McKinsey & Company

NAATBatt 2025

North America data center and BESS growth

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Agenda

Data center demand

Data center power demand

How BESS can enable data center growth

Takeaways

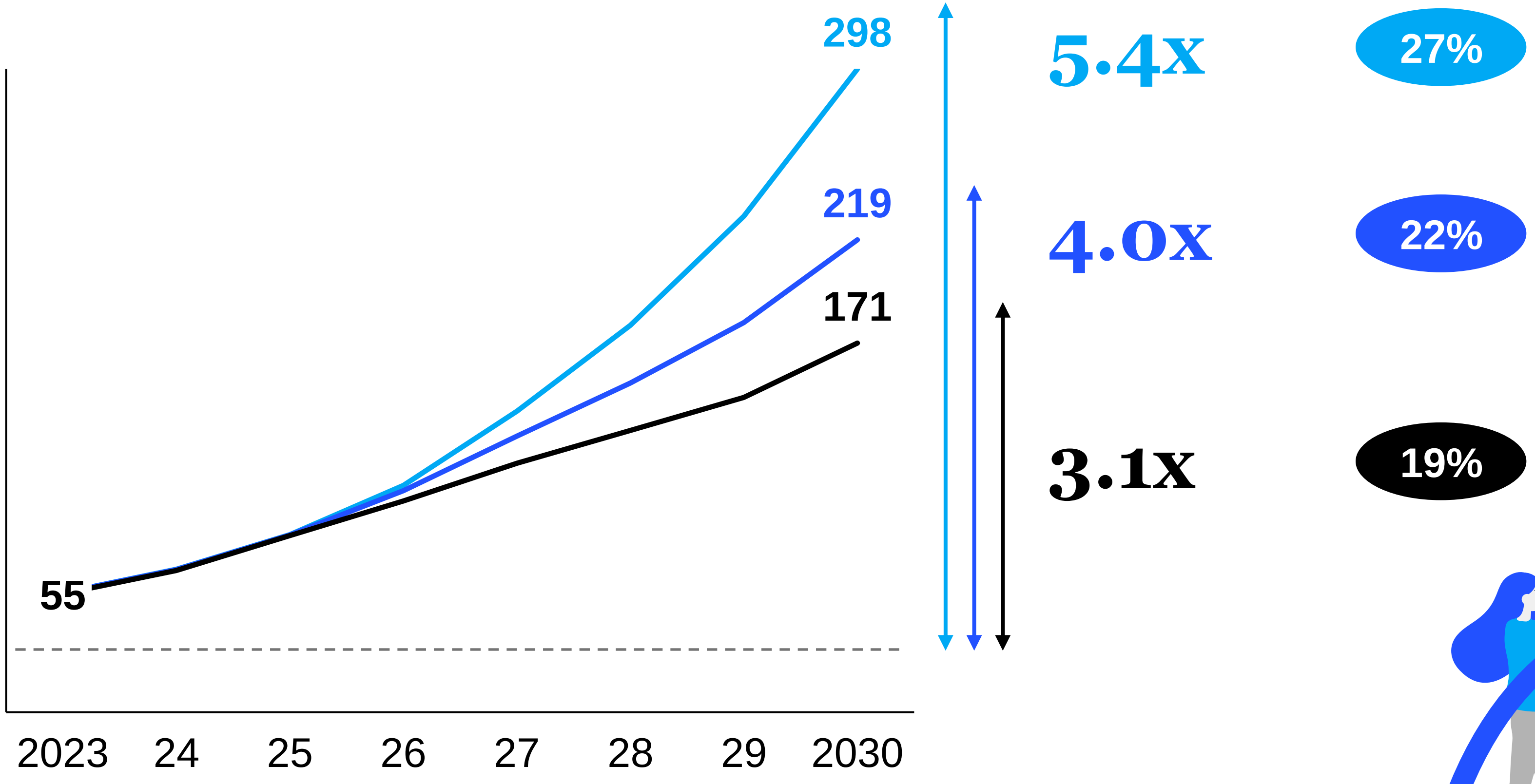
Global data center demand will more than triple to at least ~170 GW by 2030 at 19% CAGR

Estimated global data center demand, in GW

Accelerated demand, unconstrained[1] | Continued momentum[1] | Constrained momentum, ongoing demand ramp up[1]

Demand scenario, GW

CAGR '23-'30



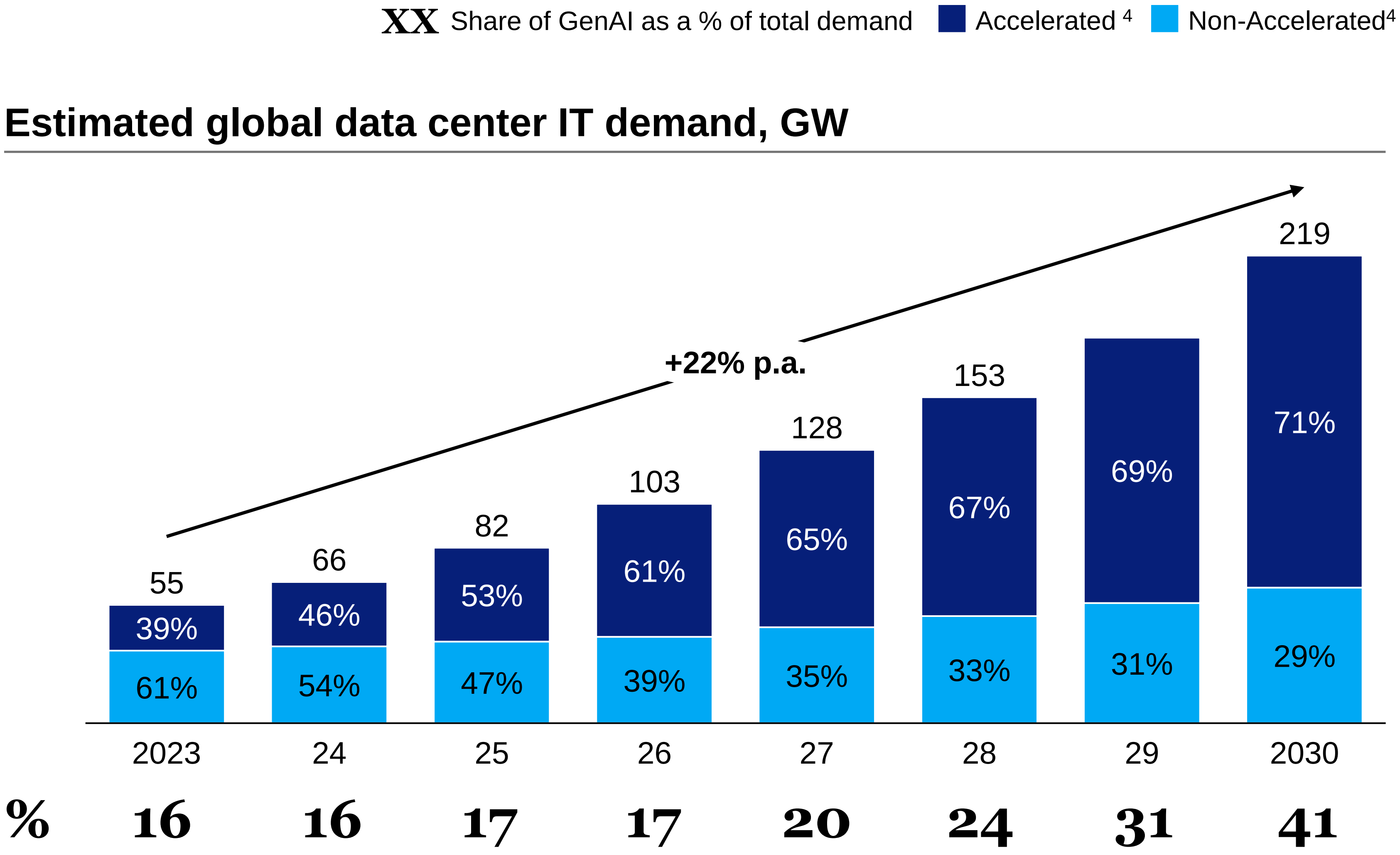
1. Defined based on GenAI adoption, power demand and power use

Source: McKinsey proprietary model

Both AI and non-AI workloads will be key drivers of DC demand growth through 2030

Continued Momentum[4]

Estimated global data center IT demand, GW



1. Graphical Processing Units; 2. Field Programmable Gate Arrays; 3. ASIC: Application Specific Integrated Circuit; 4. Accelerated/non-accelerated – defined based on chipset usage

Source: McKinsey proprietary model, industry reports, expert insights, and NVIDIA capital markets reports

Insights

Accelerated compute (e.g., GPU[1], FPGAs[2], ASICs[3]) **expected to rise to 70% total demand**, while GenAI (e.g., text/code generation, video generation) to grow to 40% of total demand by 2030

Growth in Non-AI workloads is driven by continued migration to cloud and growth of cloud native workloads

Power draw is expected to increase at higher rate than historical as servers require higher power draw and attach rates to manage increasingly complex workloads

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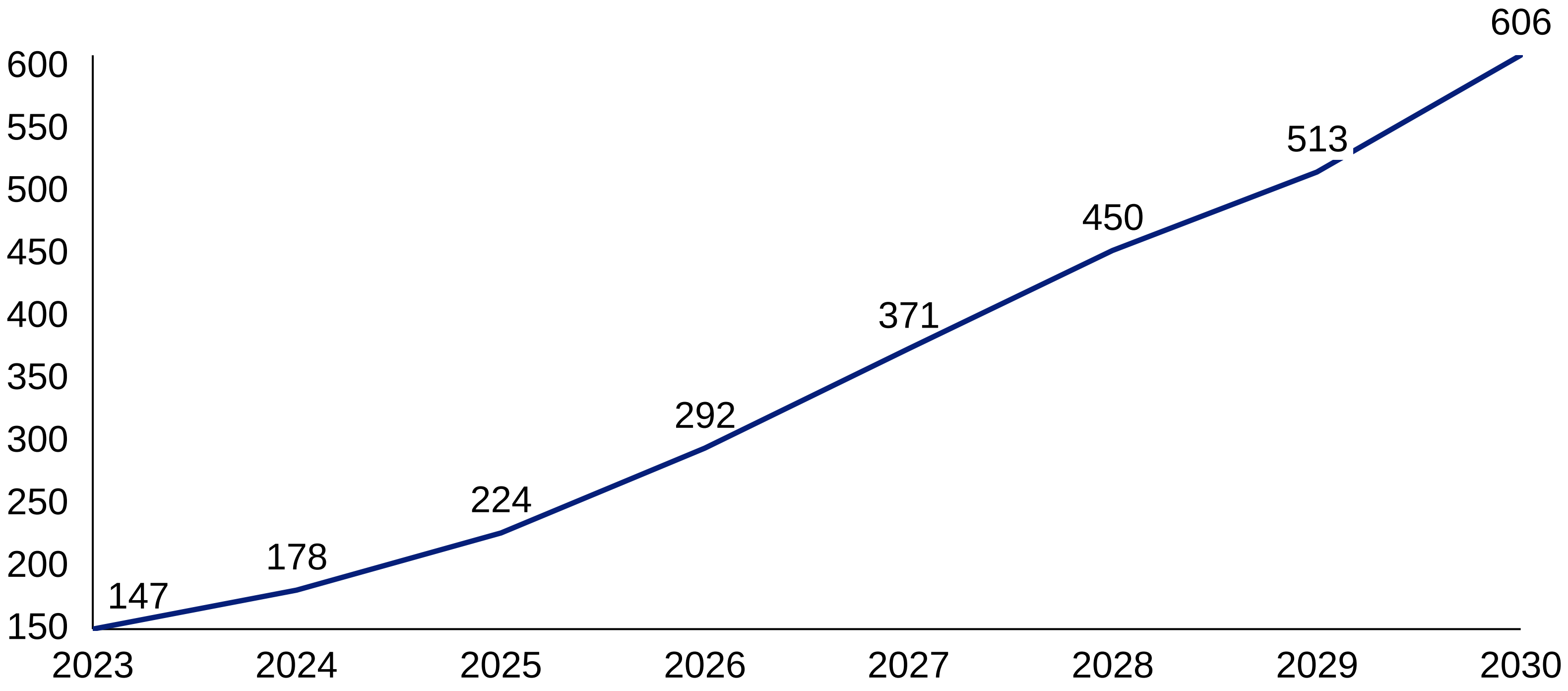
In line with demand, data center electricity demand expected to rise significantly in the US

TWh of electricity demand

XX % of total US energy demand

US datacenter energy consumption, TWh



%	2023	2024	2025	2026	2027	2028	2029	2030
%	3.7	4.3	5.2	6.5	8.0	9.3	10.3	11.7

Insights

Data center power demand will increase substantially in the **US from 2023 to 2030 –adding ~460 TWh of new electricity demand, at a CAGR of ~22%**

Power demand in the US has **hardly grown from 2007 in aggregate**, and data center load may make up ~30% of all net new demand added between any two consecutive years until 2030

Source: McKinsey Energy Solutions Global Energy Perspective 2023; McKinsey proprietary model

To successfully scale, data centers must solve multiple power and energy challenges that are impeding data center deployment

Deep dive next

Challenges	Power Availability	Site selection	Long lead equipment delay	Skilled labor availability
Description	• **Inadequate generating, transmission and distribution (T&D) infrastructure** with increasing load demand from industrial and data center customers • For specific markets in the US, **PUC[1]s are pushing back on grid expansion for data centers over cost-sharing concerns**, pushing data centers to fund upgrades themselves or invest in on-site generation and storage to reduce grid dependency[2]	**Competition for optimal construction sites** with lower operational risk, connectivity, and standardization potentially can impede GTM timing	**Protracted acquisition of critical long lead equipment** due to supply chain constraints, absence of centralized strategic sourcing and inadequate vendor management resulting in longer construction timelines[3]	**Delays in construction project timelines and capacity delivery** from a shortage of skilled labor in many markets[4]

Due to these challenges, utilities and data centers are exploring *storage* as alternative to centralized T&D buildout

1. Public Utility Commissions; 2. Example: "AEP Ohio reaches agreement with stakeholders on data center interconnection rules" (2024); 3. Transformer lead times have been increasing for the last 2 years - from around 50 weeks in 2021, to 120 weeks on average in 2024 (Wood Mackenzie 2024); 4. Shortages of highly-skilled electrical technicians with experience in medium voltage and direct current (DC) terminating and connecting (Reuters 2024)

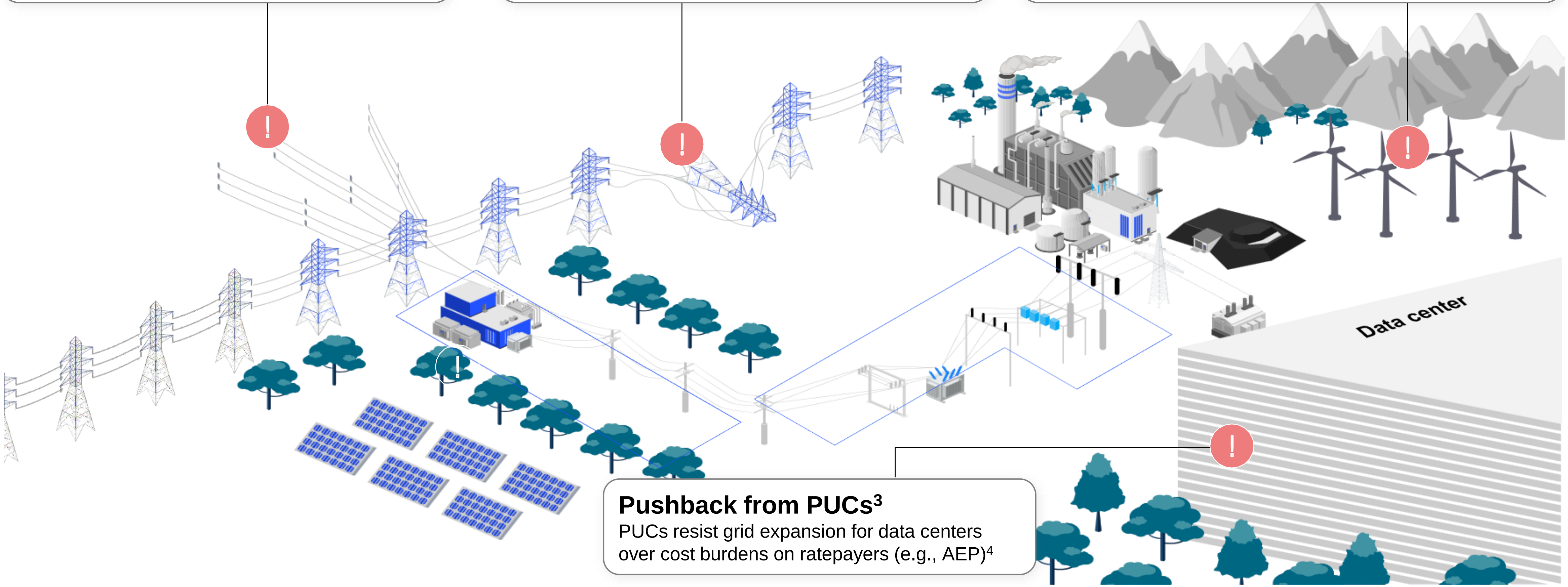
Source: McKinsey Energy Storage Insights, team analysis

Power availability | US power grid likely to face significant challenges to achieve speed and scale of required data center expansion, requiring innovative solutions

Congested utility grid
Utilities often lack the resources to connect the growing number of interconnection applications quickly, particularly in congested regions

Lack of T&D[1] infrastructure
In areas with high data center concentration (e.g., Virginia, Dublin), lack of local T&D infrastructure limits the ability to accommodate new load requests[2]

Insufficient availability of renewable energy
Data center expansion in specific regions coupled with sustainability goals requires substantial and consistent power; not all regions have enough RE to meet those goals



Pushback from PUCs[3]
PUCs resist grid expansion for data centers over cost burdens on ratepayers (e.g., AEP)[4]

1. Transmission and distribution; 2. Example: PJM Interconnection opened a competitive auction for transmission projects partly due to data center demand (2024); 3. Public utility commissions; 4. Example: "Rising data center loads pose grid reliability, residential cost risks: APS executive" (2024)

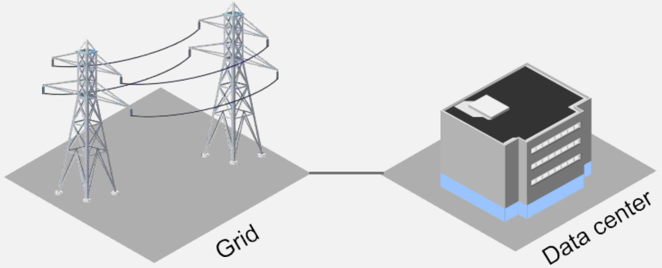
Source: McKinsey team insights, press search

There are 3 main ways datacenters can mitigate power challenges and improve speed-to-power

Not exhaustive

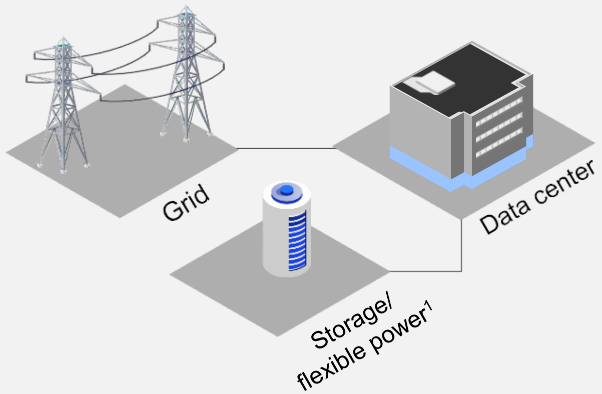
✓ Benefits
✗ Challenges
■ Microgrid

1 Traditional grid connected power



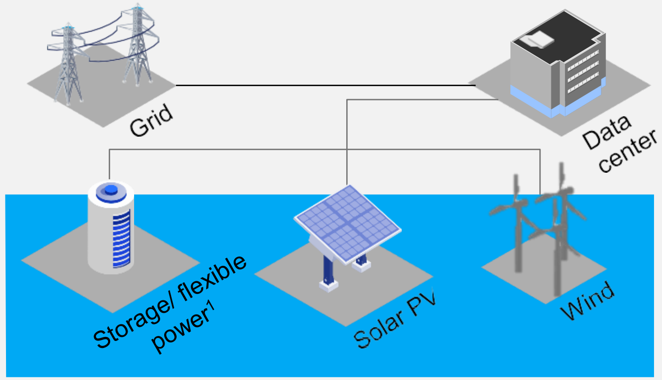
- ✓ Continuous, reliable power from the grid
- ✓ Developers front CAPEX and OPEX project cost; data centers take on less risk in project development
- ✗ Depending on market, can take 3+ years to connect to grid

2 Traditional grid connected + onsite flexible power



- ✓ Reduces need for large interconnection; potential faster speed to power
- ✓ Reduces need to draw power from the grid during high electricity prices (e.g., time-of-use, demand charges)
- ✗ Data center takes on full project cost for flexible asset

3 Onsite generation (with or without grid connection)



- ✓ Potential faster speed to power for data center (depending on how fast you are building out microgrid)
- ✓ Reduces need for large interconnection
- ✗ Data center takes on project cost for microgrid

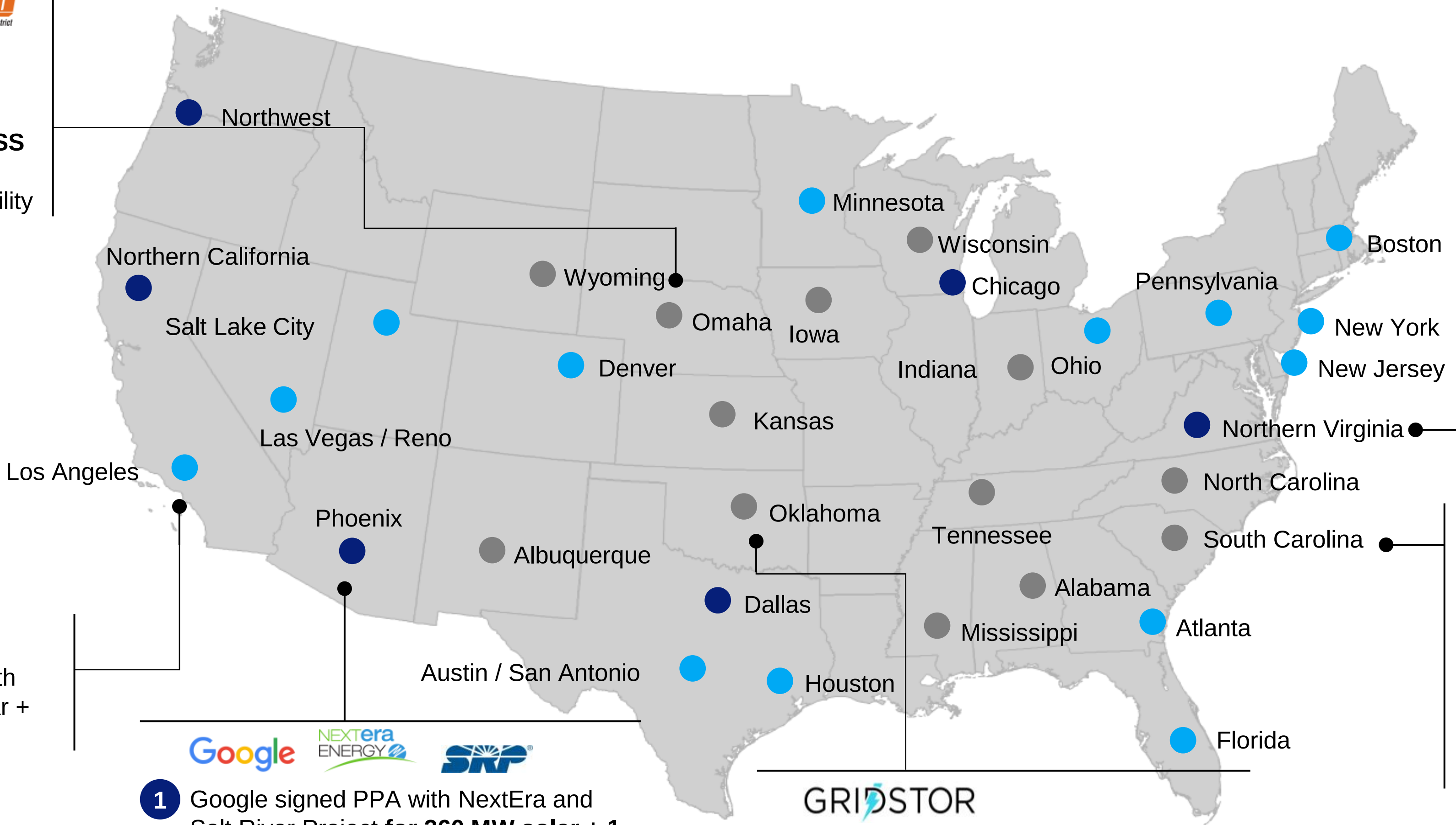
1. Includes BESS, natural gas, hydrogen fuel cells, LDES and other flexible technologies

Source: McKinsey team analysis

Given the challenges data centers are facing, we see BESS deployed in different ways based on grid and data center needs

Not exhaustive

- **Large data center demand** — Large existing data center demand over ~800MW
- **Secondary data center demand** — Relatively smaller demand between but typically high growth
- **Emerging Markets** — Recent hyperscale activity due to cheap and sustainable / cleaner power with negligible colocation presence



1 **Google signed offtake agreement with NextEra Energy** at Pierce County Energy Center **solar + BESS** project and will also share capacity rights with local utility

1 **Amazon signed a PPA** with AES for energy from a solar + BESS power plant

1 Google signed PPA with NextEra and Salt River Project **for 260 MW solar + 1 GWh BESS plant** to power nearby Mesa, Arizona data center

2 Gridstor acquired **200 MW/800 MWh grid-connected BESS project** being built to serve data center demand in Eastern Oklahoma

2 Iron Mountain installing battery onsite the Prince William County data center to **both provide the grid with ancillary services and UPS services for the data center**

3 Google and Intersect Power developing co-located renewables + BESS energy parks to **serve Google's data center energy needs and provide grid services while reducing transmission infrastructure buildout**

Source: Public announcements

What is driving BESS growth in data centers

Not exhaustive

	Speed-to-power	High electricity prices	Required costly infrastructure build
Challenges	**3+ years to connect to the grid in some markets**	**20% increase in retail electricity prices from 2020 to 2023**	**~$50 to $150 million in grid investment per data center[1]**
BESS advantages	By using BESS, data centers can reduce reliance on building out additional, length interconnection capacity to address peak demand	More cost effective to provide behind-the-meter BESS during high electricity prices to lower demand charges, peak shaving costs, etc.	More CAPEX effective to integrate BESS with generating resources in a microgrid; BESS can reduce dependence on the grid and manage data center energy needs internally rather than investing in costly transmission and distribution infrastructure
Example	RACKSCALE DATA CENTERS — RackScale and Energy Vault partnership[2]	switch — Switch Citadel Campus in Reno, NV	Google, Intersect Power — South Carolina Google and Intersect Power renewables + storage industrial park project

1. Dependent on size of data center; 2. Public announcement

Source: CAISO, EIA (Energy Information Agency), RTO Insider; Utility Dive, public announcements

Not exhaustive

We are seeing BESS being adopted in an increasing number of datacenters in North America

Power purchase agreement (PPA) | Onsite BESS

Hyperscaler[1]	BESS players[2]	Announced (Completion)	Description
aws	FLUENCE A Siemens and AES Company; aes	2024	**Baldy Mesa solar farm, California** 75 MW Solar + 300 MWh BESS
			Bellefield solar farm, California 1GW Solar + 1 GW BESS, 2 phases
Microsoft	aes	2022	**Raceway solar-plus-storage, California** 125 MW Solar + 80 MW battery
	aes	2021	**Virginia** 576 MW contracted assets, incl. wind, solar BESS
			Additional sites in Europe, including Scotland, Ireland, Sweden
Meta	FLUENCE A Siemens and AES Company; Ørsted; SRP	2024	**Pinal country, Arizona** 300 MW Solar + 1.2GWh BESS
	Q CELLS a Hanwha company	(2024)	**Borrego Springs, California** 50 MW solar + 200 MWh BESS
Google	NextEra Energy Resources	(2023)	**Buckeye, Arizona (Sonoran Energy)** 260 MW Solar + 260MWh BESS
	SRP	(2023)	**Pinal country, Arizona** 260 MW Solar + 260MWh BESS
	Intersect Power; TPG RISE CLIMATE	2024	**Various, across the US** $20 Bn, by 2027
	X-ELIO	(2025)	**Bell Solar PV Plant** 128 MW total, 100 MW BESS

1. Hyperscalers also provide AI/ML technologies;
2. BESS players including BESS integrators and developers, investors

Source: Public annoucements

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BESS outperforms on data center BTM core needs compared to other technologies

Not exhaustive   Illustrative

Meeting core needs: Low (red), Medium (grey), High (green)

Core requirements	Relevant benchmarks	Electro-chemical batteries	Hydrogen	Natural gas	
		BESS[1]	Fuel cells	Combined cycle gas turbine (CCGT)	Gen-sets[2]
Speed to market	Technology maturity	High	Medium	High	High
	Deployment speed	High	Low	Medium	High
Scalability	Modularity	High	High	Low	High
	Locational flexibility	High	Medium	Medium	High
Technical specifications	Duration (hours)	Low	High	High	High
	Resiliency[3]	High	Medium	Medium	Medium
	Emissions[4]	High	High	Low	Low
	Footprint[5]	Medium	Low	High	High
Cost	Total cost of ownership[6] ($/MWh)	Medium	Low	Medium	Medium

1. Lithium-ion batteries used for onsite flexibility 2. Small size natural gas generators; 3. i.e. response speed to outage event; 4. CO_2, and air emissions (e.g., SOx, NOx); 5. Land use in ha/TWh/yr; 6. Equipment cost + EPC + project development + operations and maintenance

Source: McKinsey team analysis, Lovering J, Swain M, Blomqvist L, Hernandez RR (2022) Land-use intensity of electricity production and tomorrow's energy landscape (2022), Fuelcellenergy.com, Lazard

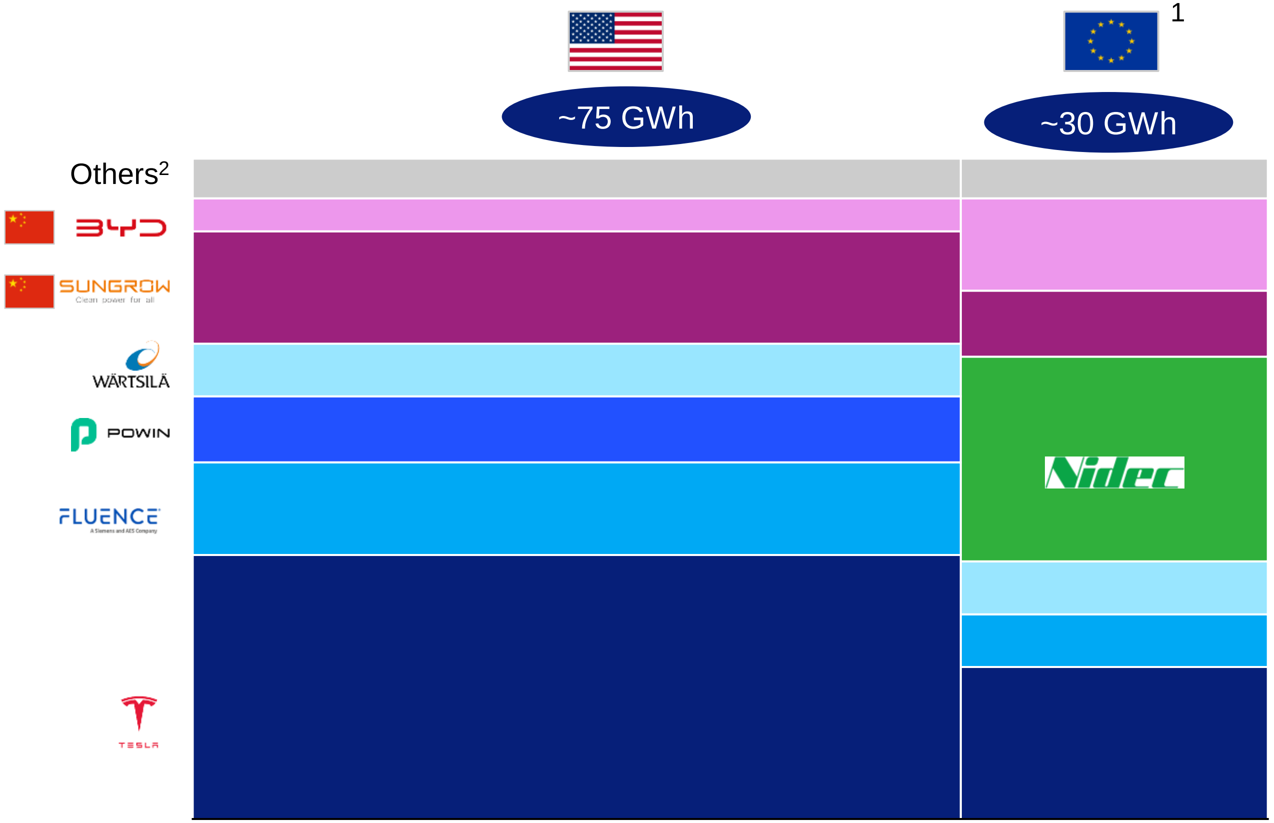
~70% of US market is coming from western integrators (e.g., Tesla, Fluence and Wartsila) but others are coming in…

Sustainable Transformation Scenario

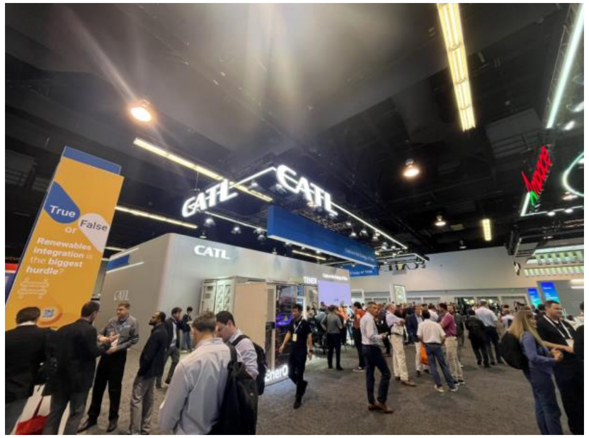
XX Cumulative installed capacity of utility scale storage, 2024

~70% of US market currently installed by Western integrators

System Integrator market share of utility scale and C&I[3] projects, 2024 est., %



…and the landscape is evolving



RE+ 2024, Anaheim, California

Many Chinese system integrators are expanding in the US…

1. Includes UK; 2. Including e-STORAGE, Trina Storage, SAFT, Envision, Prevalon and more; 3: C&I: Commercial and Industrial, i.e. onsite project

Source: McKinsey Global Energy Perspective, McKinsey Energy Storage Insights, Wood Mackenzie 'Global battery energy storage supply chain 2024 report', press announcements; expert input

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- Data center demand
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- How BESS can enable data center growth
- **Takeaways**

Key takeaways

How can battery storage help address data center power challenges?

Takeaway 1

Growth in AI training and data center demand will undoubtedly place stress on the power grid as data centers require increasing load from the grid

Takeaway 2

BESS is an effective solution to support datacenter growth; This growth is nuanced and will vary across North America

Takeaway 3

The current landscape in North America is also evolving as new entrants are entering the market and new partnerships will be formed

Thank you!

McKinsey Battery Accelerator Team