systems (also LBNL-54105)*. vol. 10, no. 3. September. pp. 131–137. [http://ascelibrary.org/doi/abs/10.1061/(ASCE)1076-0342(2004)10%3A3(130)]
- Koomey, Jonathan. 2008. "Worldwide electricity used in data centers." *Environmental Research Letters*. vol. 3, no. 034008. September 23. [http://stacks.iop.org/1748-9326/3/034008]

Copyright Jonathan G. Koomey 2026

References (2)

- Koomey, Jonathan, and Eric Masanet. 2021. "Does not compute: Avoiding pitfalls assessing the Internet's energy and carbon impacts." *Joule*. vol. 5, no. 7. June 24. pp. 1625-1628. [https://www.sciencedirect.com/science/article/abs/pii/S2542435121002117]
- Koomey, Jonathan, Zachary Schmidt, and Tanya Das. 2025. *Electricity Demand Growth and Data Centers: A Guide for the Perplexed*. Washington, DC: Bipartisan Policy Center. February. [https://bipartisanpolicy.org/report/electricity-demand-growth-and-data-centers/]
- Koomey, Jonathan, and Eric Masanet. 2026. *Understanding AI energy use (part of a special report on AI for energy, water and waste management)*. Veolia and Microsoft. February 10. [https://www.institut.veolia.org/en/publications/veolia-institute-review-facts-reports/ai-energy-water-and-waste-management]
- Mills, Mark P. 2013. *The Cloud Begins with Coal: Big Data, Big Networks, Big Infrastructure, and Big Power–An Overview of the Electricity Used by the Global Digital Ecosystem*. Digital Power Group. August. [http://www.tech-pundit.com]
- Lee, Vivian. 2023. *The Impact of GenAI on Electricity: How GenAI is Fueling the Data Center Boom in the U.S.* Boston, MA: Boston Consulting Group (BCG). September 13. [https://www.linkedin.com/pulse/impact-genai-electricity-how-fueling-data-center-boom-vivian-lee/]
- Leiserson, Charles E., Neil C. Thompson, Joel S. Emer, Bradley C. Kuszmaul, Butler W. Lampson, Daniel Sanchez, and Tao B. Schardl. 2020. "There’s plenty of room at the top: What will drive computer performance after Moore’s law?" *Science*. vol. 368, no. 6495. pp. eaam9744. [http://science.sciencemag.org/content/368/6495/eaam9744.abstract]
- Lovins, Amory B. 2025. *Artificial Intelligence Meets Natural Stupidity: Managing the Risks*. May 10. [https://integrative-design-for-radical-energy-efficiency.stanford.edu/amory-lovins]
- Luers, Amy, Jonathan Koomey, Eric Masanet, Owen Gaffney, Felix Creutzig, Juan Lavista Ferres, and Eric Horvitz. 2024. "Will AI accelerate or delay the race to net-zero emissions?" *Nature*. vol. 628, April 22. pp. 718-720. [https://doi.org/10.1038/d41586-024-01137-x]
- Malmodin, Jens, Nina Lövehagen, Pernilla Bergmark, and Dag Lundén. 2024. "ICT sector electricity consumption and greenhouse gas emissions – 2020 outcome." *Telecommunications Policy*. vol. 48, no. 3. 2024/04/01/. pp. 102701. [https://www.sciencedirect.com/science/article/pii/S0308596123002124]
- Martin, Eliza, and Ari Peskoe. 2025. *Extracting Profits from the Public: How Utility Ratepayers Are Paying for Big Tech’s Power*. Cambridge, MA: Environmental & Energy Law Program, Harvard Law School. March. [https://eelp.law.harvard.edu/extracting-profits-from-the-public-how-utility-ratepayers-are-paying-for-big-techs-power/]
- Masanet, Eric, Arman Shehabi, Nuoa Lei, Sarah Smith, and Jonathan Koomey. 2020. "Recalibrating global data center energy-use estimates." *Science*. vol. 367, no. 6481. Feb 28. pp. 984. [http://science.sciencemag.org/content/367/6481/984.abstract]
- Masanet, Eric, Nuoa Lei, and Jonathan Koomey. 2024. "To better assess, monitor, and project AI’s growing electricity demand, energy analysts need a data revolution." *Joule*. [https://doi.org/10.1016/j.joule.2024.07.018]
- Shehabi, Arman, Sarah Josephine Smith, Dale A. Sartor, Richard E. Brown, Magnus Herrlin, Jonathan G. Koomey, Eric R. Masanet, Nathaniel Horner, Inês Lima Azevedo, and William Lintner. 2016. *United States Data Center Energy Usage Report*. Berkeley, CA: Lawrence Berkeley National Laboratory. LBNL-1005775. June. [https://eta.lbl.gov/publications/united-states-data-center-energy]
- Shehabi, Arman, Sarah Josephine Smith, Alex Hubbard, Alexander Newkirk, Nuoa Lei, Md AbuBakar Siddik, Billie Holecek, Jonathan G Koomey, Eric R Masanet, and Dale A Sartor. 2024. *2024 United States Data Center Energy Usage Report*. Lawrence Berkeley National Laboratory. LBNL-2001637. December 19. [https://eta-publications.lbl.gov/publications/2024-lbnl-data-center-energy-usage-report]
- Smith, Sarah Josephine, Alex Hubbard, Alexander Newkirk, Mohan Ganeshalingam, Billie Holecek, Dale A Sartor, Michael Mills, and Arman Shehabi. 2026. *United States Data Center Energy Usage Report: 2025 Update*. Berkeley, CA: Lawrence Berkeley National Laboratory. June. [https://doi.org/10.71468/P1RP4F]

Copyright Jonathan G. Koomey 2026