TEXAS RE

Artificial Intelligence in the Electric Industry

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International Energy Agency

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June 11, 2025

Antitrust Admonition

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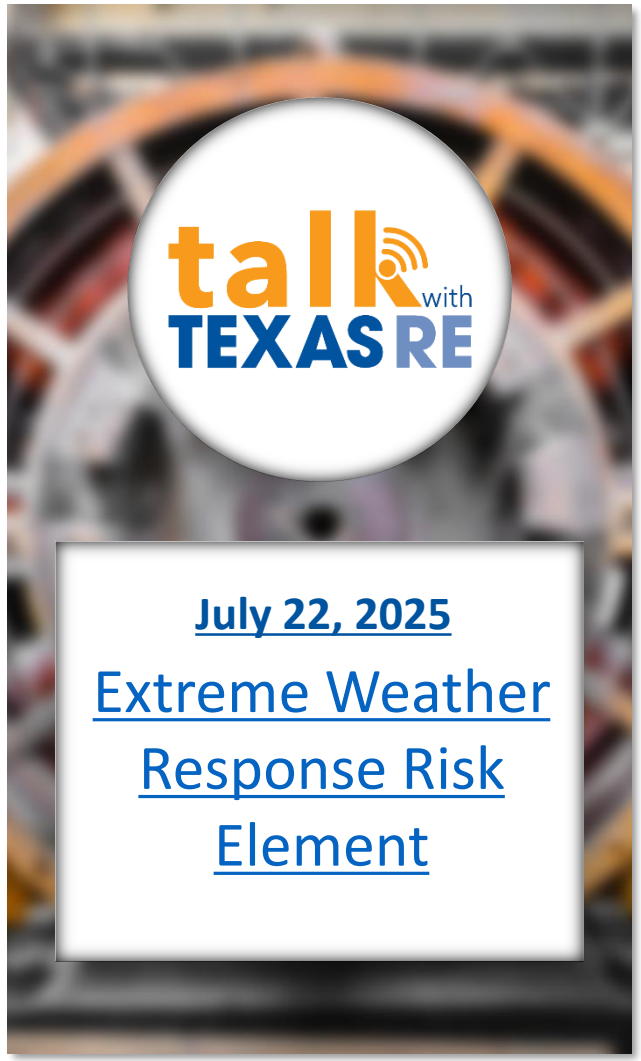
Upcoming Texas RE Events

June 16, 2025

2024 Reliability Performance and Regional Risk Assessment

June 24, 2025

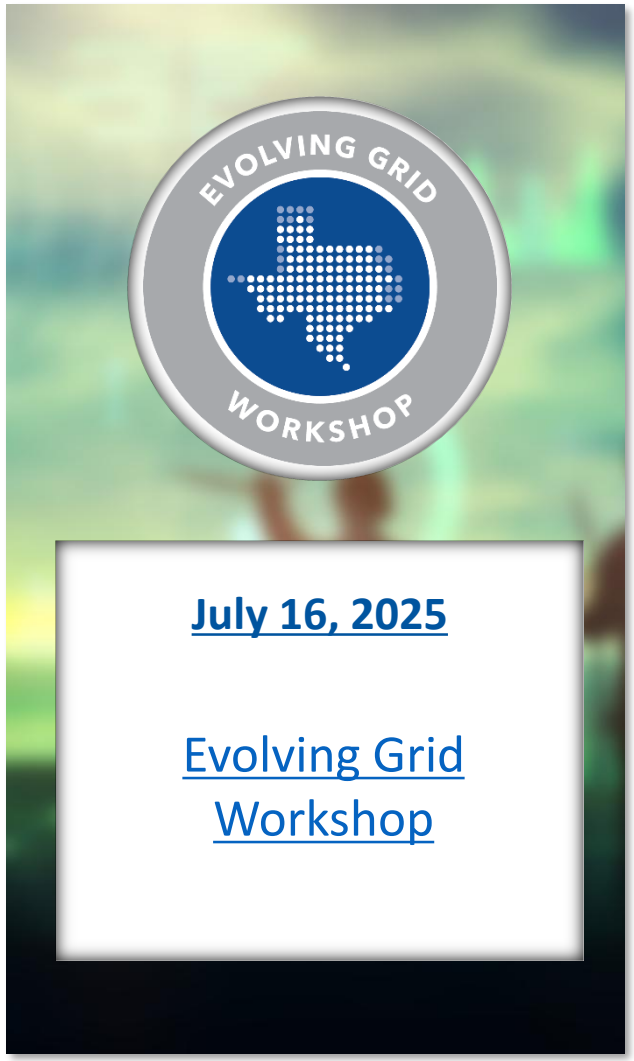
Modeling and Model Verification



July 22, 2025

Extreme Weather Response Risk Element

Upcoming Texas RE Events



July 16, 2025

Evolving Grid Workshop

September 17, 2025

Q3 MRC, AGR&F, and Board Meetings

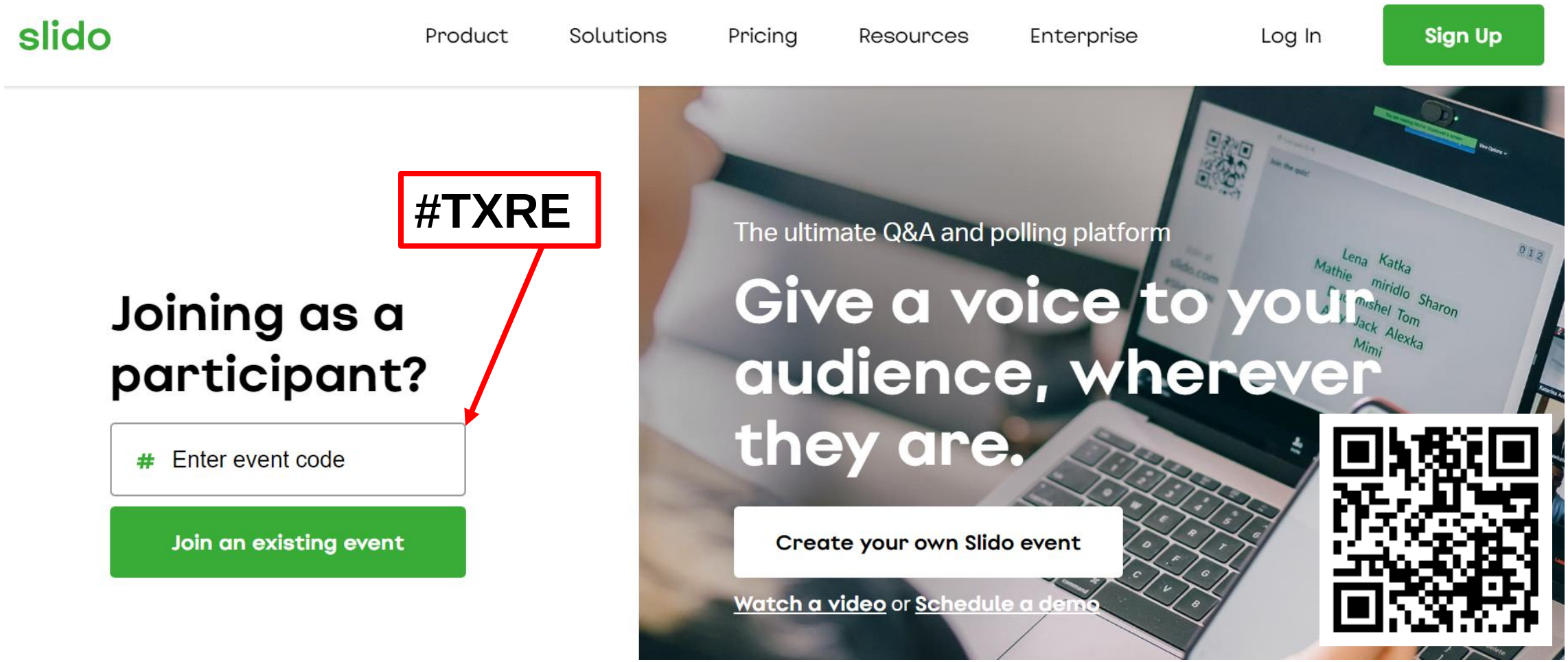
October 1, 2025

Winter Weatherization Workshop

Upcoming ERO Enterprise Events

Date	Event
June 16	Technical Talk with RF (RF)
June 19	Reliability & Security Monthly Update (WECC)
July 17	Reliability & Security Monthly Update (WECC)
July 21	Technical Talk with RF (RF)

Slido.com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International Energy Agency

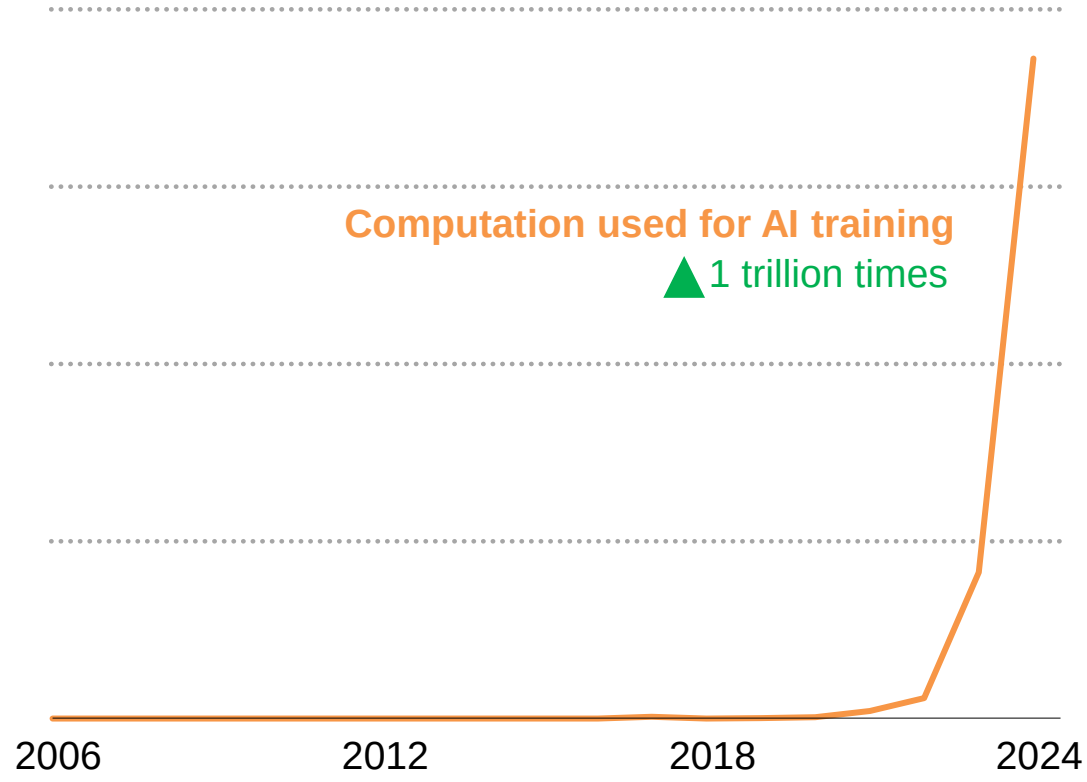
Energy and AI

Thomas Spencer, Senior Energy Analyst, STO

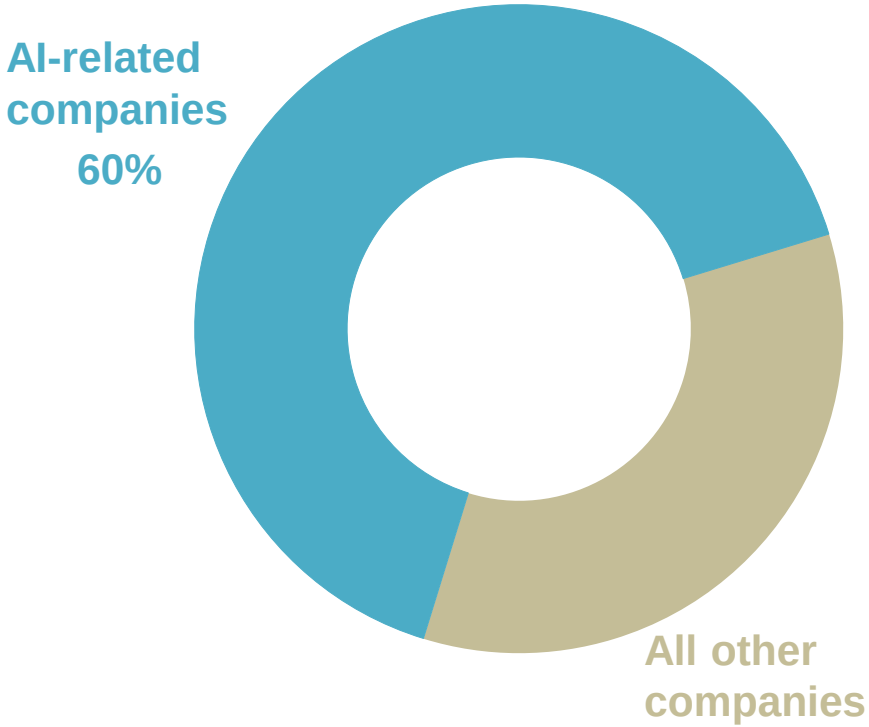
11 June 2025

The rise of artificial intelligence

AI model training size

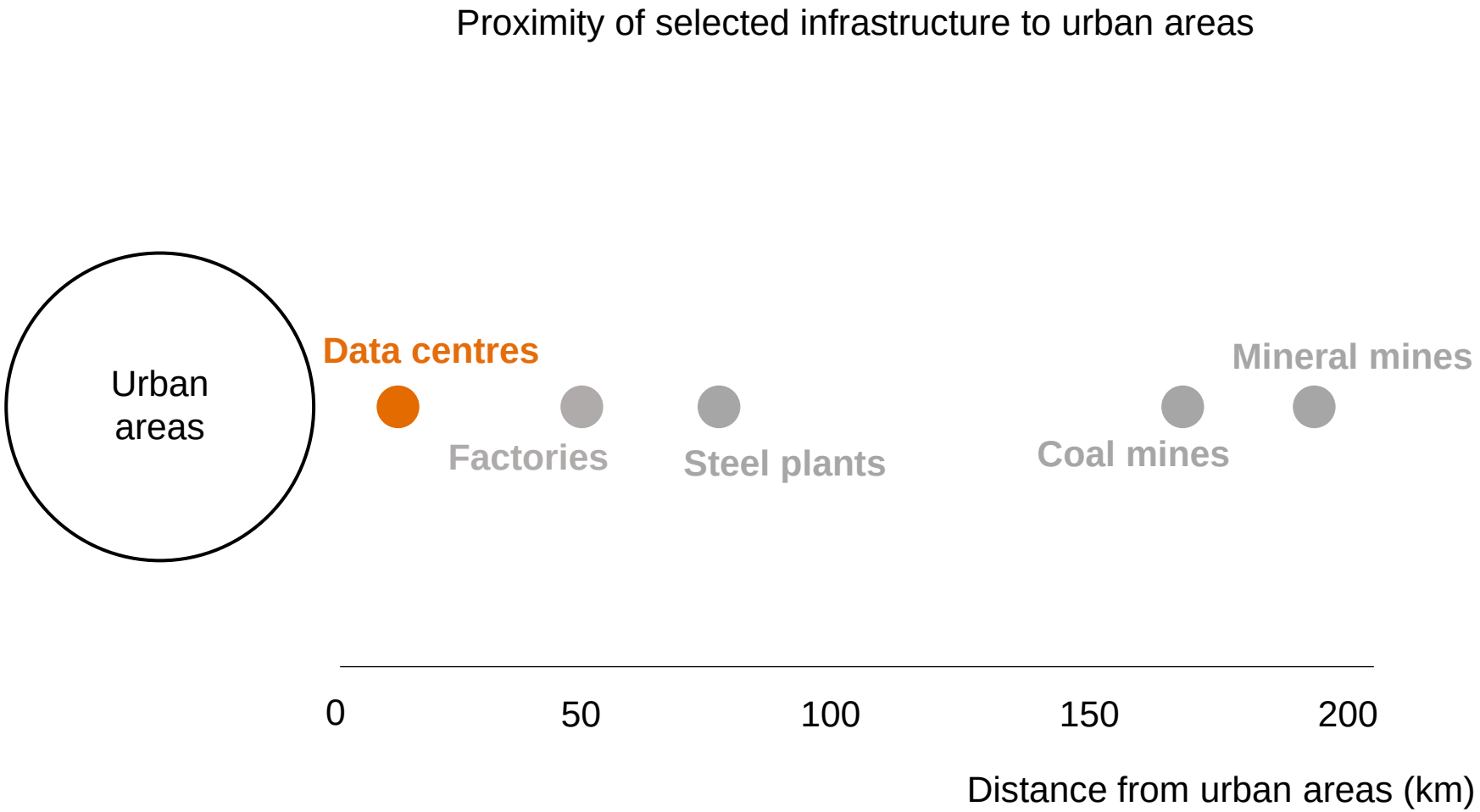


Change in market capitalisation of the S&P500 (November 2022 to March 2025)



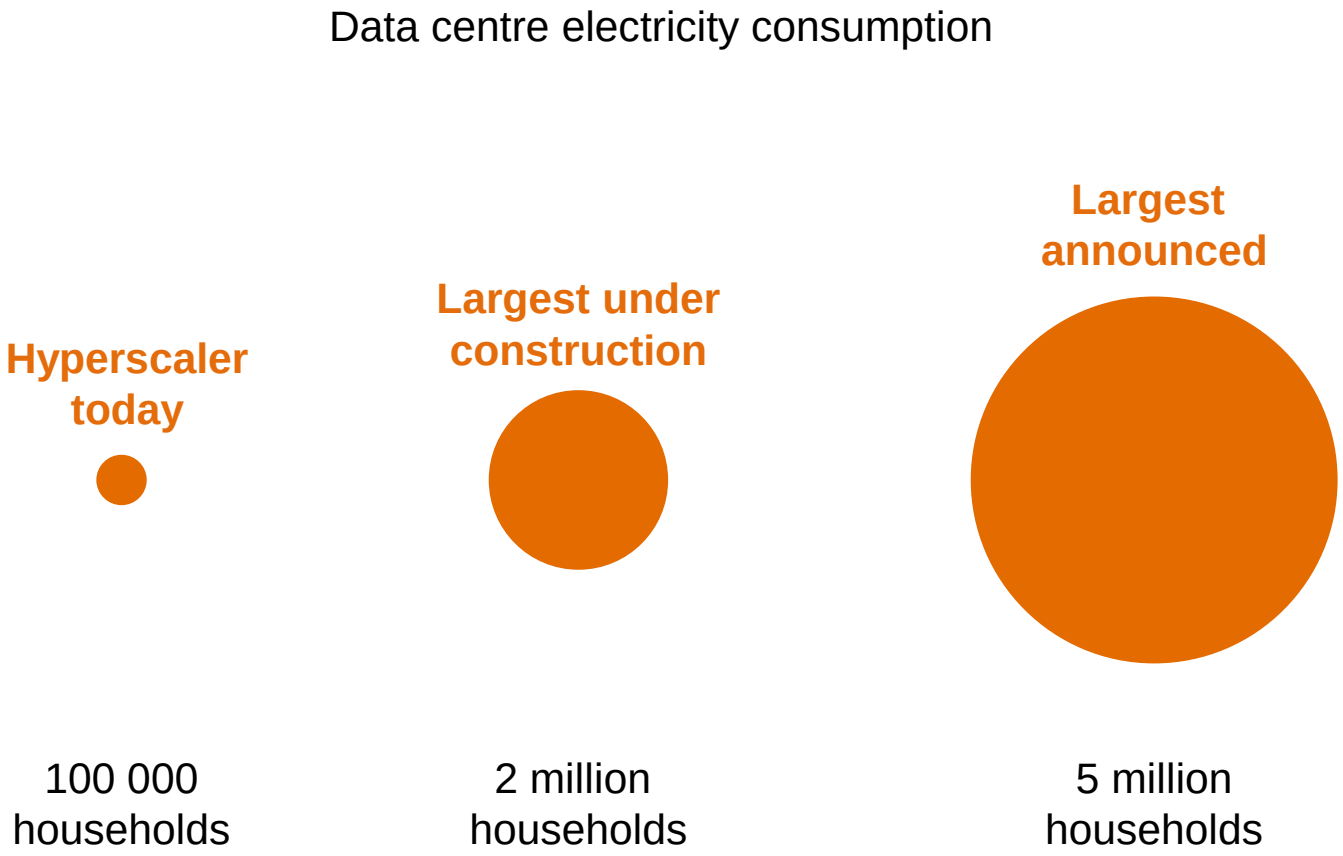
Cheap and abundant computing, more data, and technical breakthroughs have ushered in a new age of AI. AI-related companies drove most of the increase in market cap, in anticipation of the growth opportunities.

Data centres cluster together



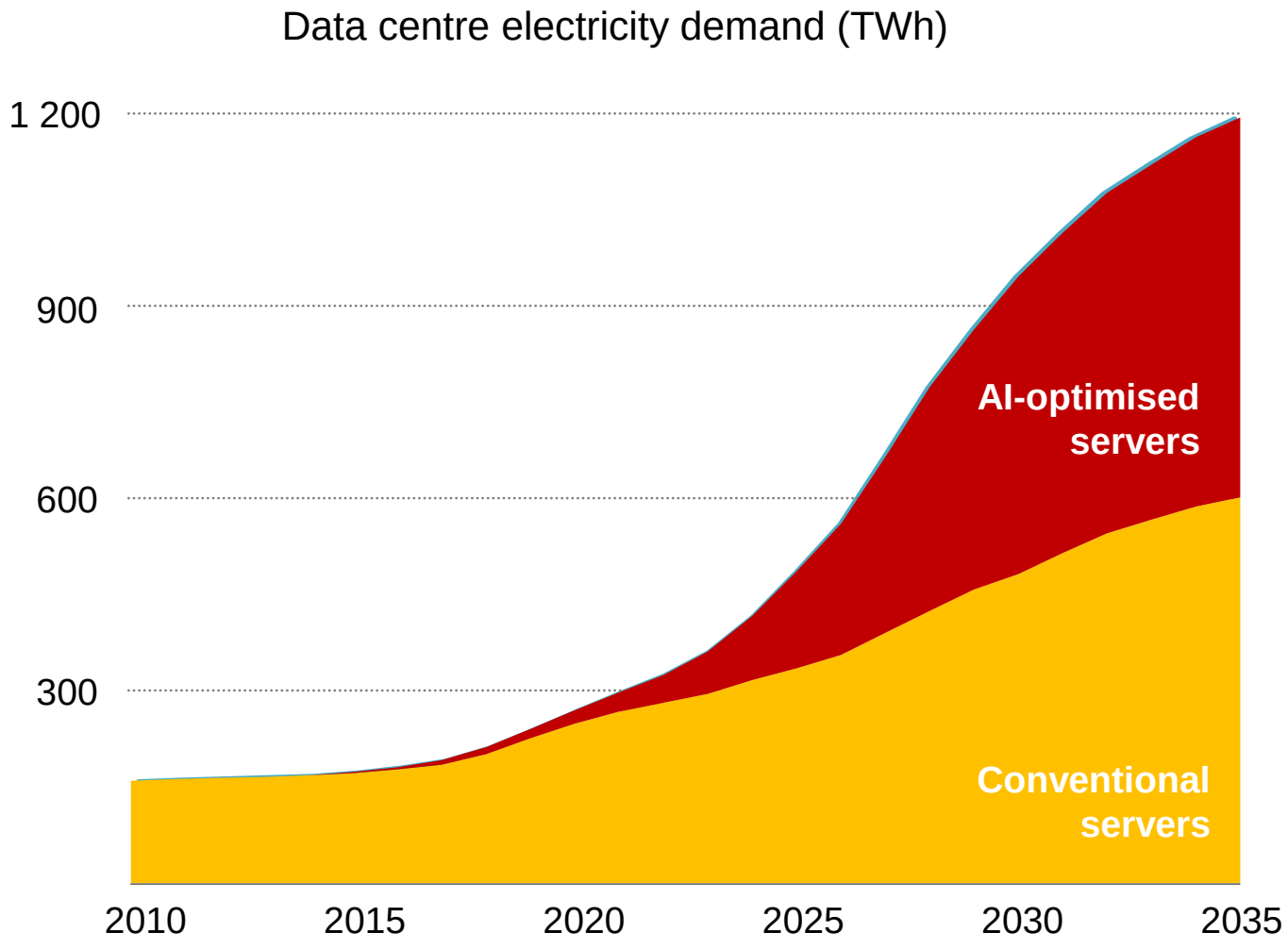
Data centres are both power intensive and tend to cluster together, creating challenges for local grids.

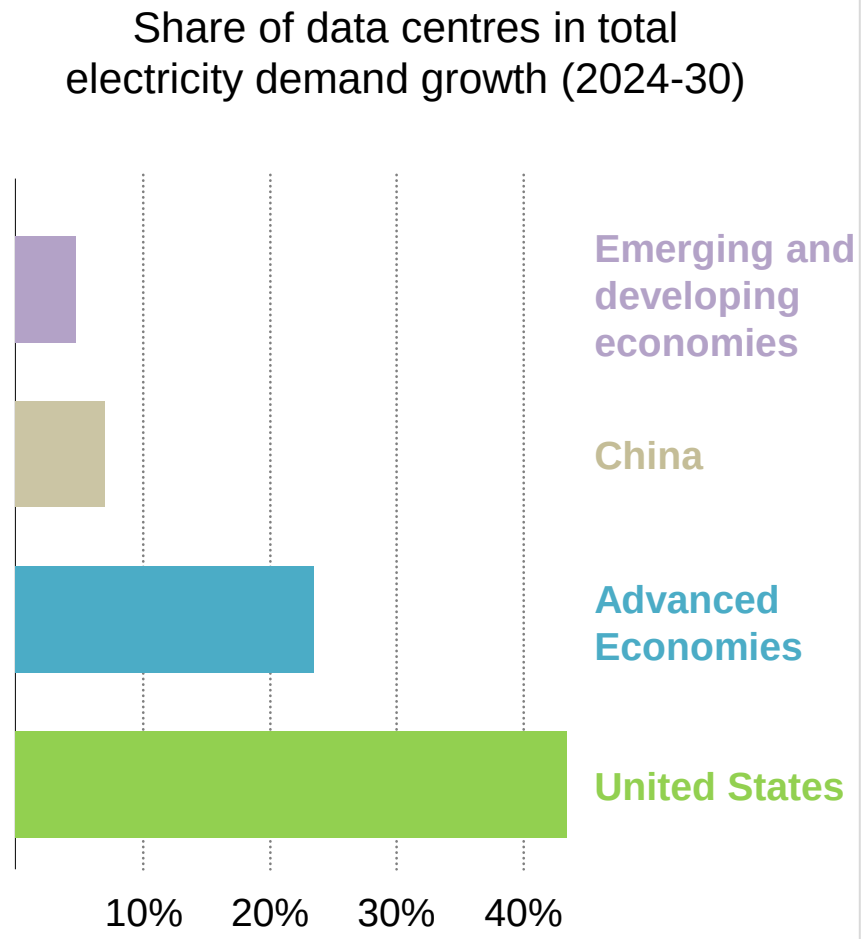
Data centres cluster together – and are growing in size



Data centres are both power-intensive and tend to cluster together, creating challenges for local grids. They are also increasing in size, with the largest under construction 20 times larger than a typical hyperscaler today.

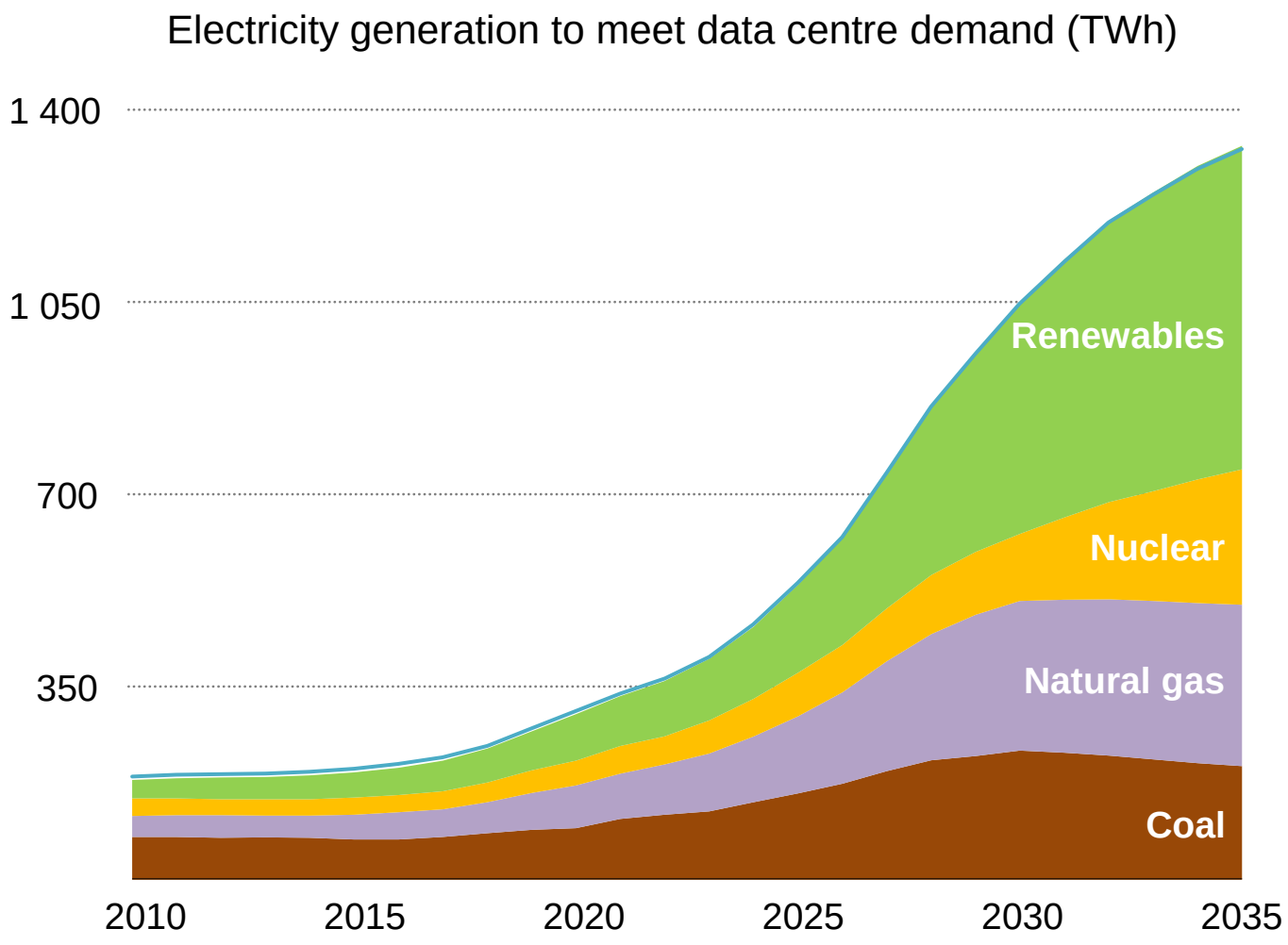
Data centre electricity demand surges

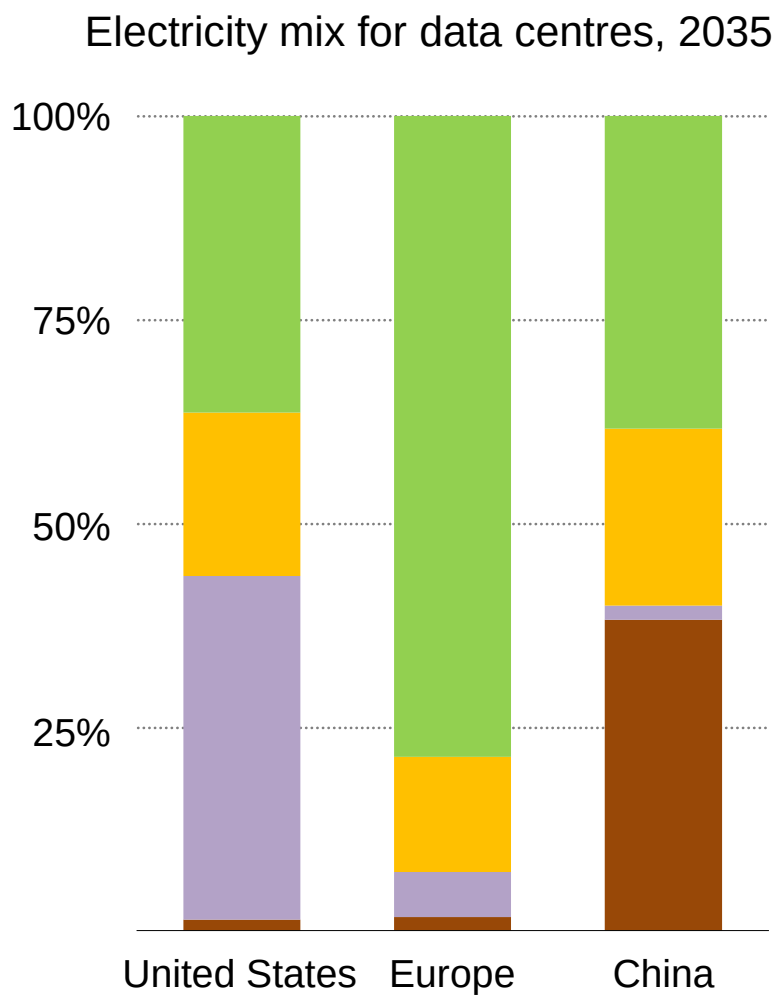




Data centre electricity demand more than doubles to 2030 and almost triples by 2035, driven by AI. In the United States, data centres account for nearly half of demand growth to 2030.

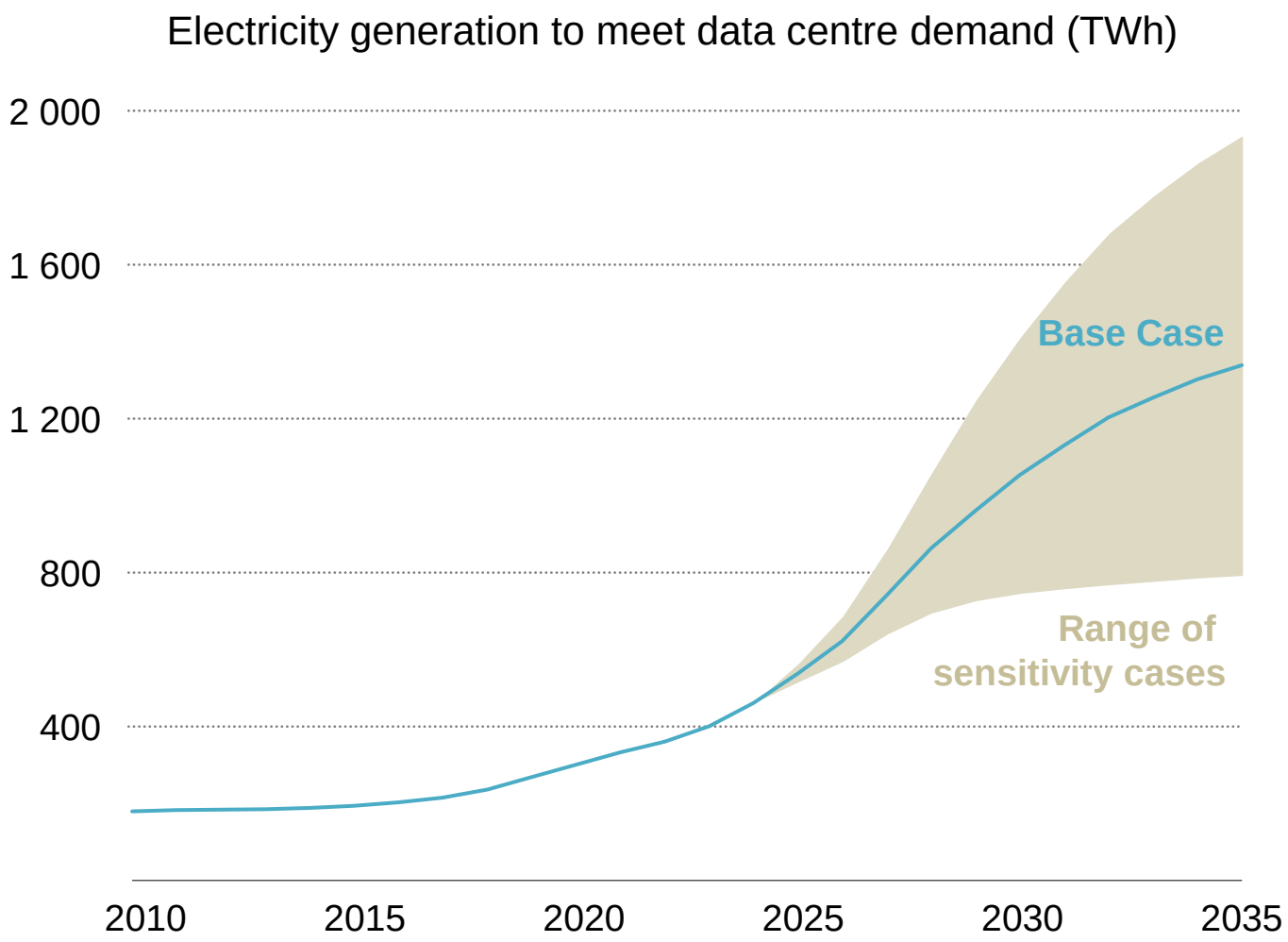
A diverse range of sources will be needed to meet demand





Over half of the electricity demand growth is met by renewables followed by natural gas, nuclear and coal;

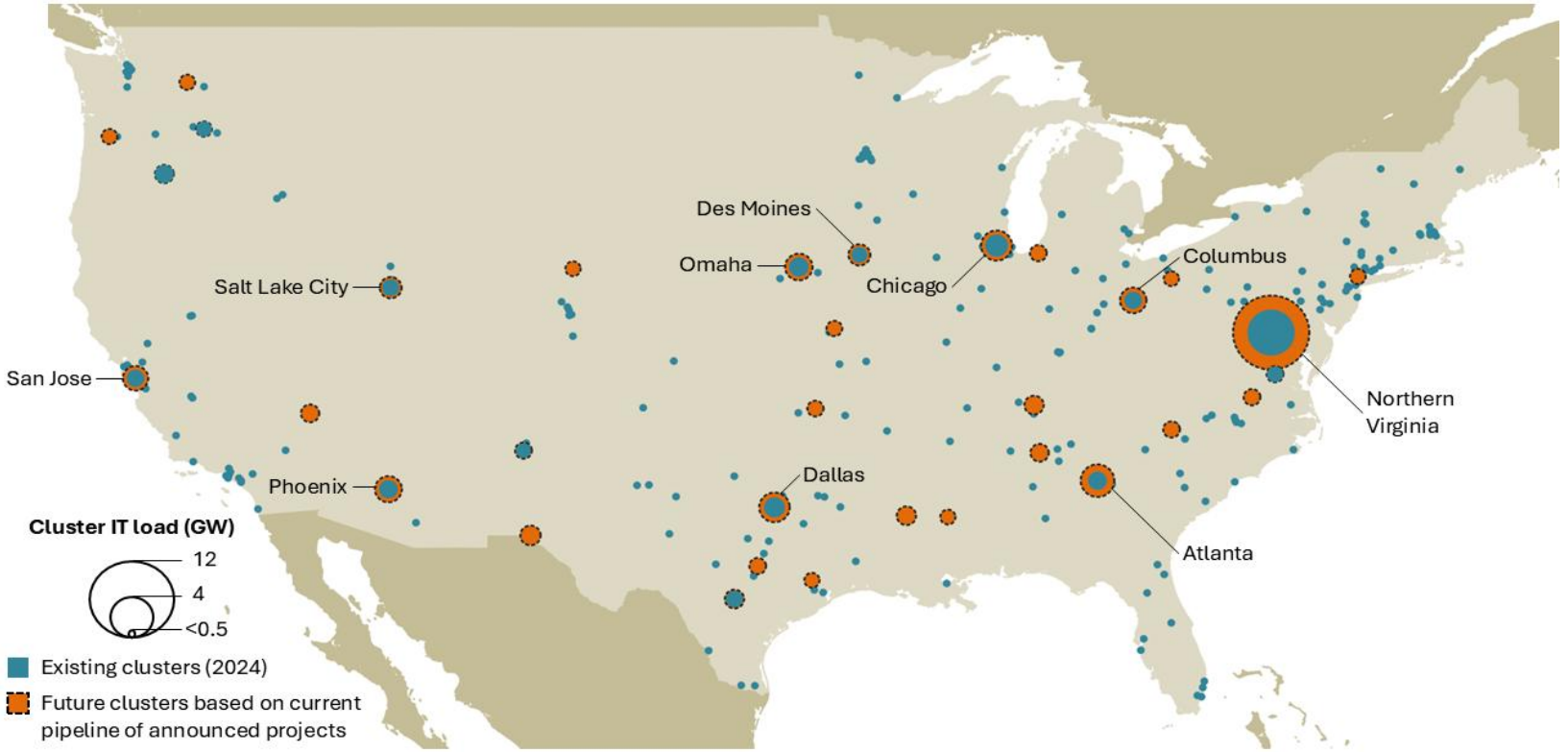
A diverse range of sources will be needed to meet demand



Over half of the electricity demand growth is met by renewables followed by natural gas, nuclear and coal; but there are large uncertainties in the electricity demand outlook

Data centre clustering only partially reduces

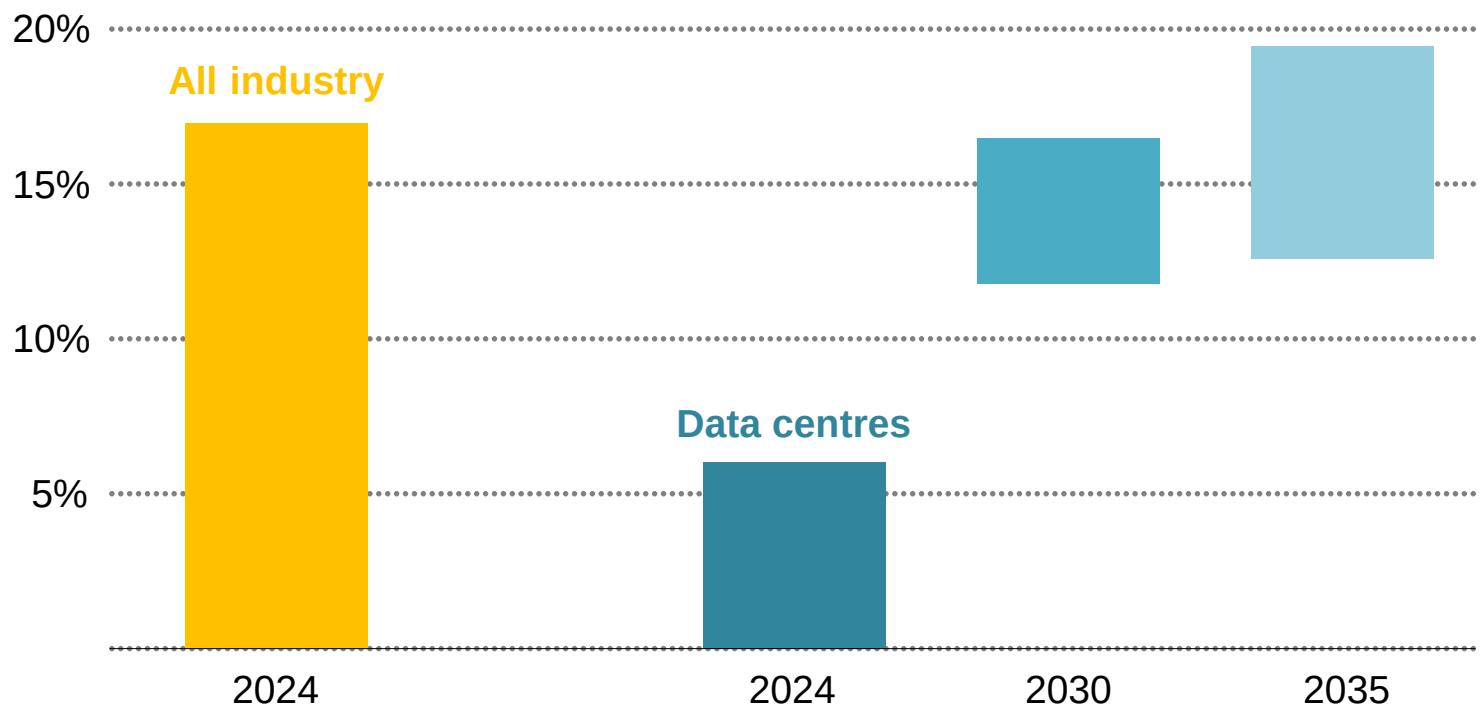
Data centre hubs by installed and planned capacity, continental United States, 2024



Despite the clear benefits of reducing the spatial concentration of data centres, around half of capacity under development is in pre-existing clusters, raising concerns over local grid bottlenecks.

The rapid growth of data centres requires smart integration

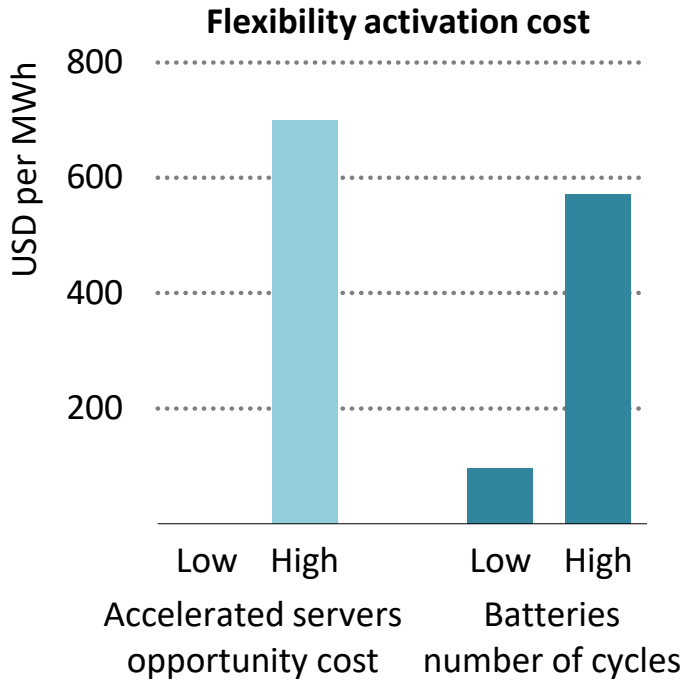
Data centre sector and industry sector connected load as a share of total peak demand, United States



Today, total data centre installed capacity in the United States equates to slightly more than 5% of peak load; by 2030, the installed capacity of data centres in peak load could be as much as the entire industry sector today.

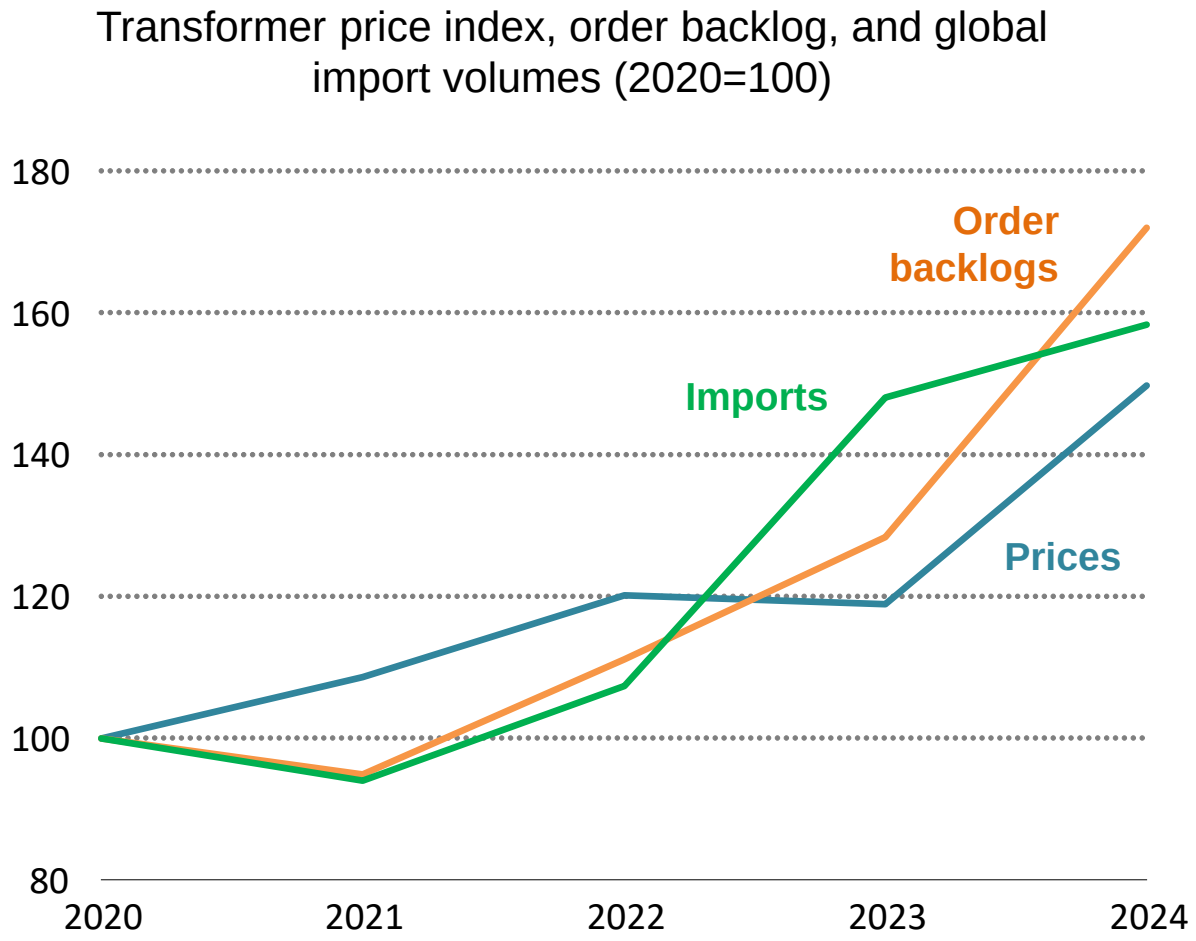
Data centre flexibility depends on opportunity cost and regulation

Flexibility costs from data centres and batteries versus electricity market prices in Texas



Data centres are 10 times more capital intensive on a per MW basis than an aluminium smelter; operational flexibility depends on opportunity costs and a supportive regulatory framework

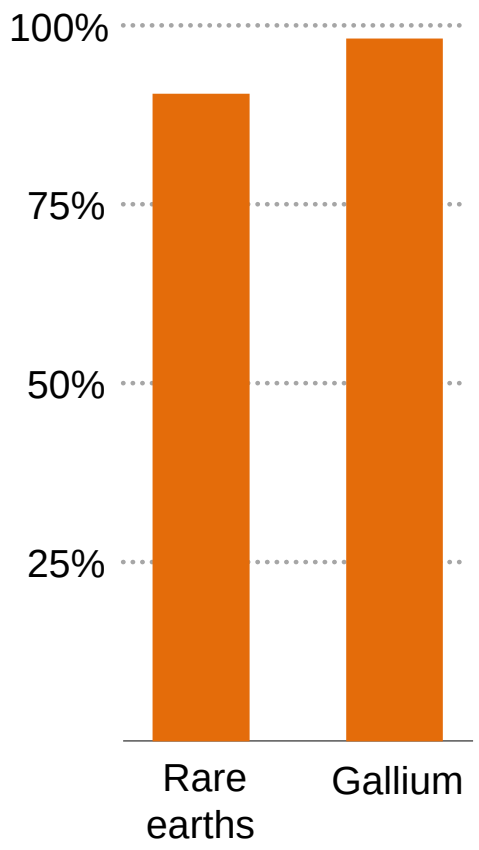
Power related supply chains are showing signs of strain



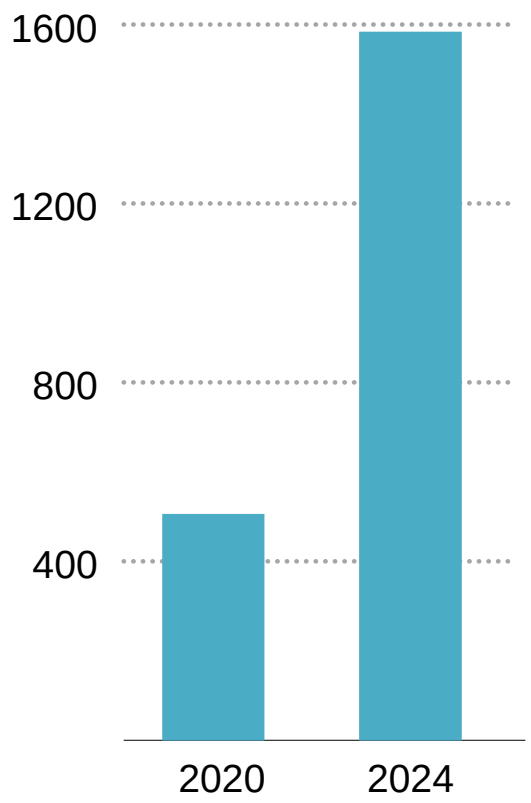
As a result of a surge in orders, prices and order backlogs for transformers have increased substantially since 2020; building a new "data centre sized" transmission line can take 4-8 years in advanced economies

AI could sharpen some energy security concerns & help address others

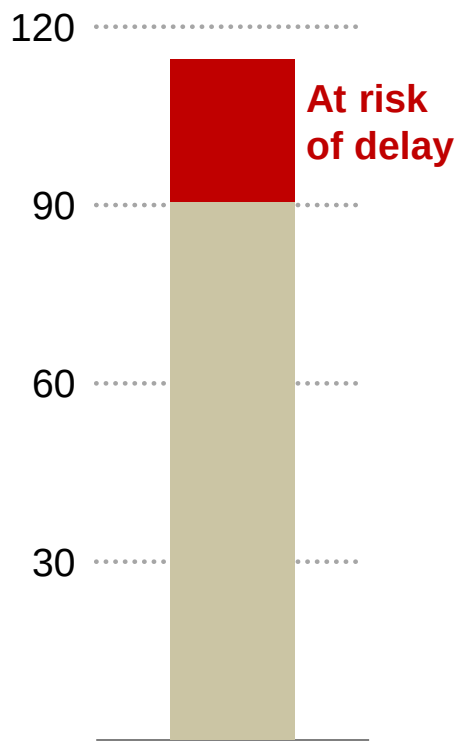
Share of largest country in refined supply



Weekly cyberattacks on energy utilities



Capacity additions of data centres from 2025-30 (GW)



The rise of AI sharpens the focus on supply chain and cyber security, but AI can also address security concerns; unless the electricity sector steps up, around 20% of planned data centre capacity could be at risk of delays.

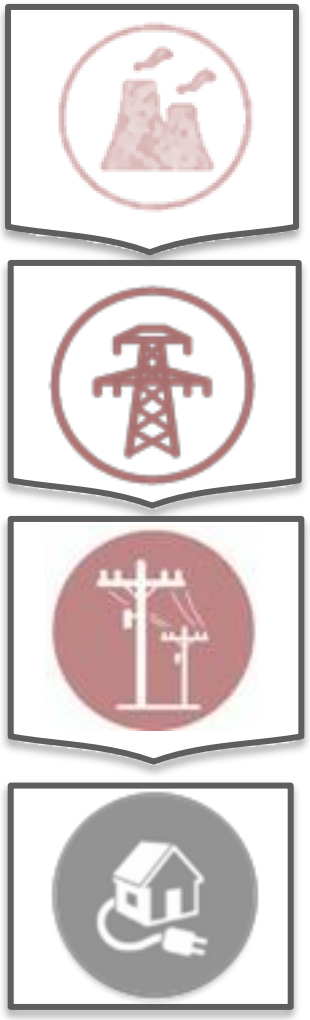
TEXAS
The University of Texas at Austin

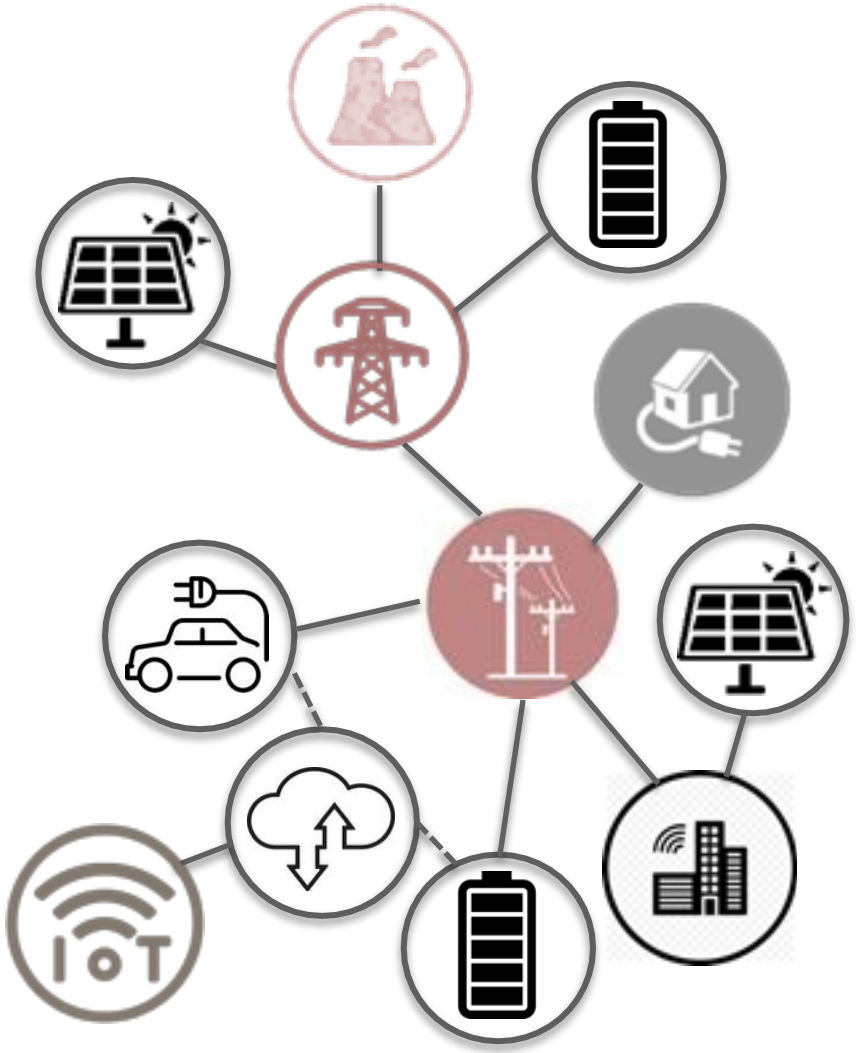
Artificial Intelligence in the Electric Industry

Javad Mohammadi

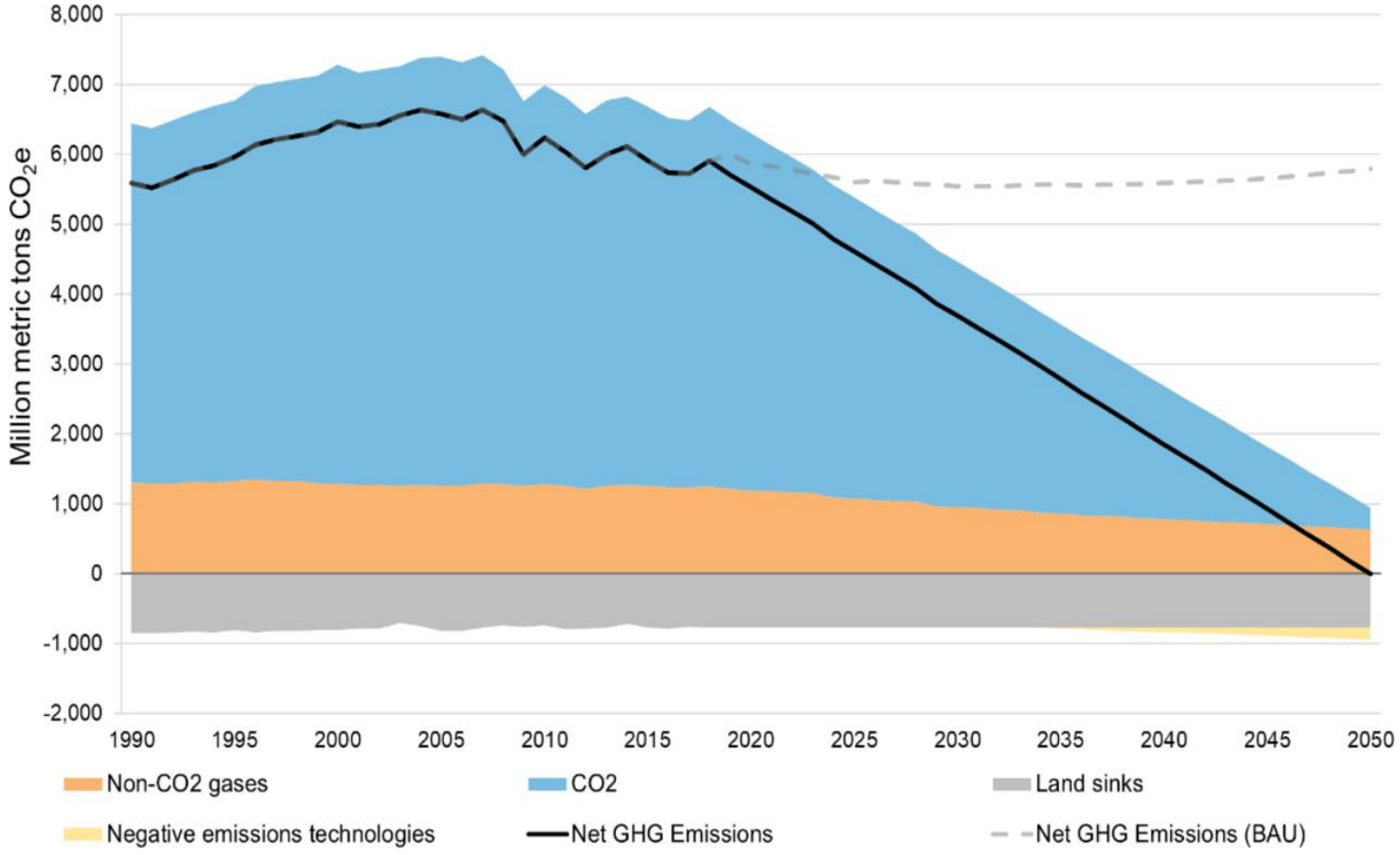
Assistant Professor, UT Austin

The energy value chain is transforming





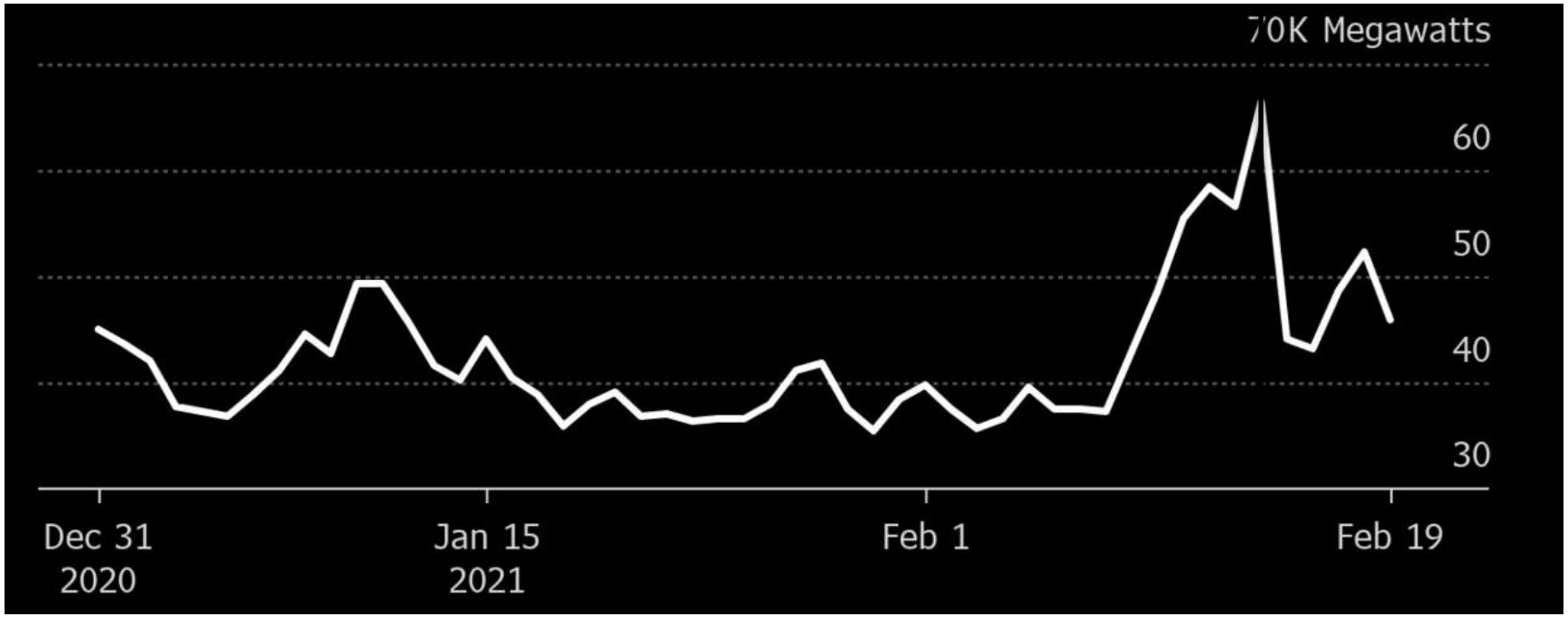
Decarbonization



Source: National Academics of sciences engineering, and medicine

The need for resiliency

"Texas and California Blackouts: A Song of Ice and Fire"

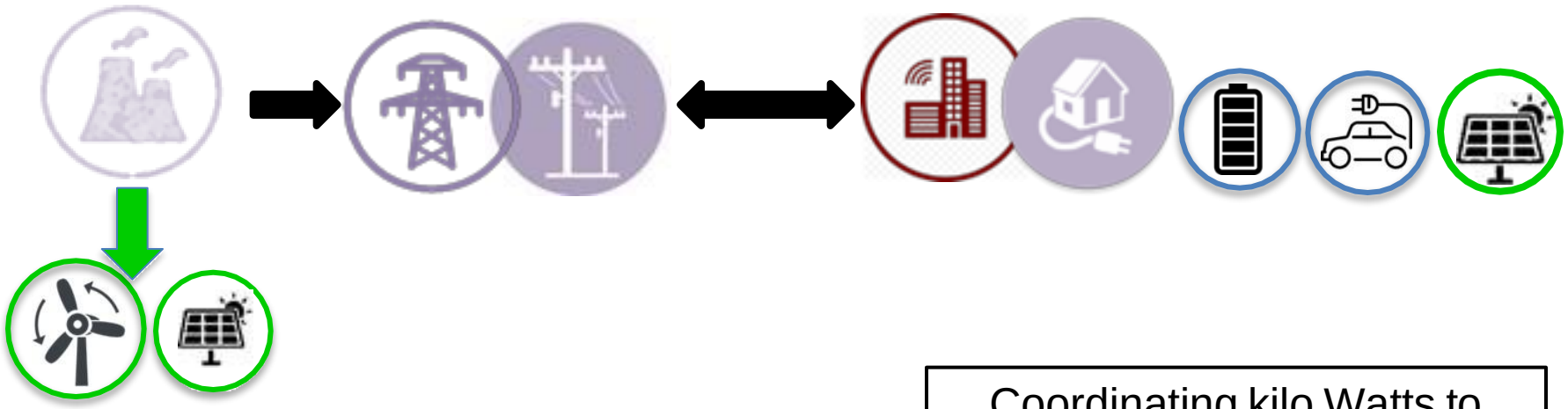


Source: https://www.bloomberg.com/news/features/2021-02-20/texas-blackout-how-the-electrical-grid-failed

Meeting decarbonization goals with resilience

Grid modeling & optimization

Integration & coordination of building energy prosumption



Managing Mega Watts

Coordinating kilo Watts to make Mega Watts

How can AI help?

Advanced analytics for top-down management

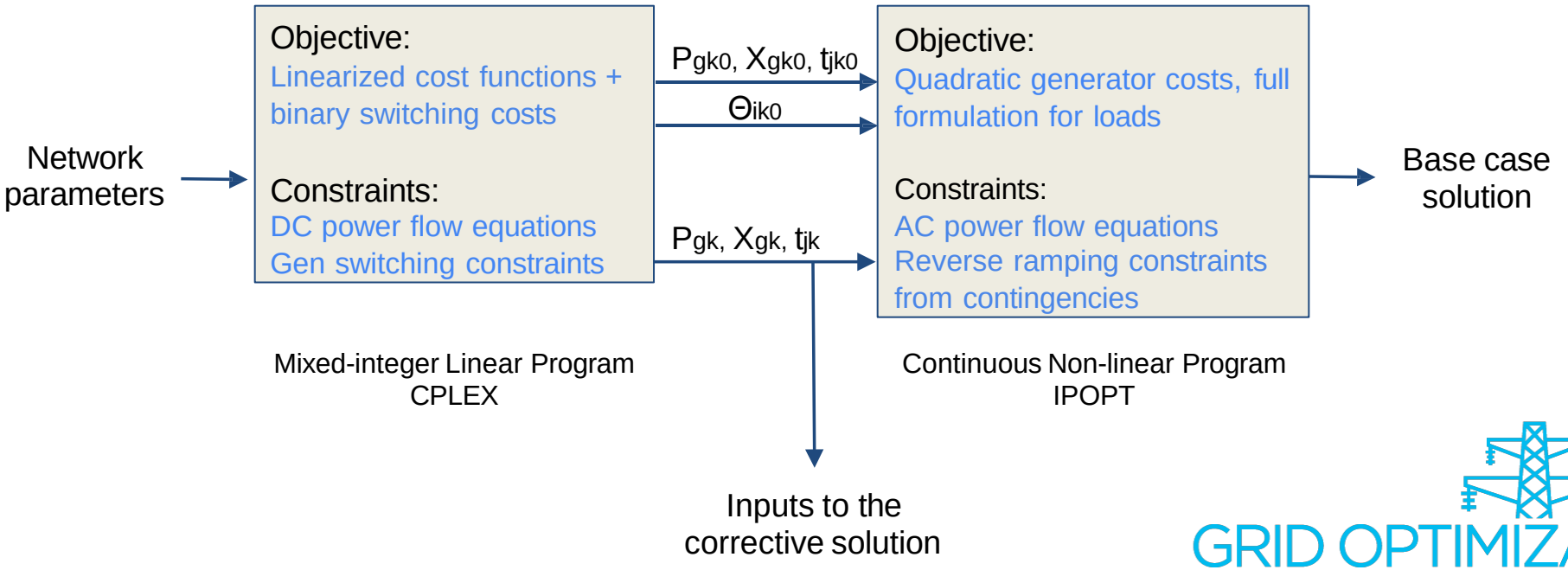
- Security Constrained Optimal Power Dispatch
- Mix Integer Non-linear programming
- Focus on speed for finding a feasible solution
- Selective simplifications of the problem formulation
- Up to $31K node systems

Transmission Line and Transformer Switching NOT Allowed		Transmission Line and Transformer Switching Allowed	
Real-Time (5 Min)	Offline (60 Min)	Real-Time (5 Min)	Offline (60 Min)

GRID OPTIMIZATION (GO) COMPETITION

arpa·e
CHANGING WHAT'S POSSIBLE

Advanced analytics for top-down management



GRID OPTIMIZATION (GO) COMPETITION

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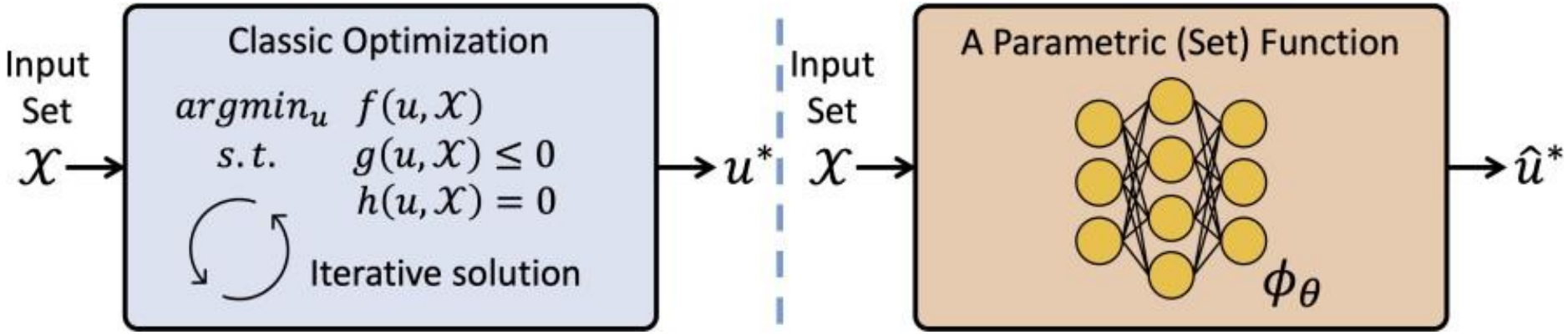
CHANGING WHAT'S POSSIBLE

Source: Sharadga, H., Mohammadi, J., Crozier, C., & Baker, K. (2025). Scalable Solutions for Security-Constrained Optimal Power Flow with Multiple Time Steps. IEEE Transactions on Industry Applications.

Speeding up decision-making

LOOP: **L**earning to **O**ptimize the **O**ptimization **P**rocess

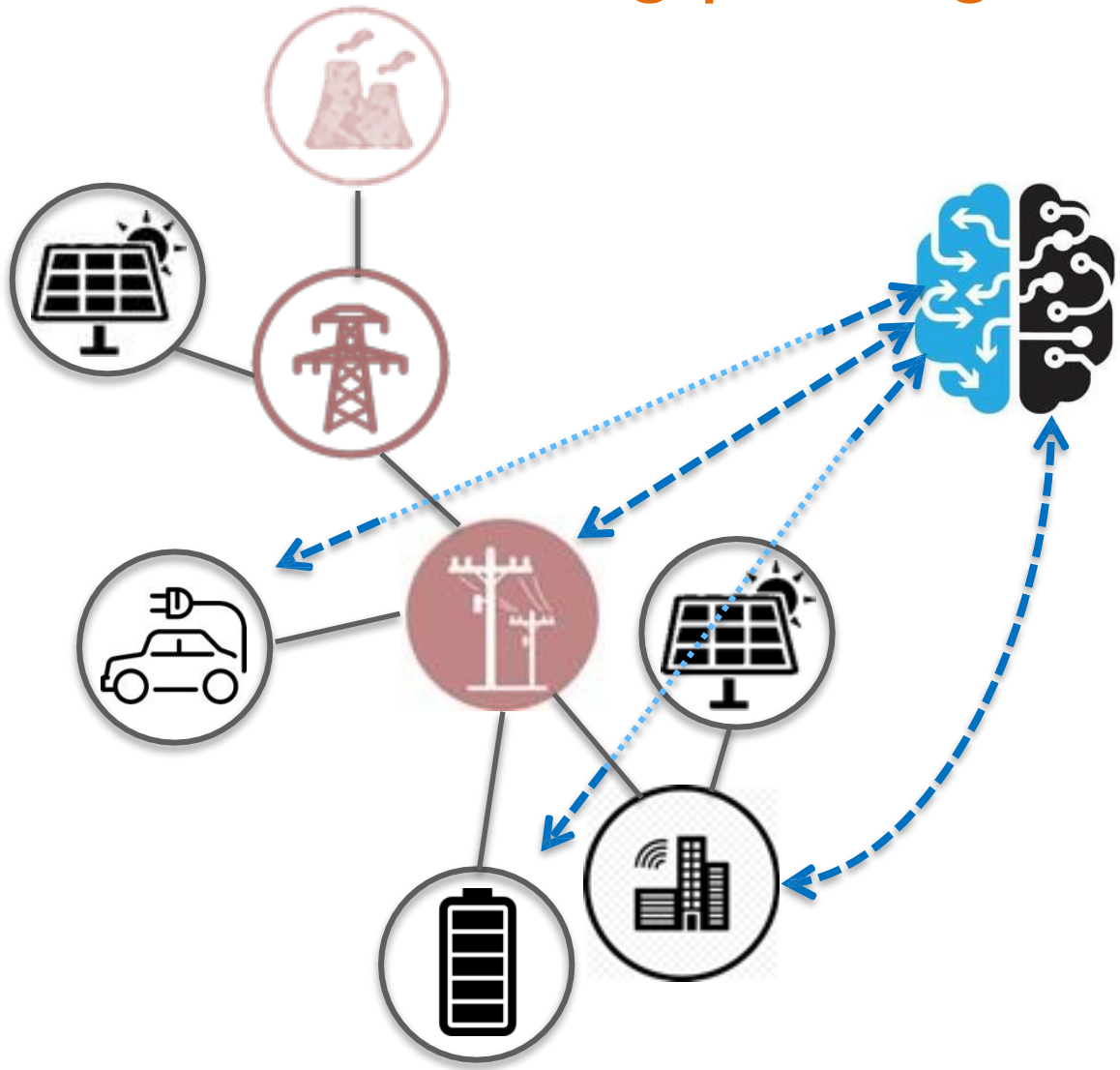
- Removing iterations from optimization ➔ Significant speed-up



Source: Li, M., Kolouri, S., & Mohammadi, J. (2023). Learning to solve optimization problems with hard linear constraints. IEEE Access, 11, 59995-60004.

The need to revisit decision-making paradigms

Centralized

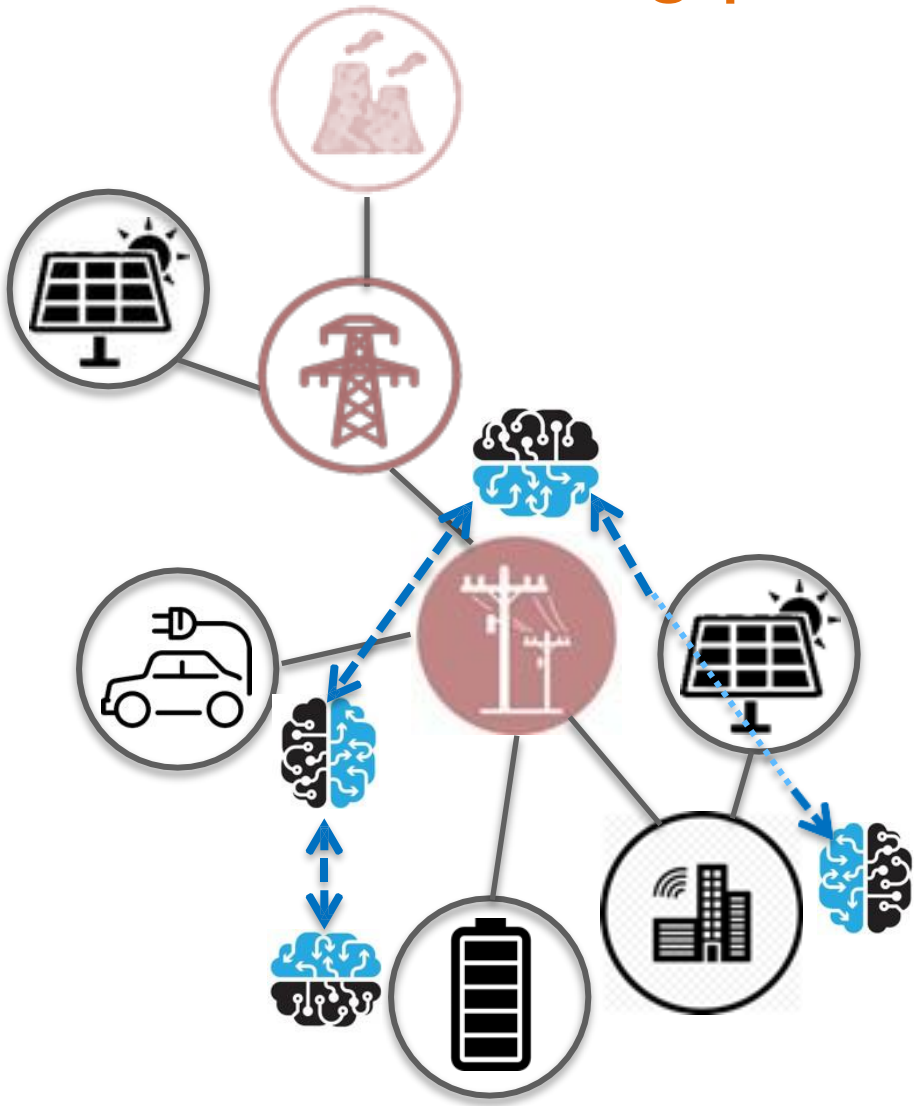


The need to revisit decision-making paradigms

Centralized

Distributed

- Computationally efficient
- Privacy-preserving
- Adoptable



The need to revisit decision-making paradigms

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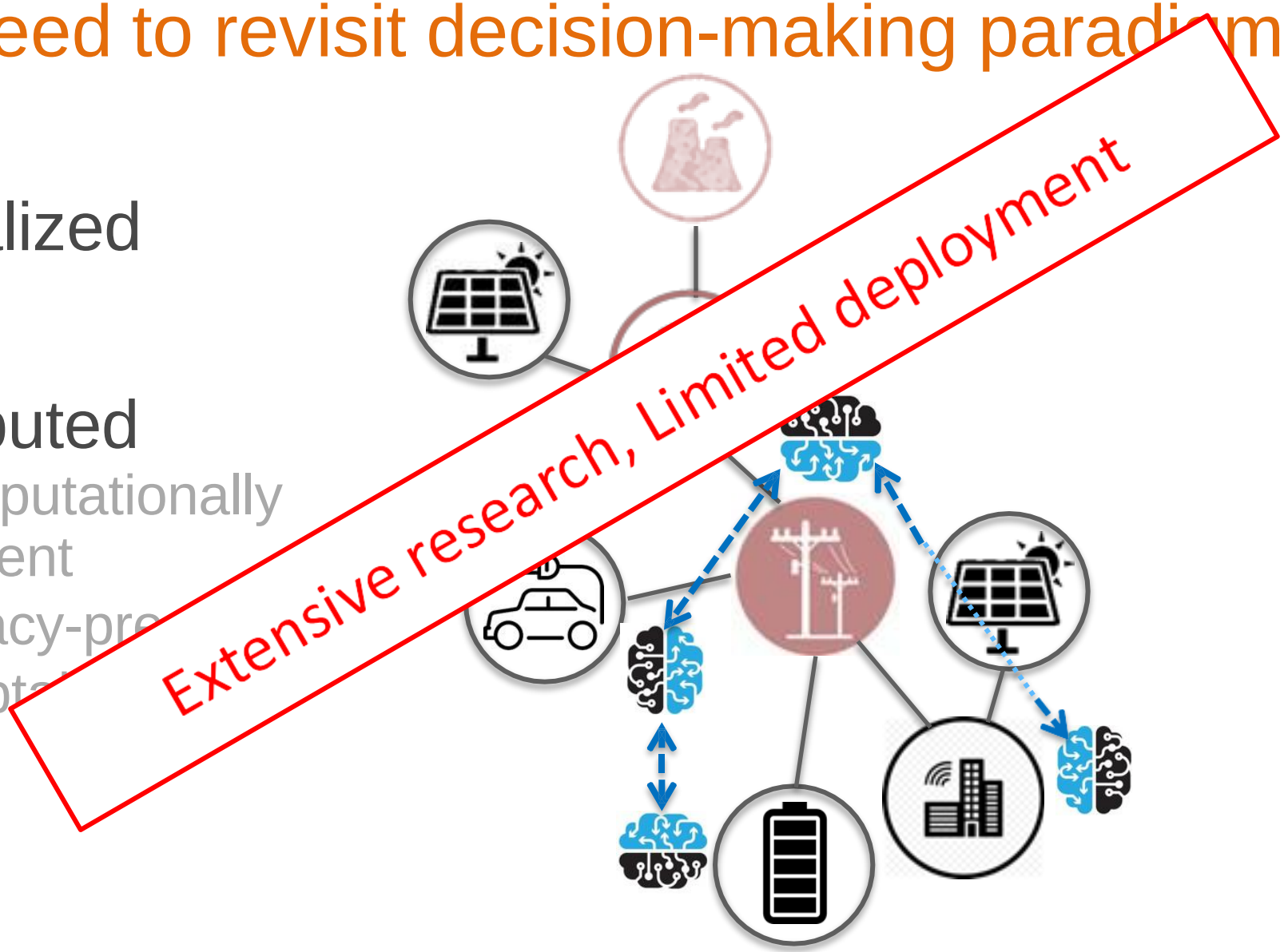
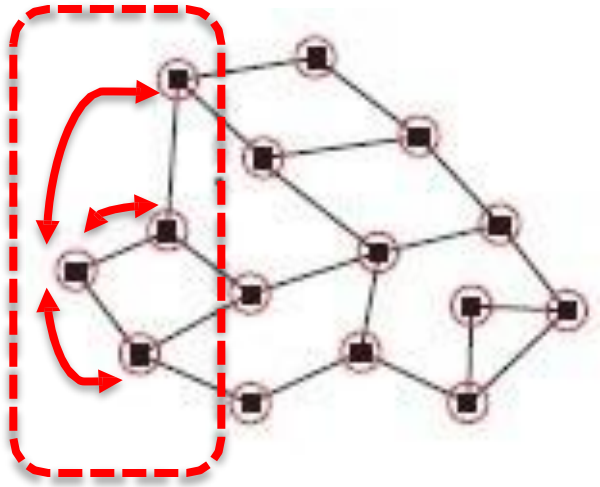


Auto-tuning inter-agent interaction

Automating selection of design parameters

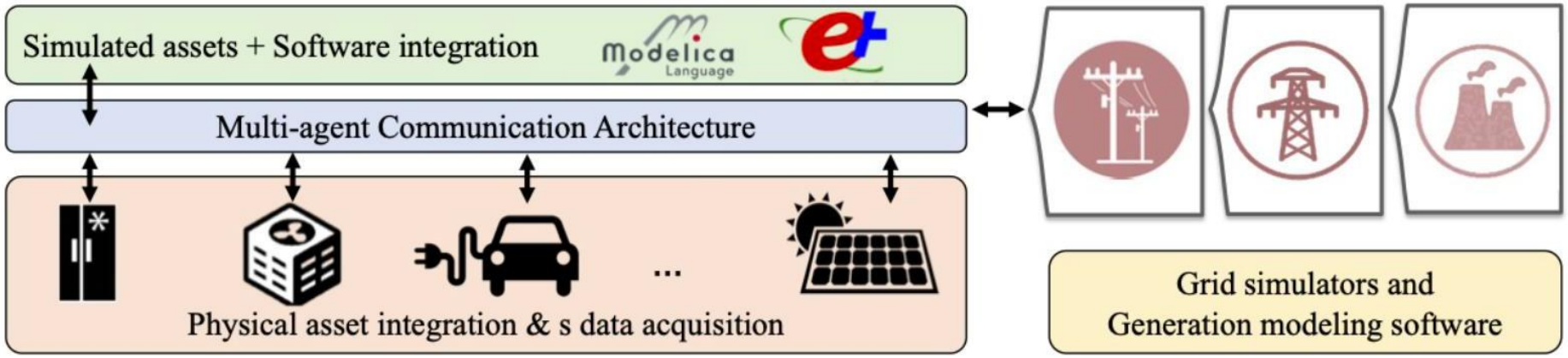
- Information absorption/dissemination rate
- How to value neighbor's information?
- Traditionally derived based on convergence analysis

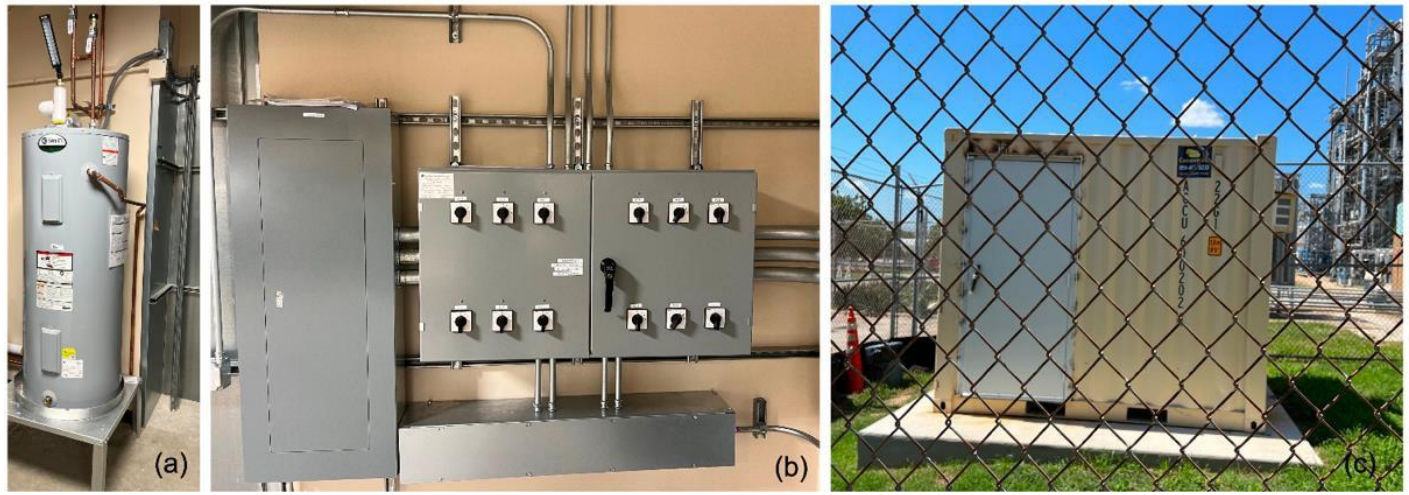
- Using AI for selecting the best parameters inside the feasible range



Source: Du, Yuhan, Meiyi Li, Javad Mohammadi, Erik Blasch, Alex Aved, David Ferris, Philip Morrone, and Erika Ardiles Cruz. "Learning assisted agent-based energy optimization: A reinforcement learning based consensus+ innovations approach." In 2022 North American Power Symposium (NAPS), pp. 1-6. IEEE, 2022.

Towards deployable AI-based optimizers for power grid





What needs to be done!

Data Gaps

- Generating realistic data sets
- Creating partnerships

Trusting AI?

- Transparency issues
- Performance guarantees
- ….

Thank you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