Fast, Flexible Solutions for Data Centers

Summary Overview

RMI Strategic Insights &
Carbon Free Electricity (CFE)

June 2025

Executive Summary

Despite their significant energy usage, data centers could be a boon: data center operators are ready to invest in efficient, flexible, and low-cost energy sources that can mitigate stranded asset risks for utilities and keep ratepayer costs in check.

Before you panic: Data centers use just 2% of global electricity today—and may account for approximately 10% of projected electricity demand growth between 2024 and 2030. This is less than the growth from industrial operations, electric vehicles, household appliances, and space cooling. However, in certain regions, data centers can account for as much as a quarter of electricity demand. Hyperscale data centers are over 100 times the size of typical data centers today and may increase the burden on grid infrastructure and other customers in these regions.

Many utilities, specifically in the US, have a track record of over-forecasting demand, spending billions of dollars building power plants for load that did not materialize. U.S. utilities over-forecast 10-year demand growth by 17% between 2006 to 2023.

This risk is more salient today given the unpredictability of data center load growth. Planned gas capacity in the US has jumped by 20% in the last year, but there are many unknowns around the evolution of AI that could significantly reduce its energy demand. Similar panics took place around information technology power usage in the past that never came to pass.

We mapped a range of energy solutions for data centers that can temper the risks of over-building and high rate-payer costs:

- **Integrating energy efficiency measures**, including advanced cooling technologies, hardware improvements, software and product design, and data management, can reduce data center energy usage by orders of magnitude compared to today.
- **Employing flexibility technologies**, in the form of temporal flexibility, spatial flexibility, and edge generation and storage flexibility, can mitigate the impact of data center electricity demand on grid performance and reliability.
- **Building out fast, modular, and low-cost energy sources** can both favor renewable energy and support energy affordability relative to fossil alternatives.

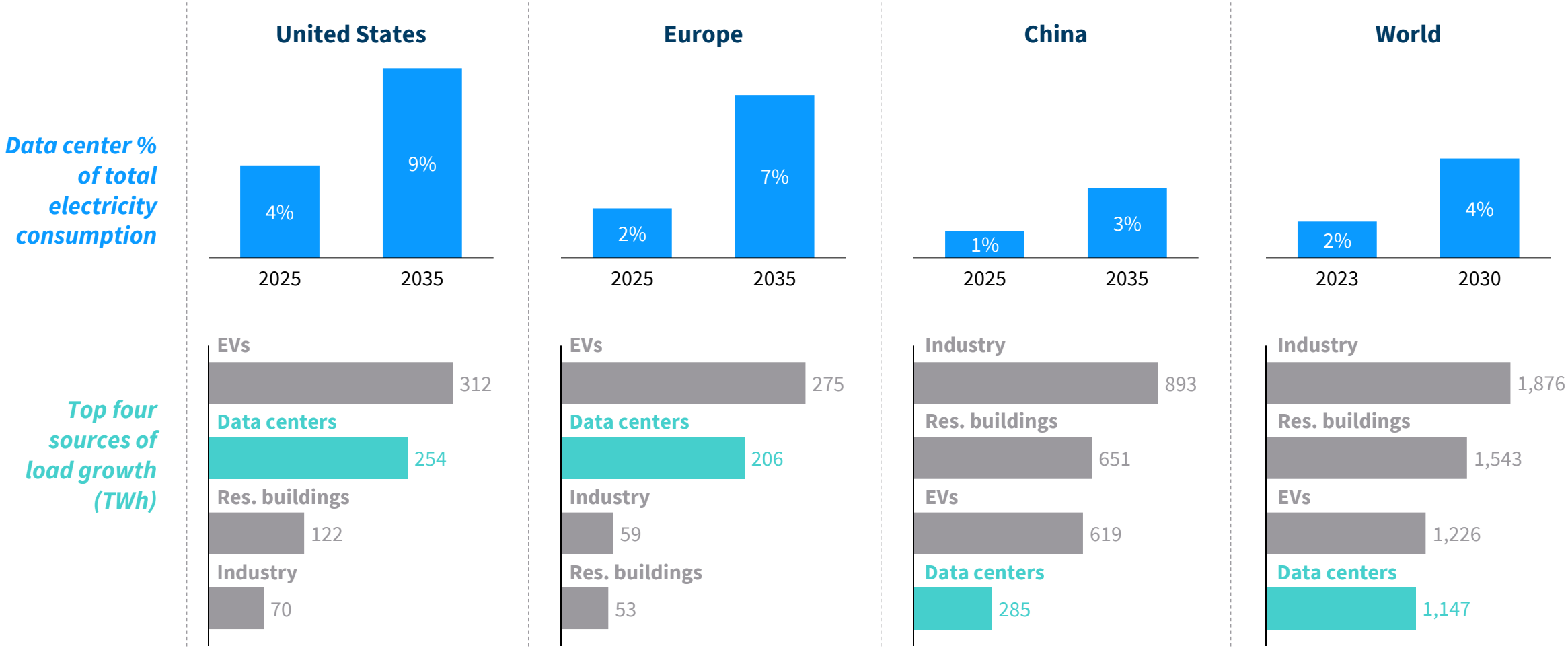
These solutions are already the most attractive options for data center operators that seek to scale rapidly while keeping costs as low as possible. They also offer a way for utilities to minimize stranded asset risks and will help policymakers and utility regulators balance their priorities of attracting economic growth, ensuring energy affordability for their constituents, and generating energy abundance for all ratepayers.

RMI

All sources are in the following slides.

Before you panic: data centers use just 2% of global electricity today

Even in the three largest markets, data centers will make up less than 10% of overall electricity demand in 2035



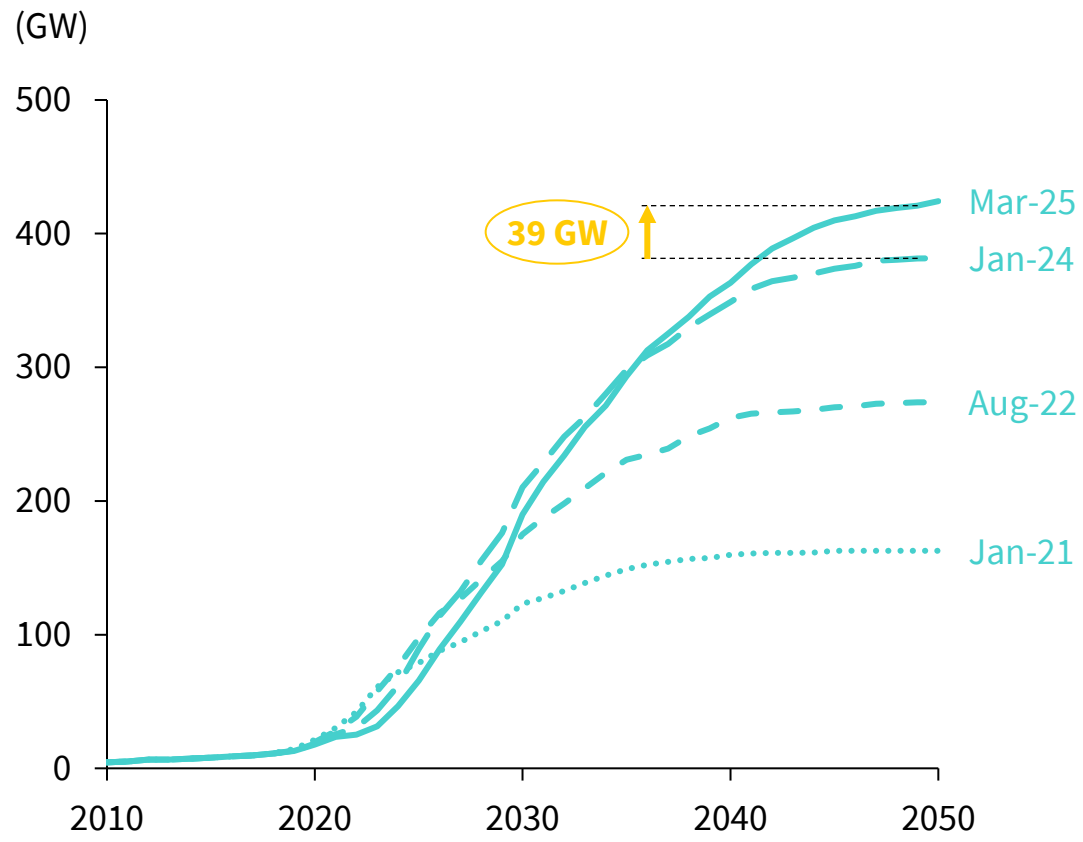
Note: Industry excludes heavy industry. Residential buildings includes air conditioning, heat pumps, household appliances, and others.

Source: BNEF New Energy Outlook 2025

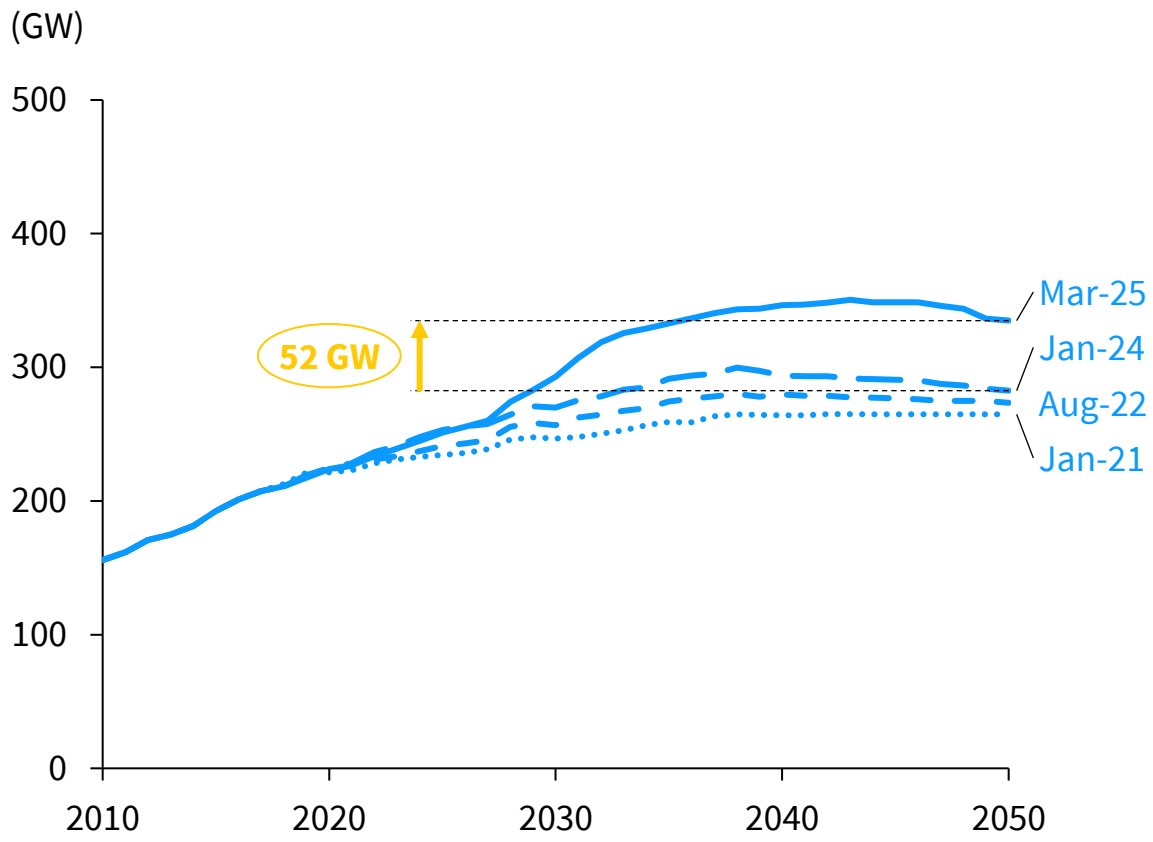
In the U.S., as utilities integrate data center growth into their forecasts, they are increasing build-out of natural gas

In 2025, utilities added more planned natural gas capacity than wind and solar

Planned wind & solar capacity in the U.S.



Planned natural gas capacity in the U.S.



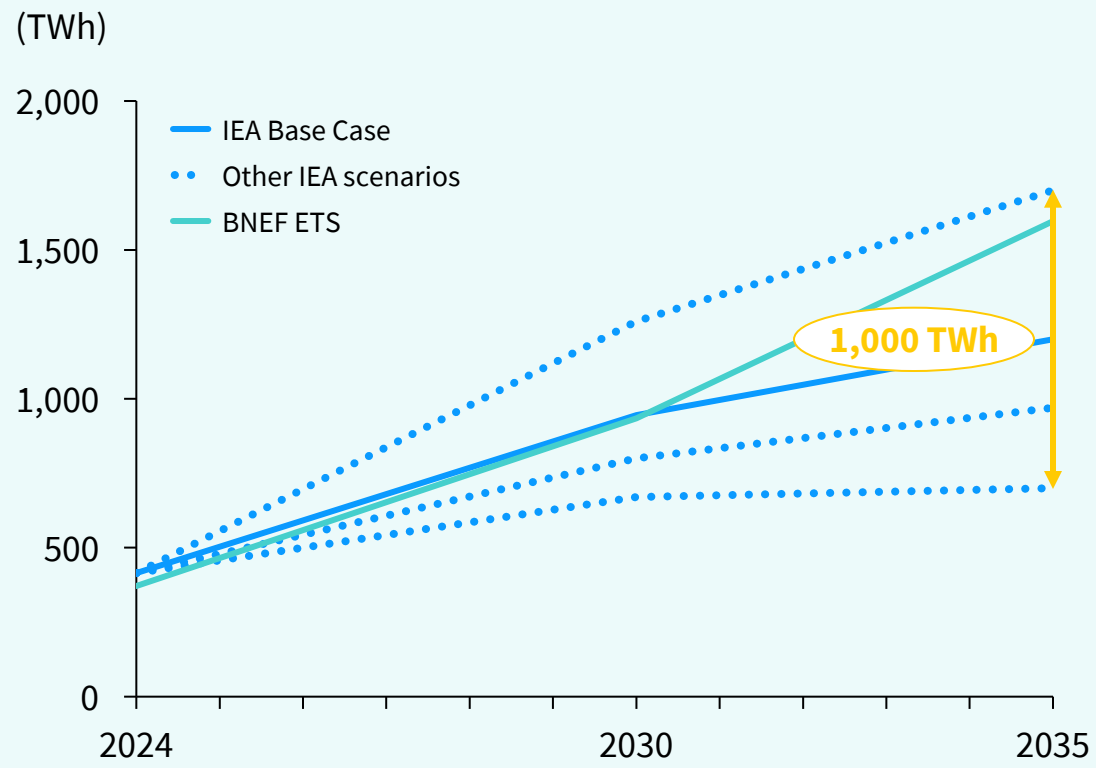
Charts include projections from 124 IRPs, covering 48% of electricity delivered to U.S. customers

Source: RMI Engage & Act

But this poses a high risk of over-building that may end up costing regular consumers billions of dollars

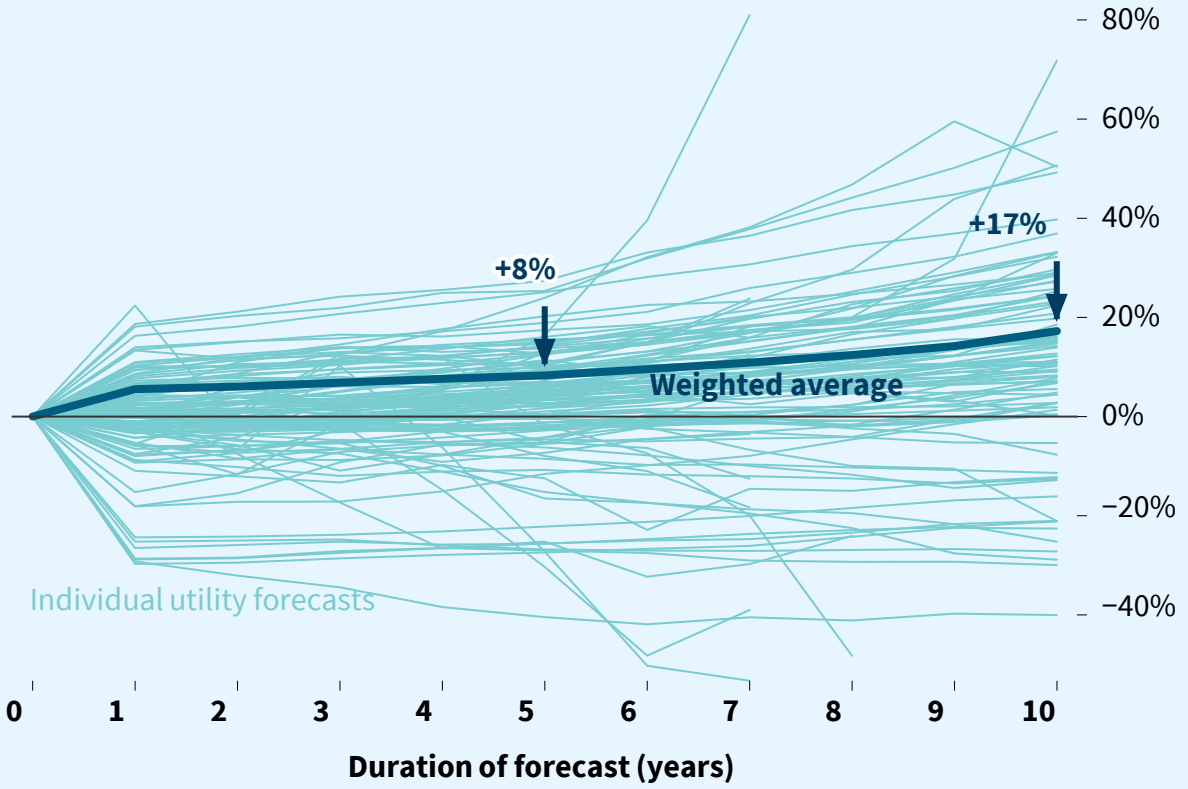
There is high uncertainty in data center demand…

Global data center energy demand forecasts



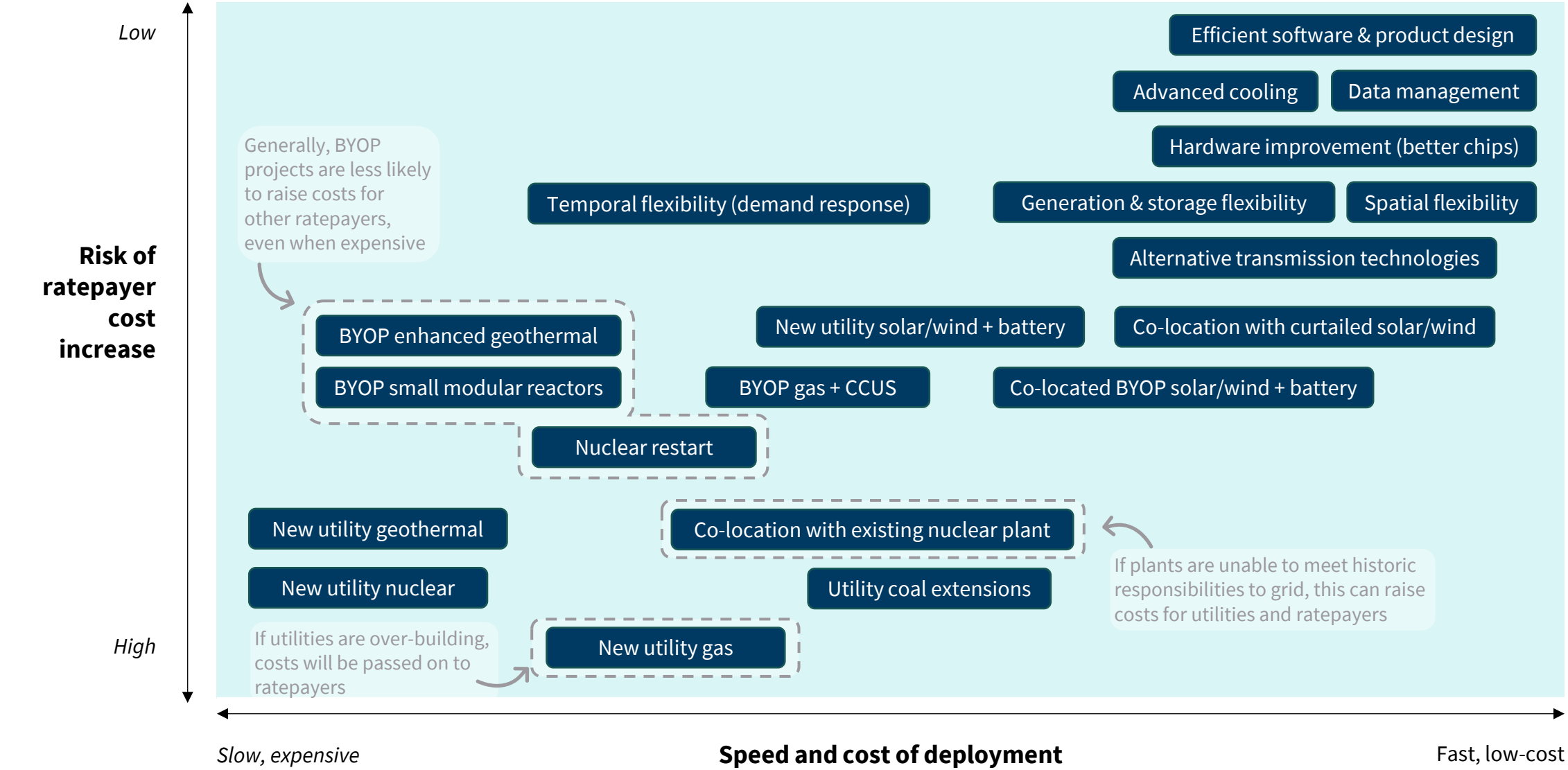
…and utilities have a track record of over-forecasting

U.S. utility peak demand forecast error, 2006-2023



Sources: [Left] IEA, Energy & AI (2025), BNEF New Energy Outlook 2025; [Right] : Alex Engel (RMI), using FERC 714 data as of October 2024

Fast and low-cost solutions can avoid increasing ratepayer costs



BYOP = Bring Your Own Power; refers to energy projects that are financed by data centers.

Source: RMI analysis based on publicly available project cost/speed data and ratepayer impact assessments.

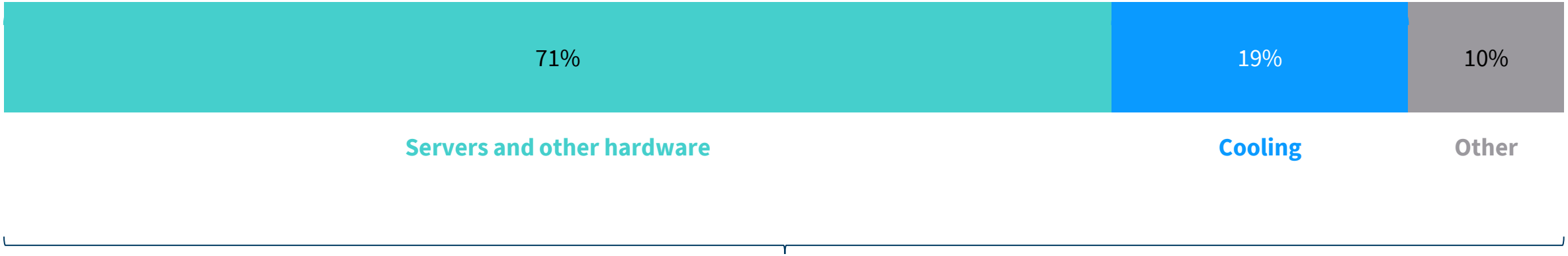
Deep-dive 1: Energy efficiency

Better software, hardware, cooling and design can radically reduce demand

Breakdown of data center energy consumption, global average

Software and hardware improvements can reduce energy consumption in servers and other hardware. For example, leading GPUs and TPUs are doubling in efficiency every two years.

Advanced cooling technologies can reduce the amount of energy needed for cooling. New hyperscale data centers have already reduced their cooling usage down to an average 7%.

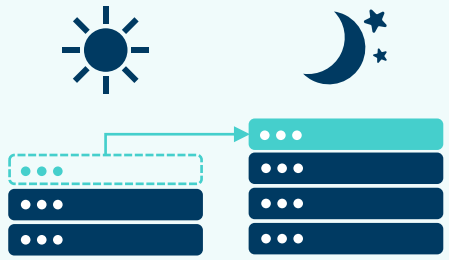


There are also opportunities to reduce overall demand for data center services, such as: **fit-for-purpose product design** (for example, small language models use over 90% less energy than large language models) and **better data governance** (about 50% of data is created and stored but never reused).

Source: IEA, Energy & AI (2025)

Deep-dive 2: Demand flexibility

Demand flexibility measures can help get more out of the existing and future grid



Temporal flexibility
shifts delay-tolerant *workloads* across *time* to reduce peak demand

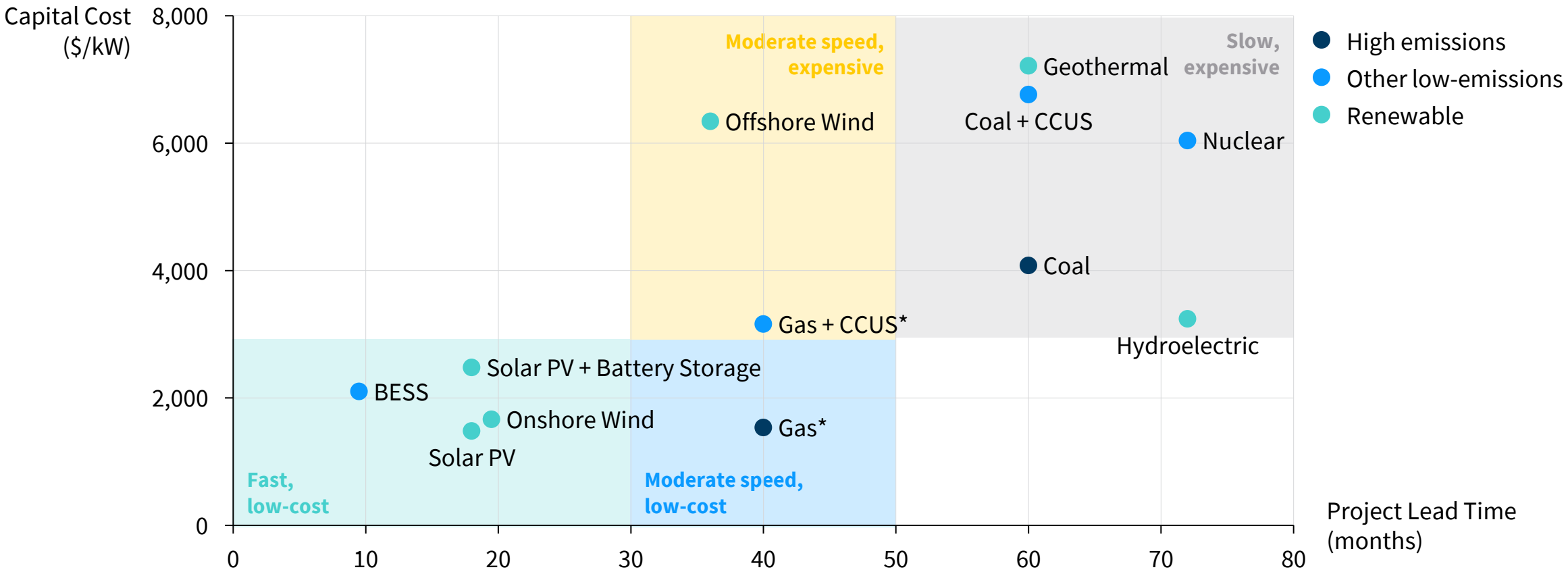
Generation & storage flexibility
shifts *power consumption* to another *source* (e.g., on-site battery storage) to reduce peak demand

Spatial flexibility
shifts delay-tolerant *workloads* (and data centers) in *space* to regions with abundant sources of cheap, clean energy

Deep-dive 3: New grid capacity additions

Solar, wind, and batteries are the cheapest and fastest way to add new capacity to the grid

Cost vs. speed of new utility-scale energy projects



Capital costs based on U.S. estimates as of 2022, except for nuclear, which reflects a 2019 estimate. Project lead time includes development, permitting, engineering, and construction.
**Current gas project lead times are significantly delayed due to turbine shortages*

Source: NREL, Electricity Annual Technology Baseline; U.S. EIA, "Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies"