



OCTOBER 2024

Energy Infrastructure is Powering the Future of Artificial Intelligence

Energy Policy Research Foundation

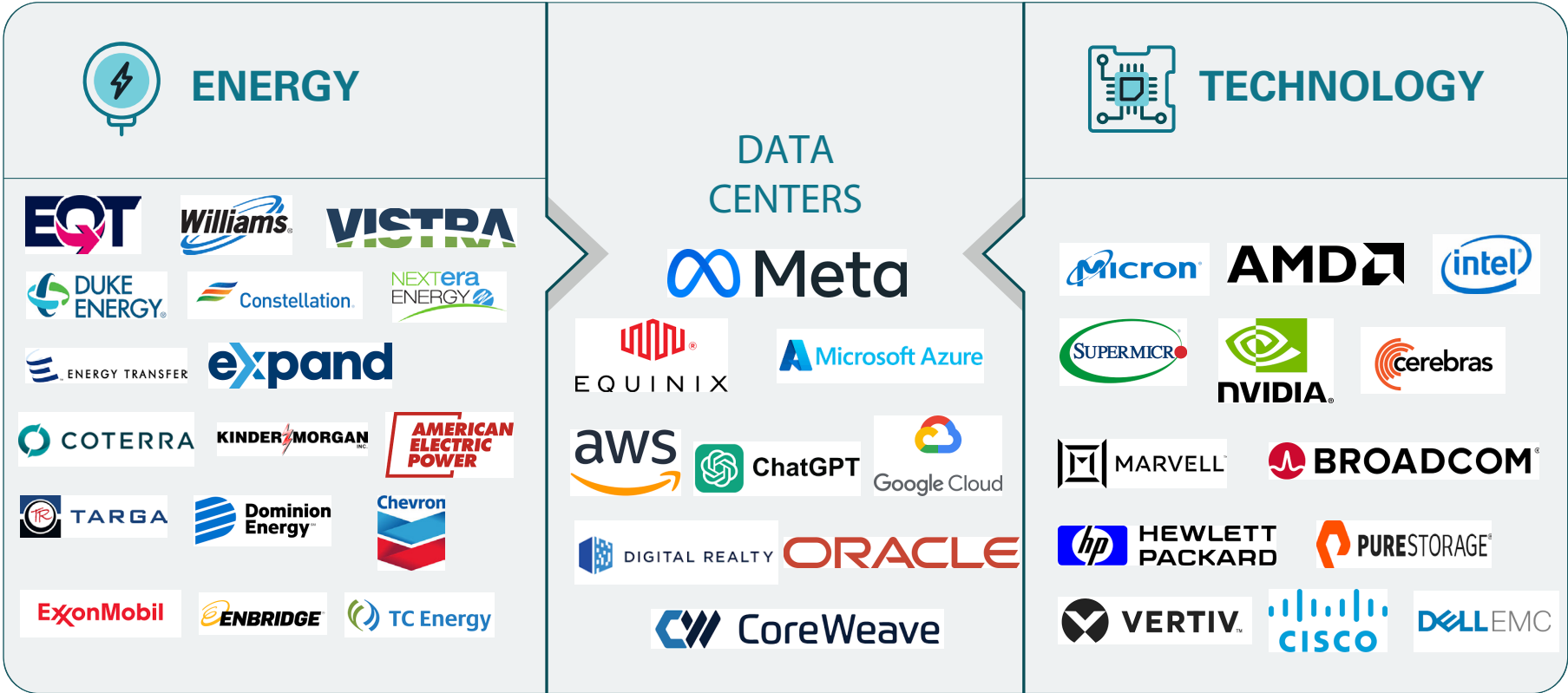
Executive summary

- 1** AI is a transformation that could be the start of the 4th industrial revolution
- 2** AI triggers the Age of Electricity as data centers are the heart of AI infrastructure
- 3** Rising electricity demand leads to the Age of Natural Gas
- 4** There is no AI without EI (Energy Infrastructure)

**Natural gas is a low-cost, low-carbon solution
poised to meet the growing electricity demand**

AI Data Center Value Chain

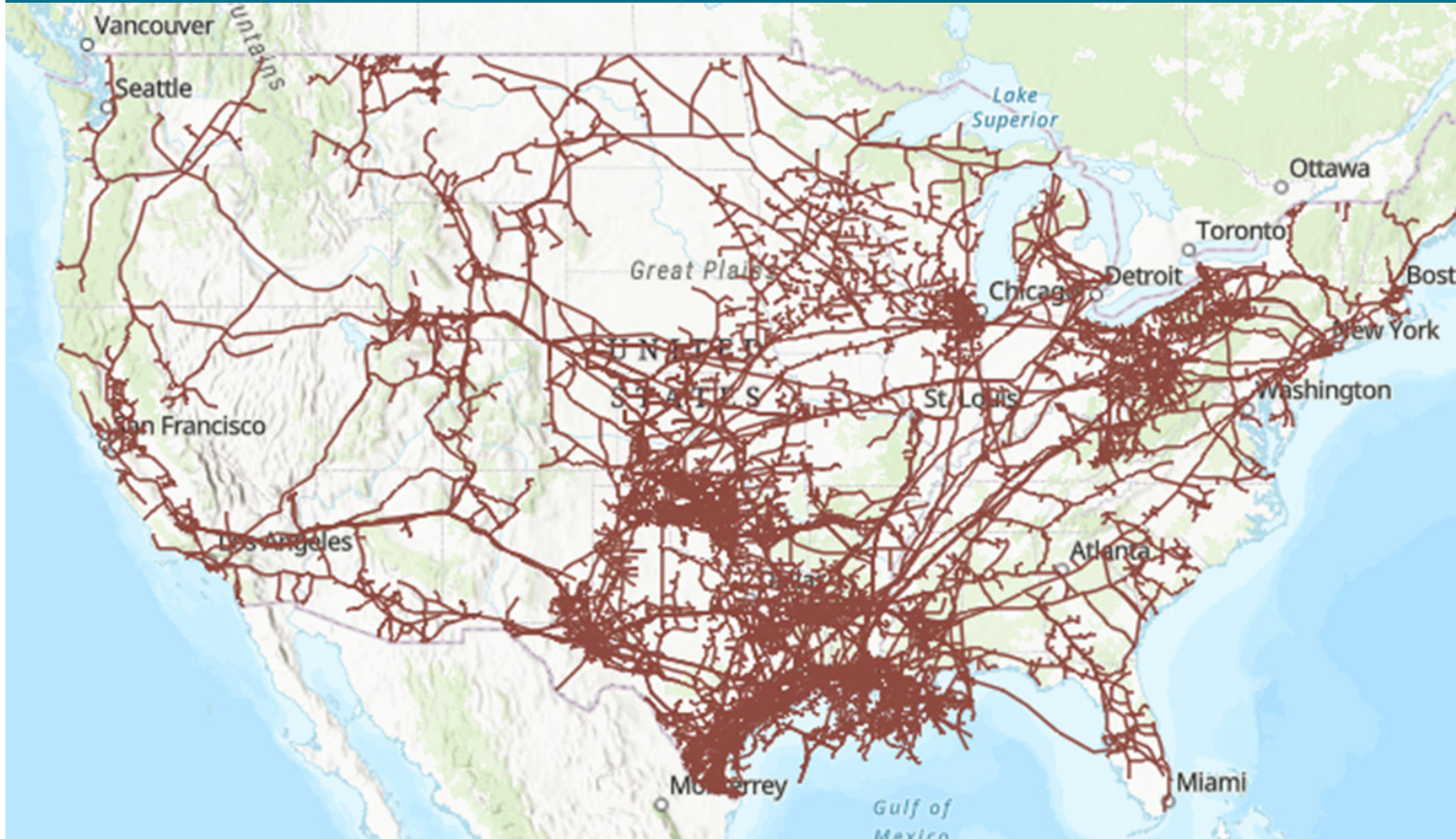
Artificial Intelligence Infrastructure Value Chain



Source: Tortoise Capital 2024

Energy infrastructure will power the future of AI

U.S. Natural Gas Infrastructure Network is the Largest in the World

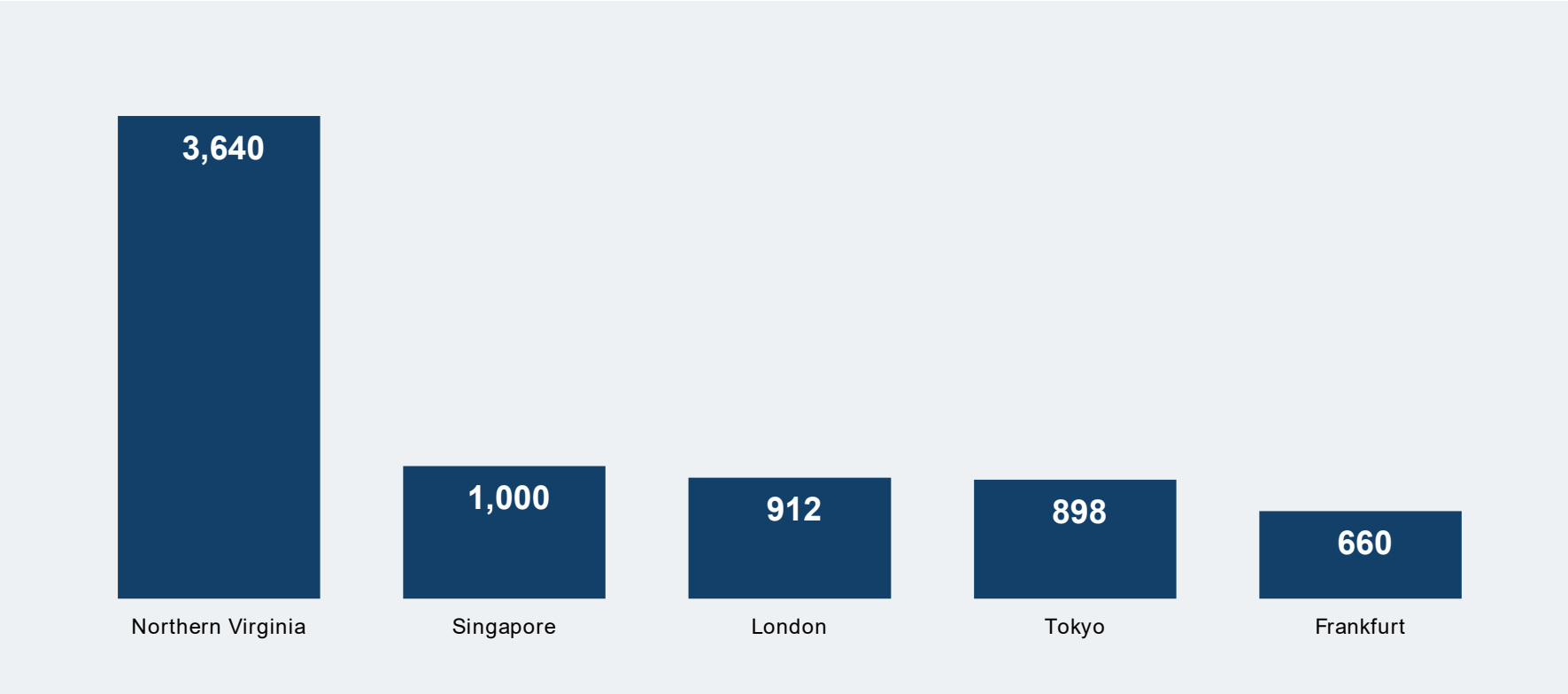


“There is no AI without EI (energy infrastructure)” - Tortoise Capital

Data center alley is the data center mecca

Data Center Alley in Northern Virginia has more data center capacity than next four world markets combined

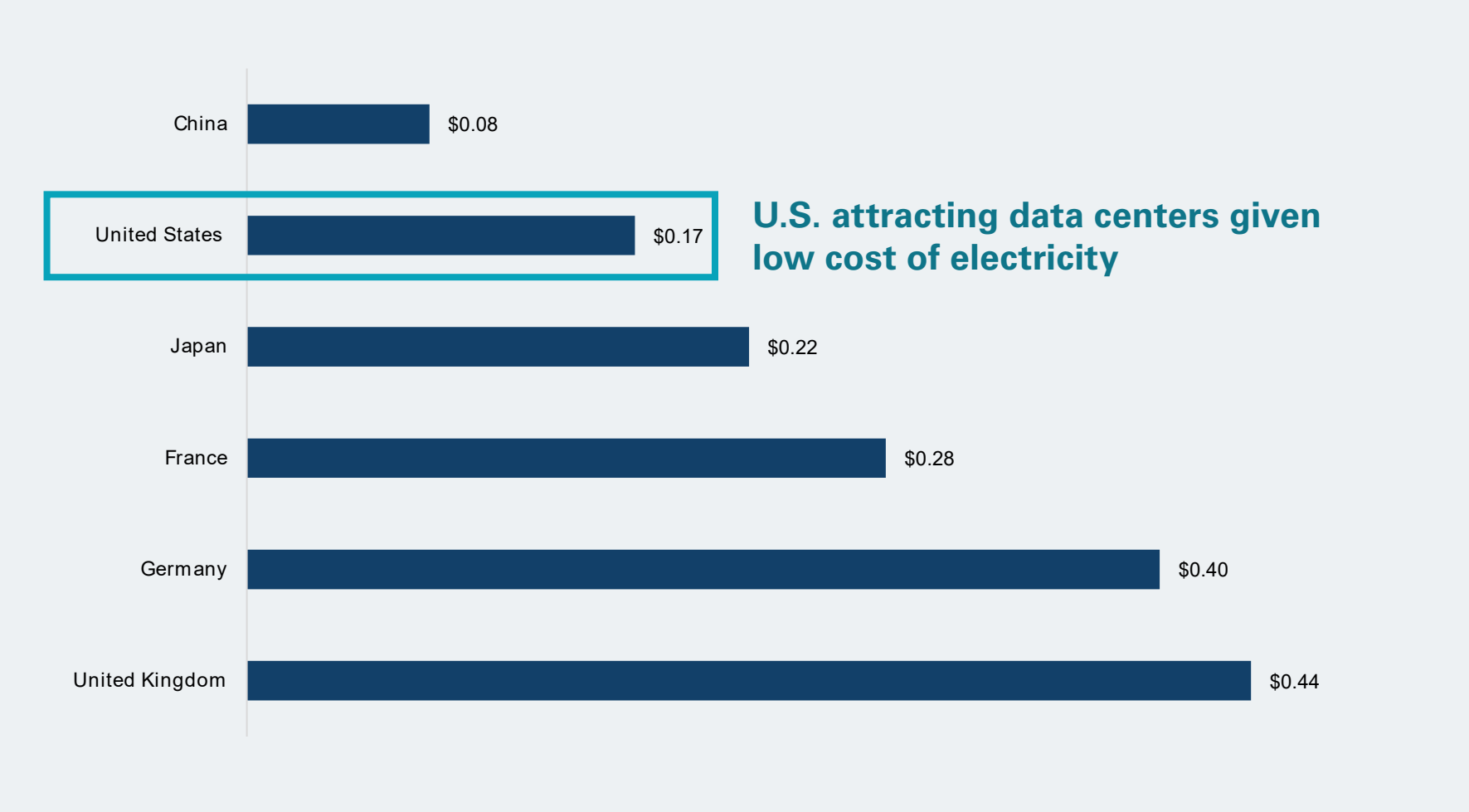
Largest Global Data Center Markets (MW Capacity)



Source: JLL Data Centers 2024 Global Outlook January 2024

U.S. has competitively low electricity prices

Global Electricity Prices, by Select Country
(in U.S. dollars per kilowatt-hour)

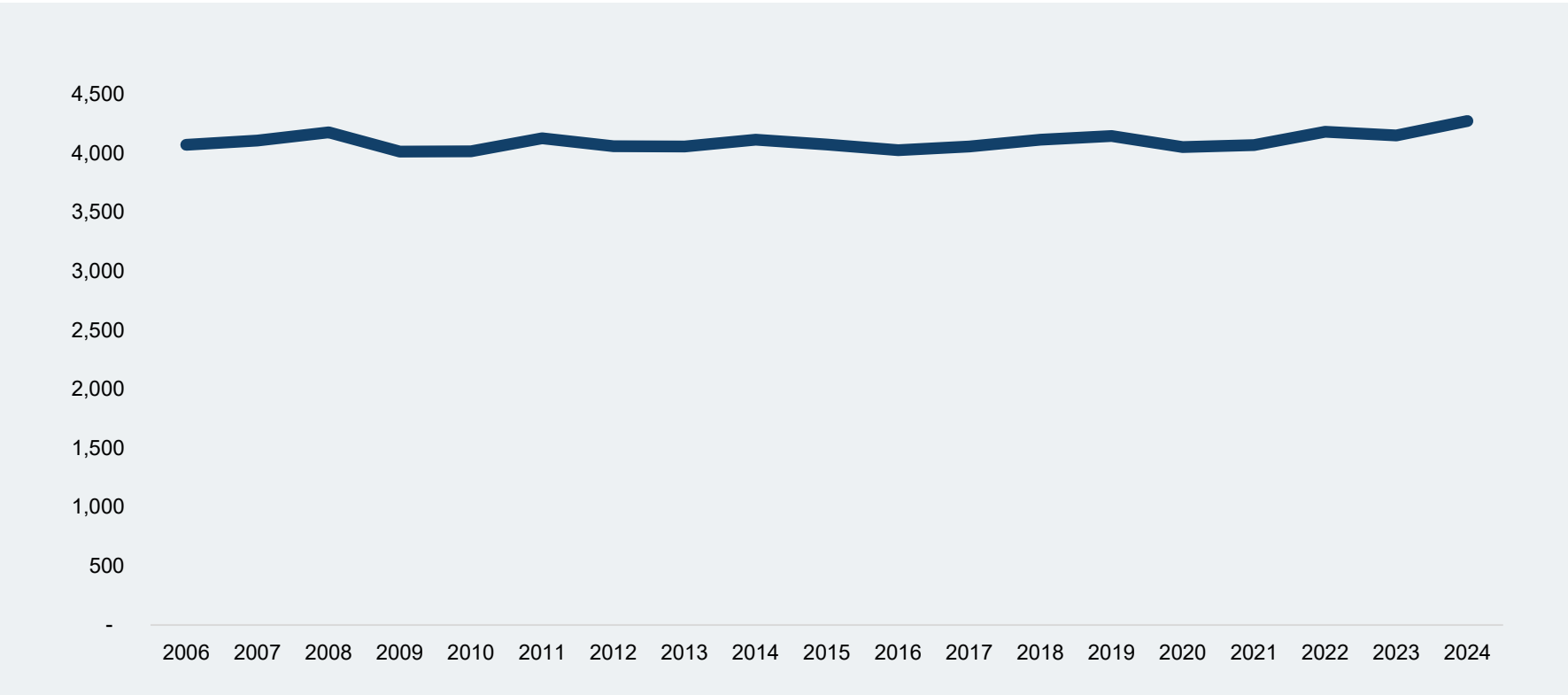


Source: Statista.com electricity prices in selected countries as of April 15, 2024

AI starts the Age of Electricity

- 1 Era of flat U.S. electricity demand is expected to be over
- 2 Age of electricity begins as increase in # of larger hyperscaler data centers + higher energy consumption per chip = U.S. electricity demand growth

U.S. Electricity Generation (2006 - 2024)
(in million kilowatthours)

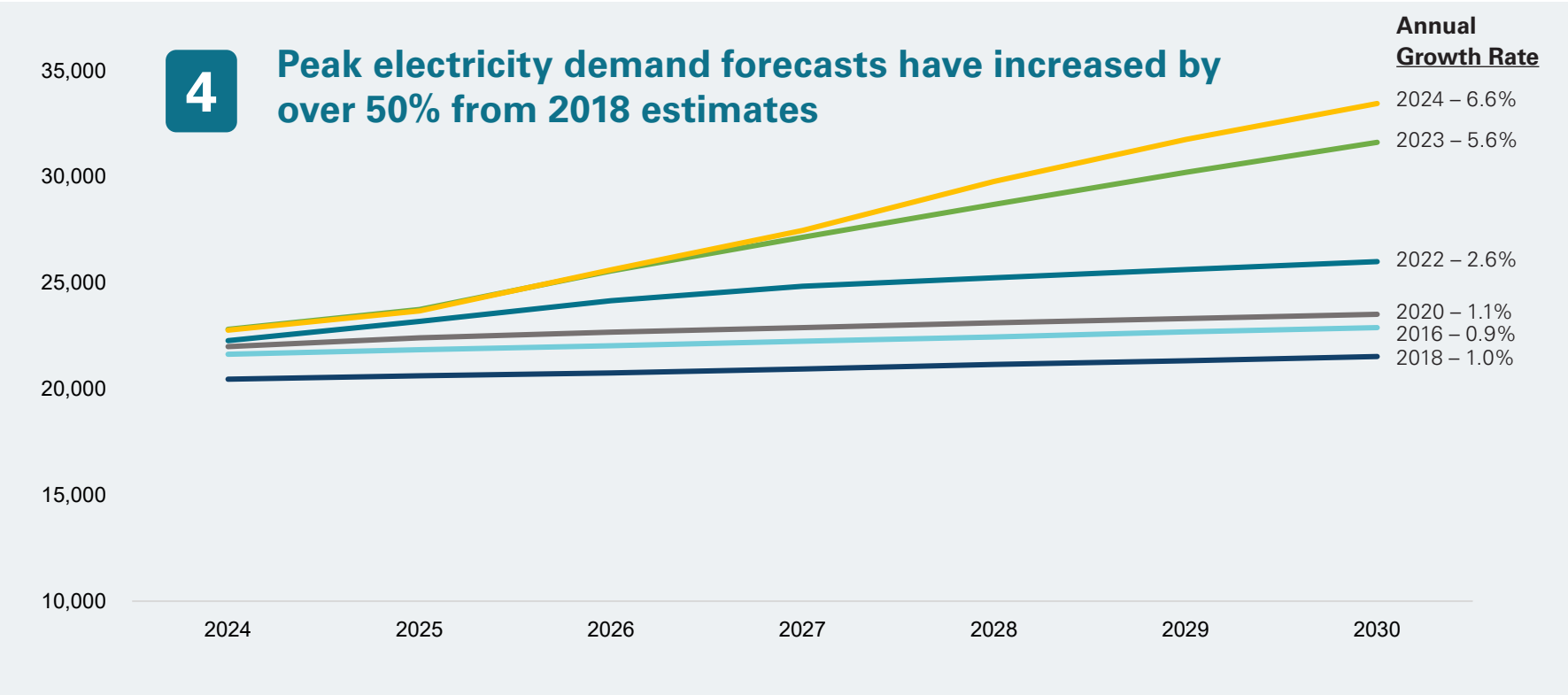


Source: EIA as of October 2024

Historical electricity demand growth forecasts for northern Virginia

- 1** More data centers have resulted in significant growth forecasts in peak electricity demand forecasts made in 2022, 2023, and 2024
- 2** Latest forecast for annual growth in peak electricity demand has grown to 6.6%/year
- 3** Electricity growth rate starts to accelerate in 2026

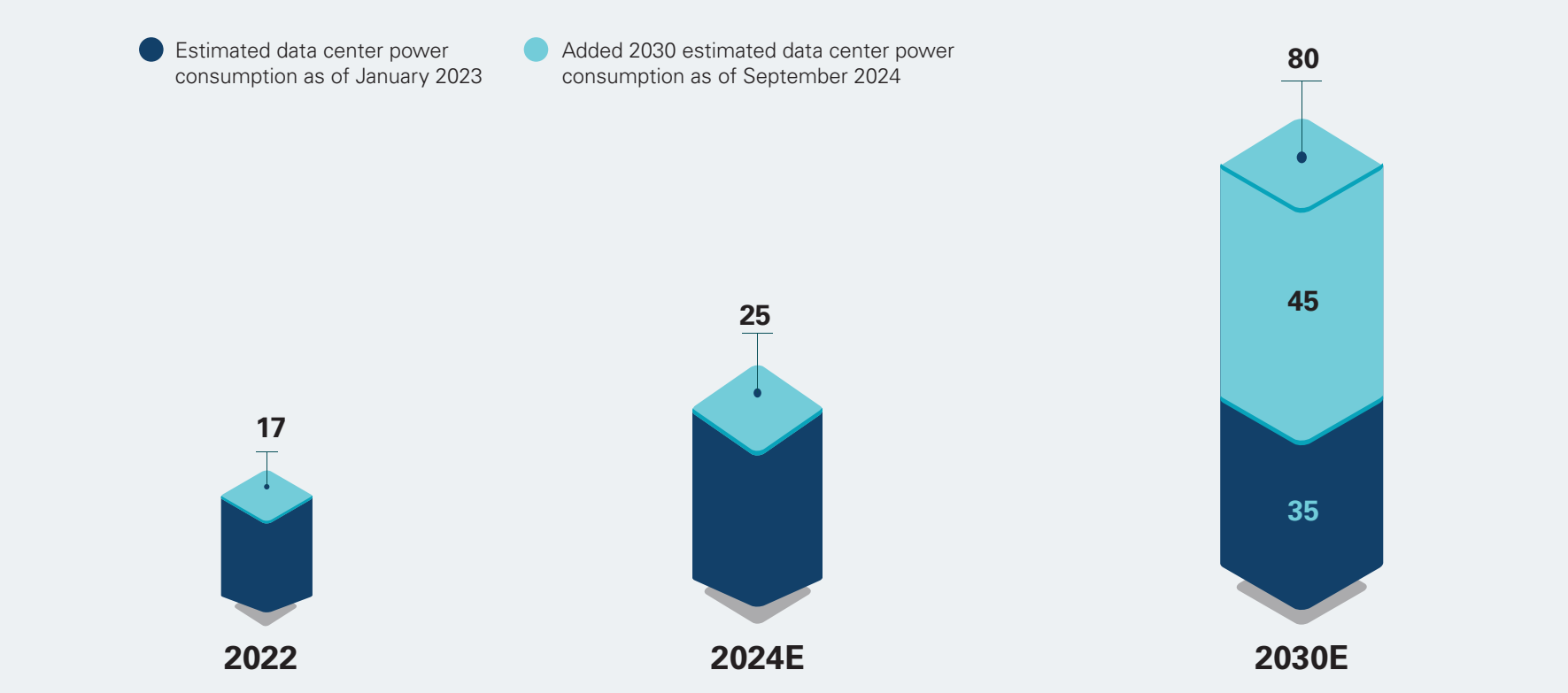
PJM DOM Winter Peak Load (MW) Forecast



Source: PJM Load Forecast Report January 2024. Projections on this page are for informational purposes only and are no guarantee of future outcomes.

AI Data Centers Drive Higher U.S. Electricity Growth Rate

Data Center Power Consumption by Provider (in gigawatts)

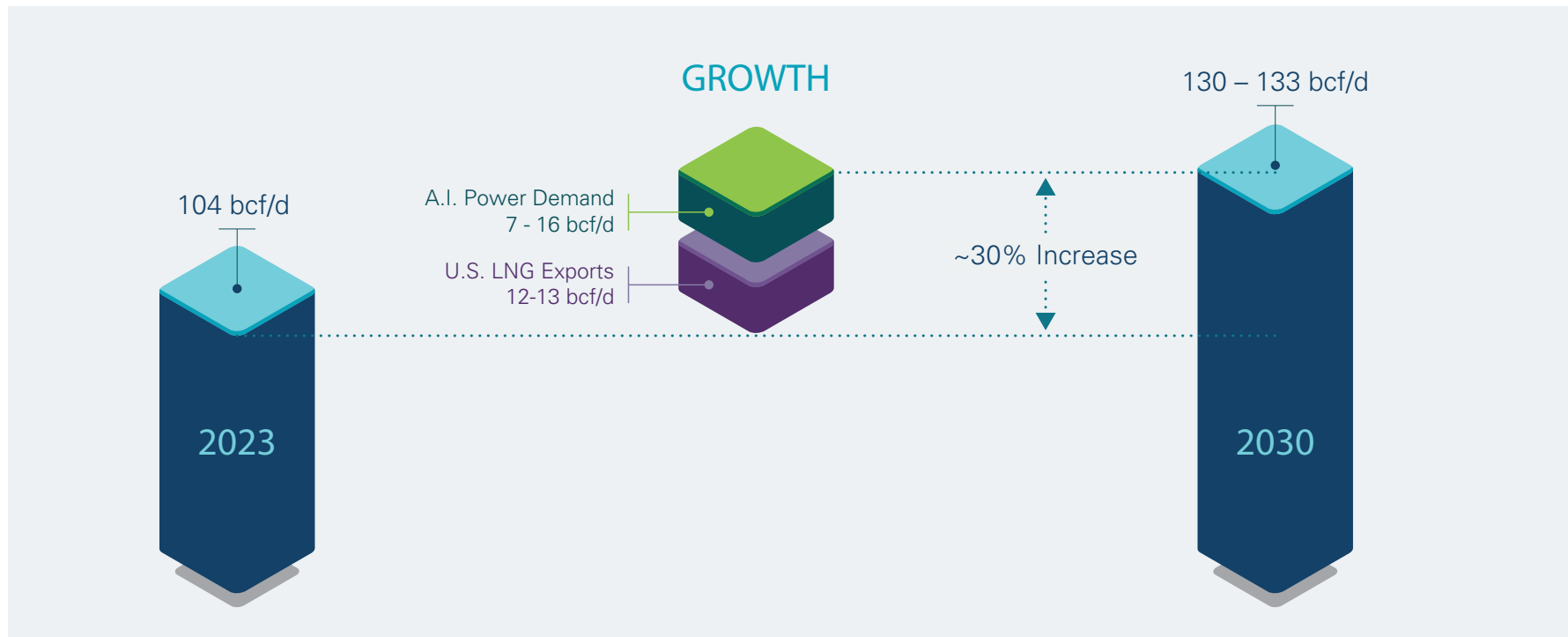


Source: McKinsey & Company Investing in the rising data center economy September 2024. Projections on this page are shown for informational purposes only and no guarantee of future outcomes.

Natural gas is fueling the AI boom

- 1 Natural gas is the largest source of energy for U.S. electricity generation representing 43%
- 2 U.S. natural gas production could grow by almost 30% between 2023 and 2030 tied to growth in LNG exports and increased demand for electricity

U.S. Natural Gas Production

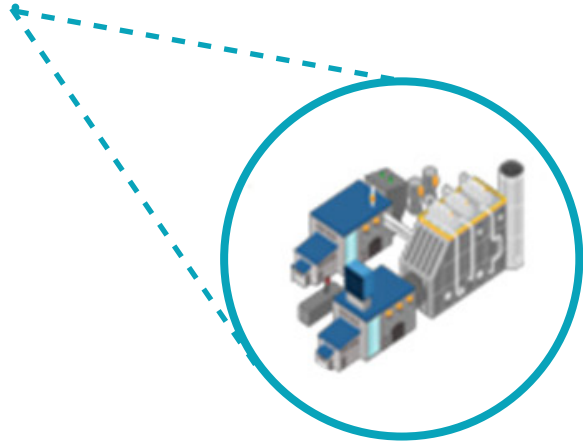


Source: EIA and Tortoise Capital estimates. Projections on this page are shown for informational purposes only and no guarantee of future outcomes.

Not all megawatts are created equally

To power 200,000 homes reliably, the grid needs ...

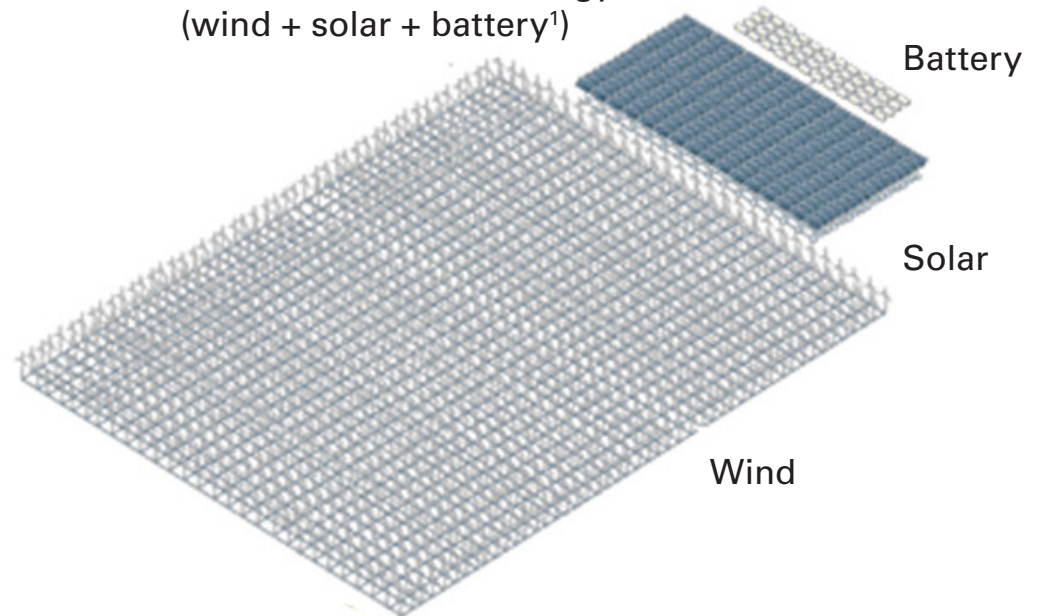
1,000 MW of modern
efficient gas plant



110 acres

or

9,000 of renewable energy
(wind + solar + battery¹)



147,540 acres (~**1,300x**)

Wind + Solar + Battery requires ~10x more capital investment, 9x more installed capacity, and ~1,300x more than a modern gas plant to achieve a similar level of reliability

Source: Vistra Investor Presentation January 2024. Assumes 1GW of CCGT @ capital cost of \$968/kw (\$1.0B), 9GW of wind+ solar + battery (\$10.3B): 4.5GW wind @ \$1,307/kw, 2.5GW solar @ \$1,120/kw, 2 GW 1-hr batters @\$807/kw based on ERCOT grid.

Conclusion: AI is considered the 4th Industrial Revolution



1	1760-1830	Era of Mechanization	Coal-fired steam engine
2	1870-1914	Technological Revolution	Automobile, light bulb, telephone, railroad, radio, electricity
3	1947-2000	Digital Revolution	Internet, computers, microprocessors, cell phones
4	2010-Present	Digital Age	Artificial intelligence, robotics, cloud computing Internet of Things

“Artificial intelligence is as revolutionary as mobile phone and the Internet” - Bill Gates



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