



**National Laboratory
of the Rockies**

Load Forecasting for a Structurally Uncertain Grid

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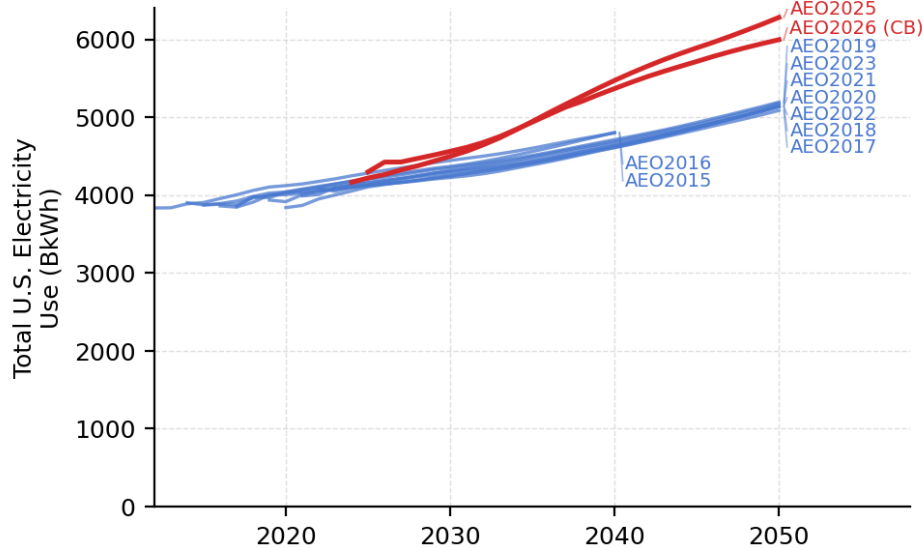
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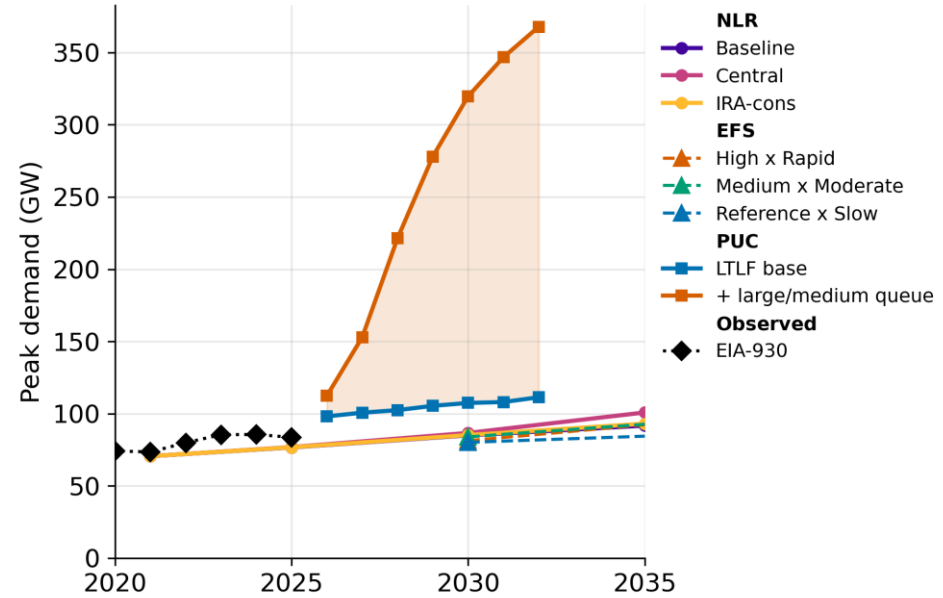
The load forecasting problem has shifted

U.S. Electricity Demand Forecasts Across AEO Vintages



Source: PJM 2019-2026

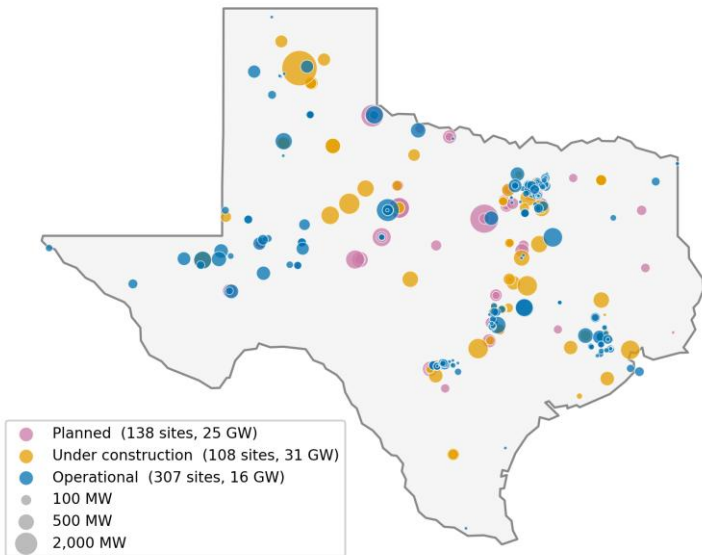
ERCOT peak demand forecasts



Sources: NLR 2024, Mai et al. 2018, ERCOT 2026, EIA 2019-2026

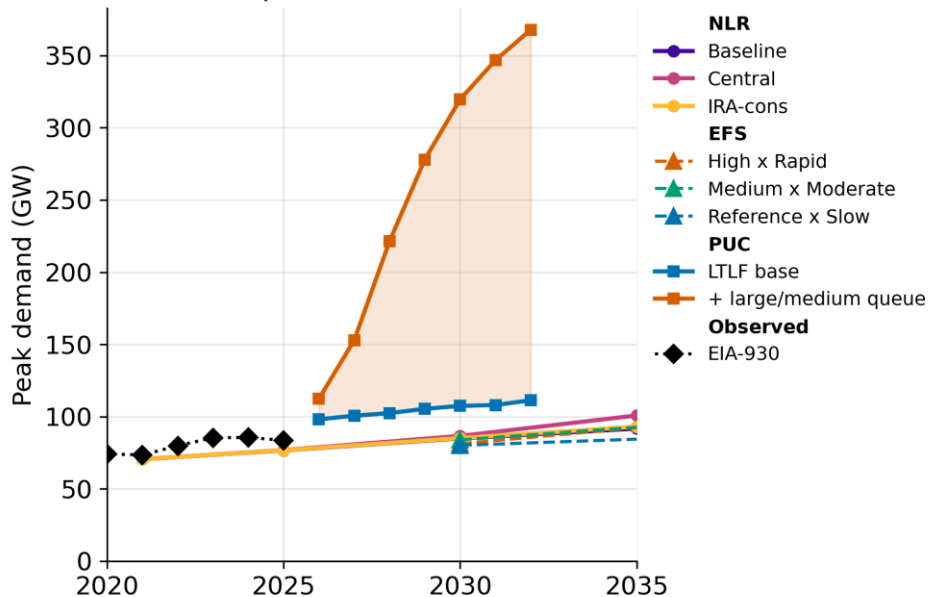
The load forecasting problem has shifted, with some jurisdictions bracing for very high growth

Texas data centers facilities



Source: Baxtel 2026

ERCOT peak demand forecasts



Sources: NLR 2024, Mai et al. 2018, ERCOT 2026, EIA 2019-2026

Unfiltered interconnection requests drive **4x growth** in ERCOT peak demand by 2032

Probabilistic method for near-term large load projections

Materialization uncertainty:

Will planned facilities get built?

Operational sites are likely to contribute load but planned and permitted projects may never break ground.

Assumed completion rates by stage:

Phase	Assumed Probability
Operational	100%
Under construction	95%
Planned	50%

Operational uncertainty:

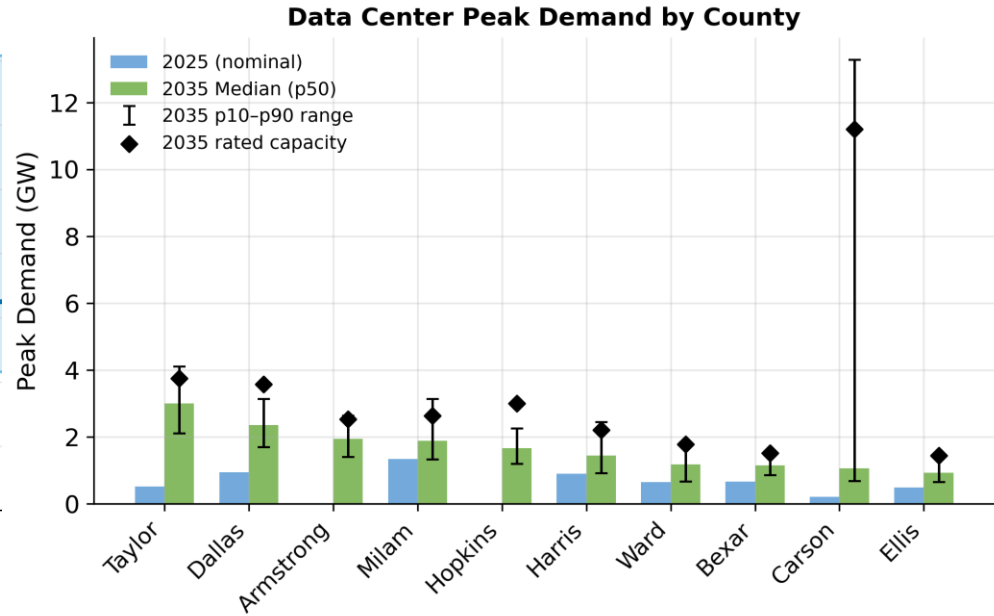
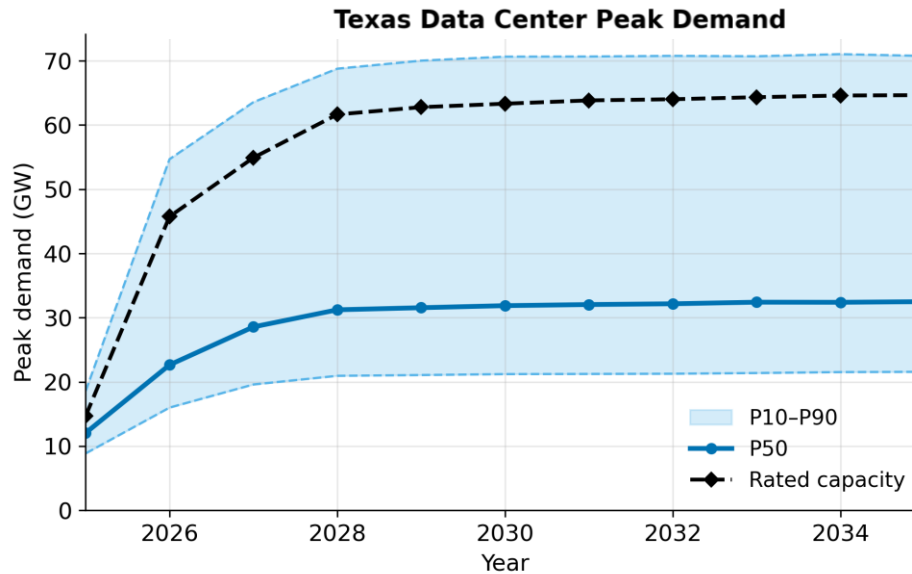
How much energy will each facility use?

Actual energy consumption depends on how fully the data center is utilized and how efficiently it operates.

Key parameters with wide ranges:

Parameter	Low	Mode	High
Utilization	0.4	0.7	0.9
PUE (cooling overhead)	1.1	1.3	1.8
Peak-to-average	1	1.15	1.3

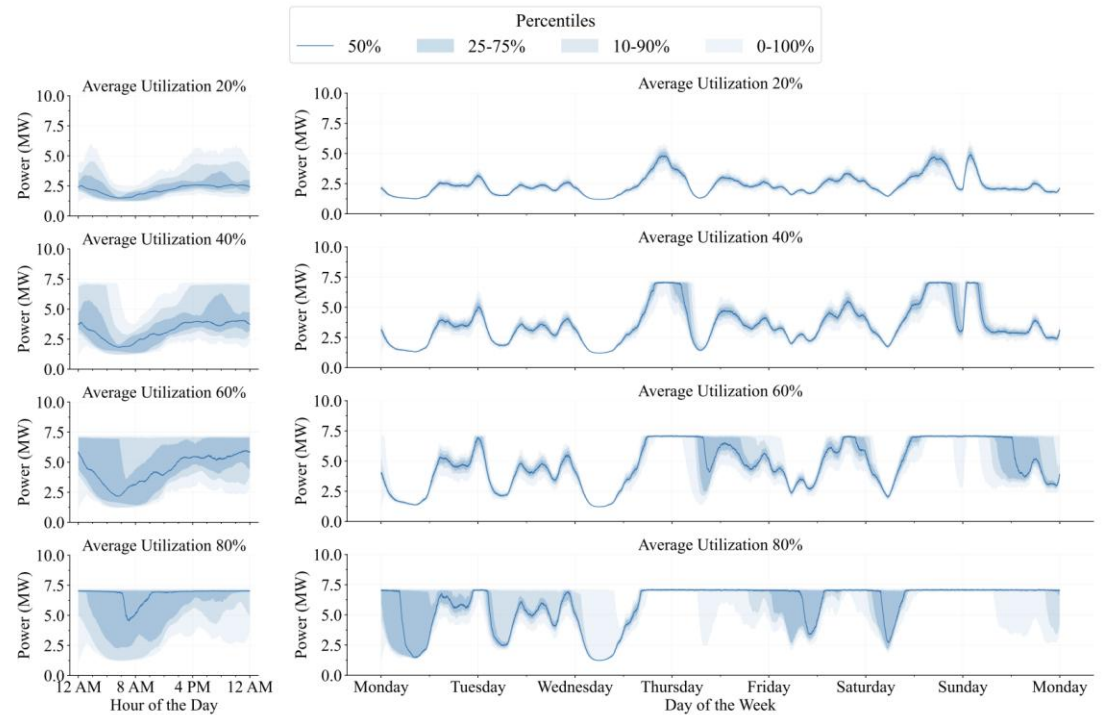
Example result: ranges of data center peak demand in Texas by 2035



Next Steps: Hourly data center load profiles needed for grid modeling

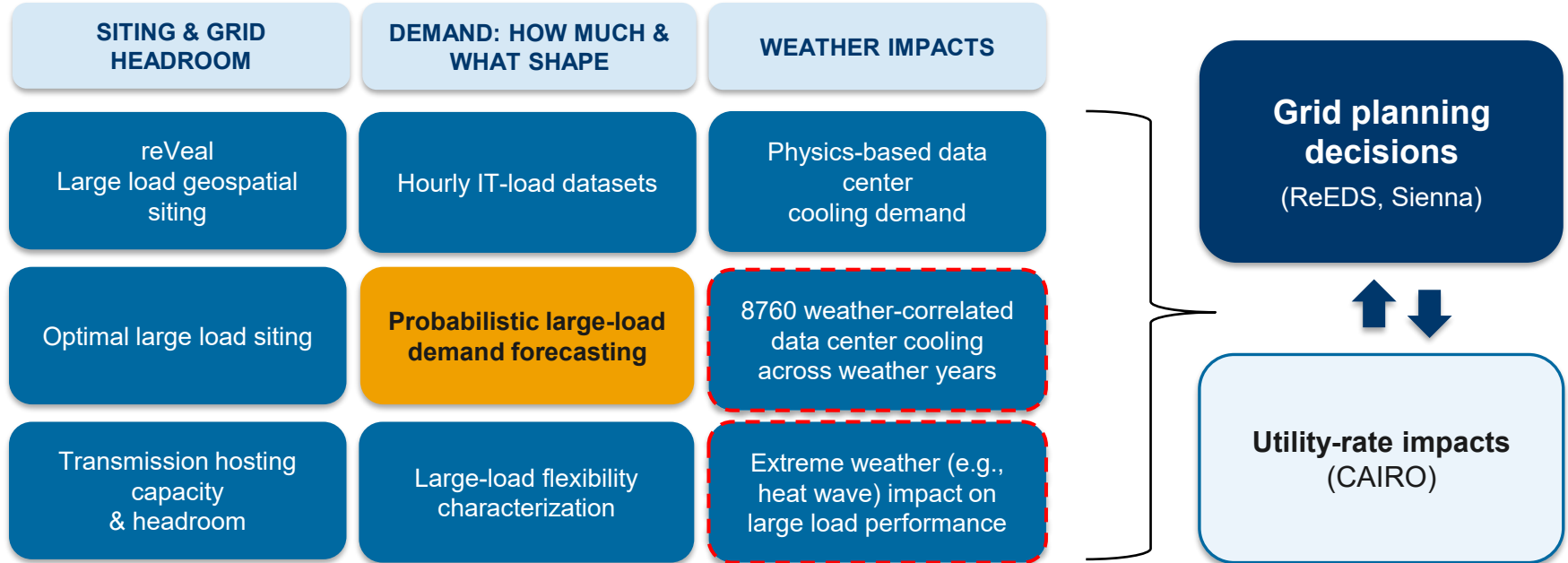
- Key Caveats
 - Currently only captures IT loads
 - Requires assumptions for average utilization

Facility-level power consumption profile distributions for a 10 MW colocation data center



Source: Vercellino et al. 2026, <https://data.nlr.gov/submissions/312>

Workstreams across NLR are tackling different aspects of large loads, from facility-level to national-scale analysis



Takeaways, open questions, and areas of ongoing work

Takeaways

- Data centers can swing load projections by 2-10x within the same planning horizon.
- County-level (or finer) projections are the structural input that feeds into hourly profile generation for grid models.
- Weather precision on an inaccurate baseline is false precision.

Future work

- Weather-correlated data center cooling loads across multiple weather years.
- Extreme weather (e.g., heat wave) impacts on large load performance.
- Behind-the-meter resource impact on grid load.
- Novel forms of load flexibility introduced by large, connected, revenue-generating loads.



Image Credit: Dennis Schroeder / NLR

Thank you

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Sources

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7. Vercellino et al. (2026). “*Measurement of Generative AI Workload Power Profiles for Whole-Facility Data Center Infrastructure Planning*,” [arXiv:2604.07345](https://arxiv.org/abs/2604.07345)