Energy Markets & Planning
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Speed to Power: Solutions for Accelerating Large Load Connections

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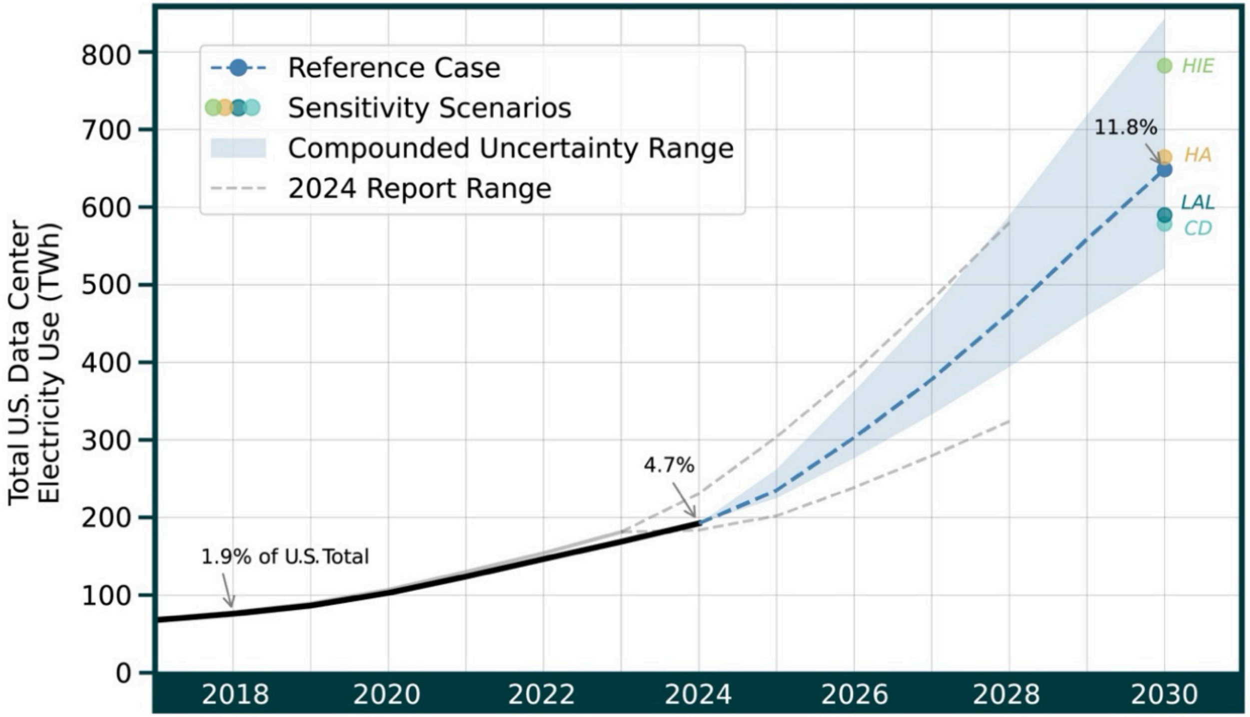
ENERGY TECHNOLOGIES AREA | ENERGY ANALYSIS DIVISION | ENERGY MARKETS & PLANNING

Background

- Successfully and rapidly advancing AI in the United States while maintaining a reliable, affordable grid will require careful consideration of energy infrastructure and policy.
- Utilities are forecasted to have significant load growth, in part due to large loads such as data centers. For example,
  - In Texas, as of May 2026 Oncor has more than 180GW of large load in its interconnection queue.
  - As of April 2026, Georgia Power has more than 15GW of large load committed to receiving service from the utility.
- Solutions to accelerate connecting loads to the grid are emerging and evolving.



Source: LBNL 2026

HIE = High Inference Energy, HA = High ASIC, LAL = Low Accelerator Lifetime, CD = Consolidated Deployment

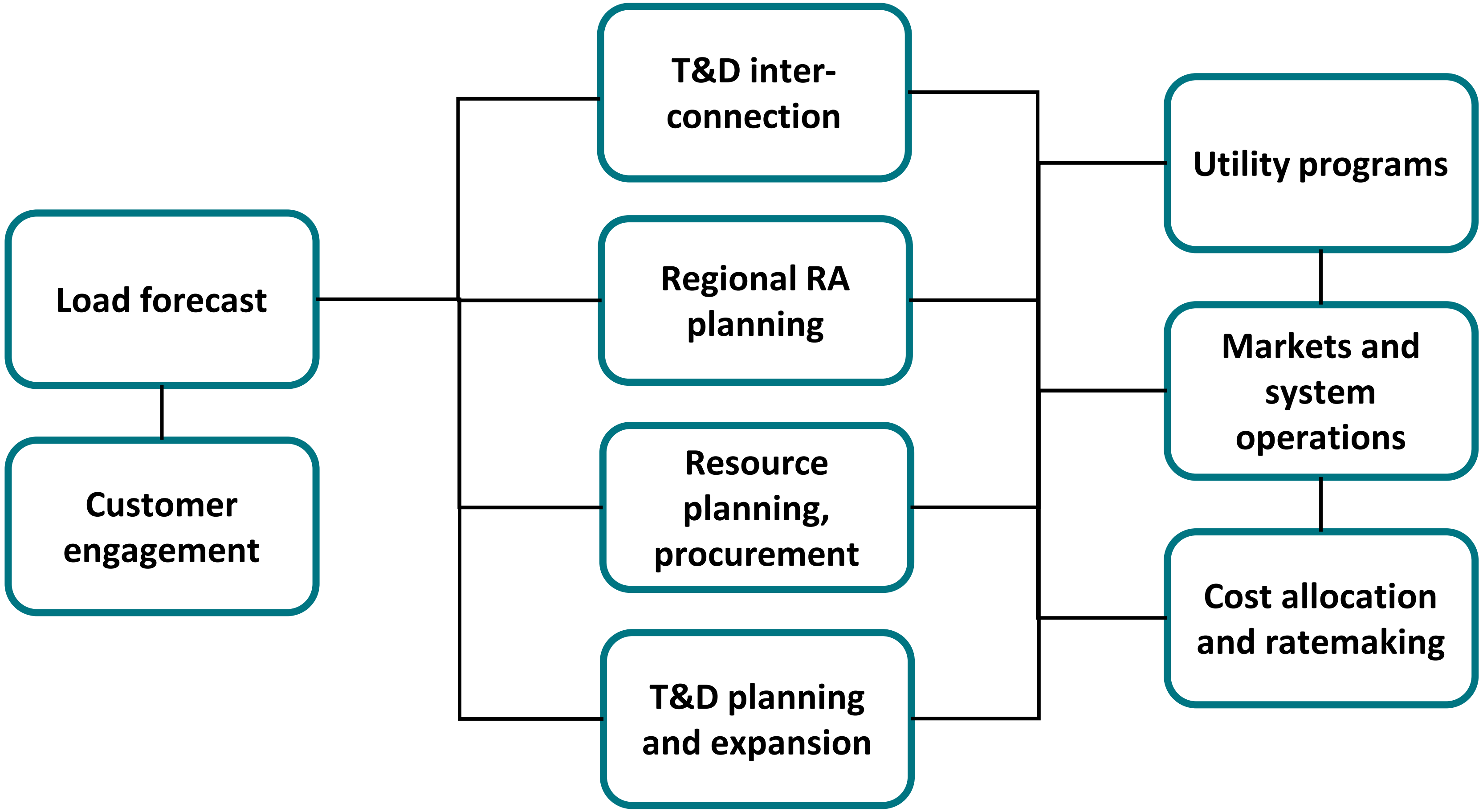
Report

- Report seeks to examine existing and emerging solutions to accelerate large load connections.
- It is a compendium of actions and a snapshot in time.
- The solutions and policy changes that are occuring in this space are extremely rapid and will continue to evolve.

Report, webinar slides and recording available here: https://emp.lbl.gov/publications/speed-power-solutions-accelerating

Report Organization

- Large loads affect multiple electricity functions: planning, investment, interconnection, operations, markets, cost allocation, and ratemaking
- Report is organized around these functions



Solution Areas and Solutions

- Report identifies 41 potential solutions for more effectively, efficiently, and fairly managing large load connections
- Primary goal of the research is to document options for a regulatory audience, but solutions are applicable to others (e.g., utilities, ISO/RTOs)
- Some solutions are near-term; others would require longer-term changes
- Report is not intended to be a roadmap; some solutions are mutually exclusive

Solution Areas
1. Load forecasting
Load forecasting approaches
Load forecast coordination
2. Interconnection
Load interconnection processes
Fast-track transmission interconnection service
Energy resource interconnection service (ERIS) for loads (transmission)
Flexible interconnection (distribution)
Self-funded network upgrades (option to build)
3. Utility procurement
Utility procurement approaches
4. Markets and operations
Energy markets and transmission service
Operating reserves
5. Cost allocation and ratemaking
Cost allocation methods
Large load tariffs
Wholesale rates for large loads

Load Forecasting

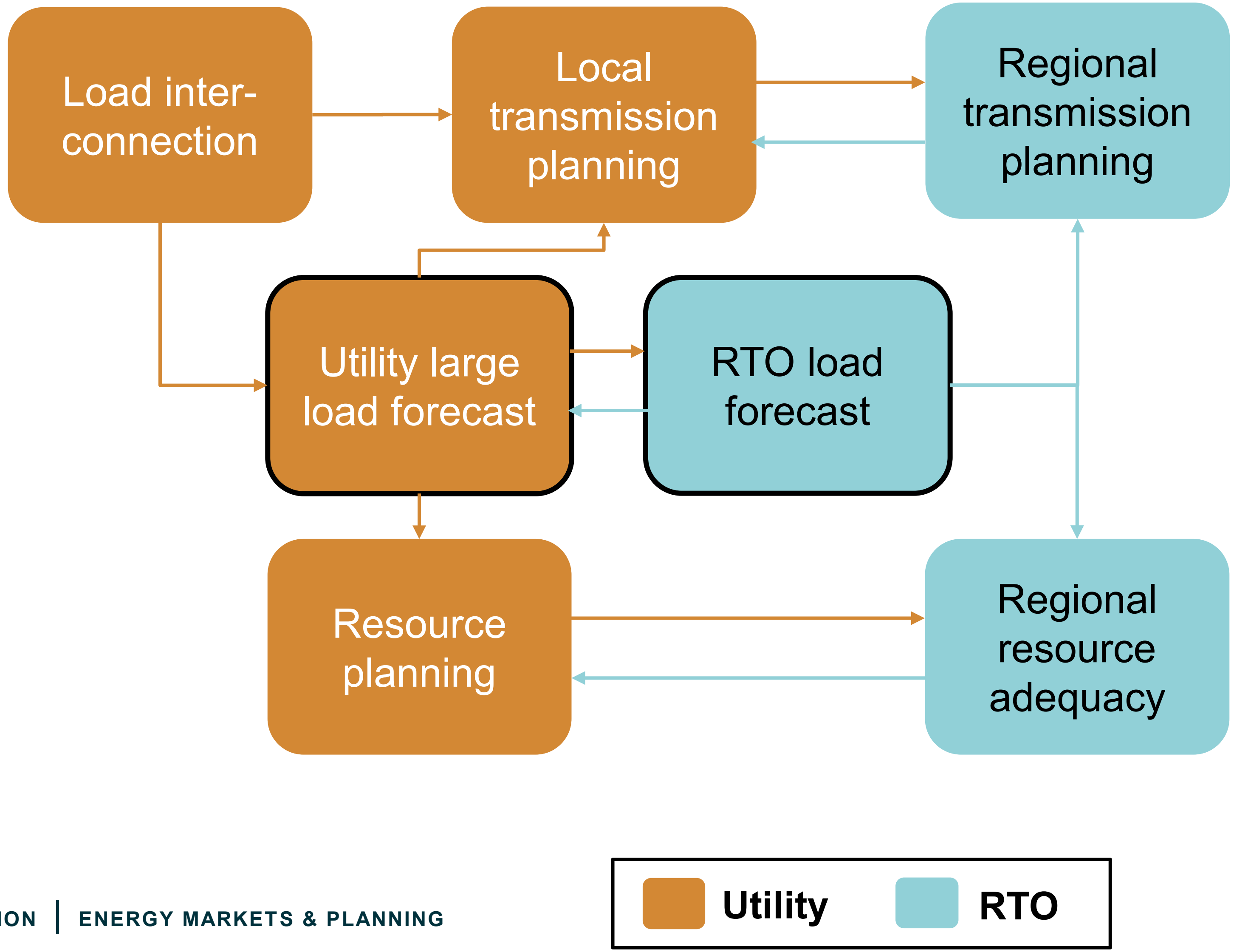
- Load forecast solutions focus on approaches to large load forecasting and coordination among creators and users of load forecasts

Load Forecasting	
S1. Load forecasting approaches	S1.1 Separate load forecasts for large loads S1.2 Regular customer engagement and market research S1.3 New methods for large load forecasting S1.4 Milestone requirements for inclusion in forecasts S1.5 Processes for monitoring project duplication in forecasts S1.6 Forecast reporting requirements
S2. Load forecast coordination	S2.1 RTO* guidelines on large load forecasting S2.2 State involvement in RTO load forecast adjustments S2.3 Data sharing and exchange on large-load forecasting

* RTO is a regional transmission organization

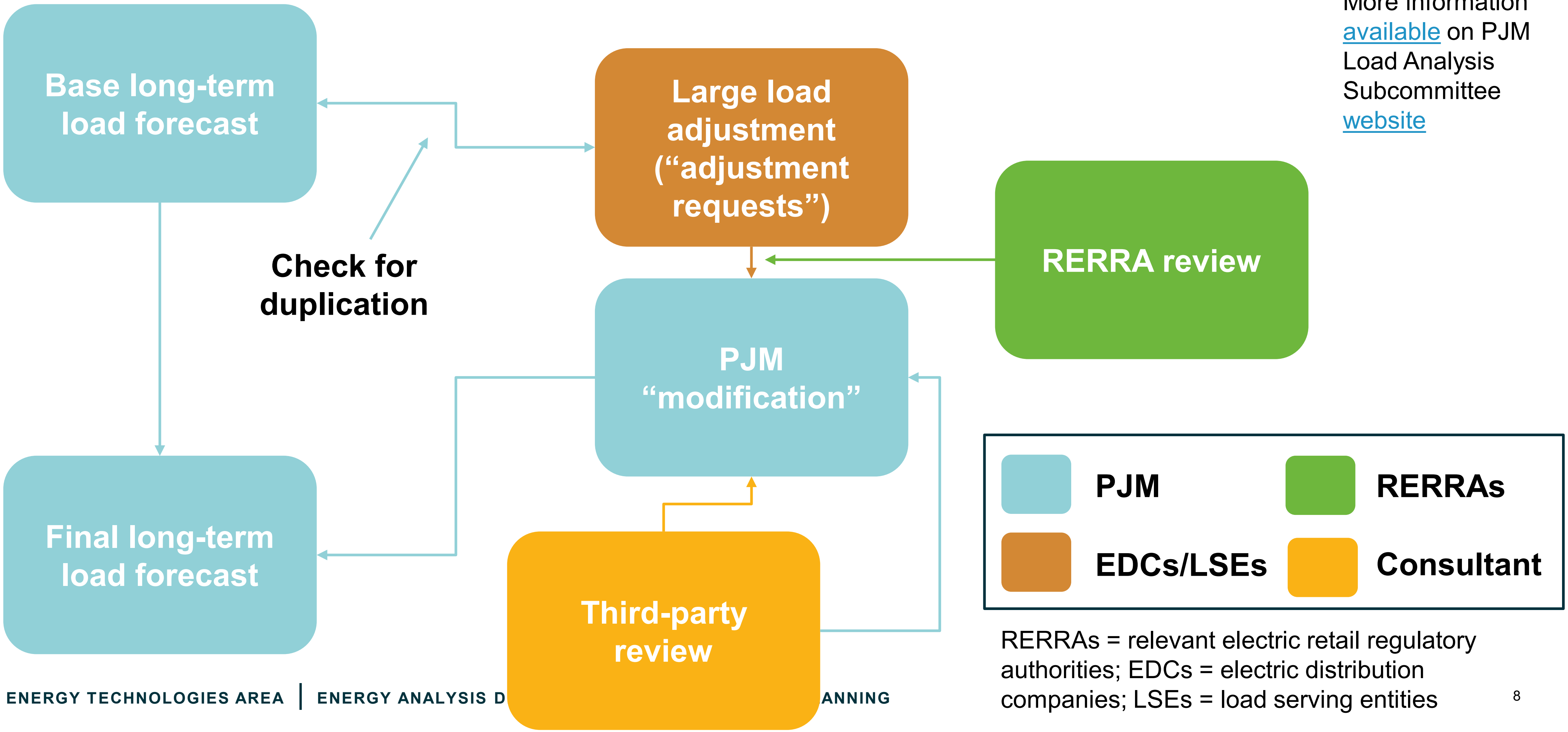
Large Load Forecasters and Users

- Most large load forecasts rely heavily on information from load interconnection
- In most cases, large load forecasts are developed by utilities but also used by RTOs and ISOs
- Large load forecasts are used in:
  - **Resource planning** – to determine resource need and procure resources
  - **Regional resource adequacy** – to set RA requirements and/or clear capacity markets
  - **Local and regional transmission planning** – to identify new transmission needs



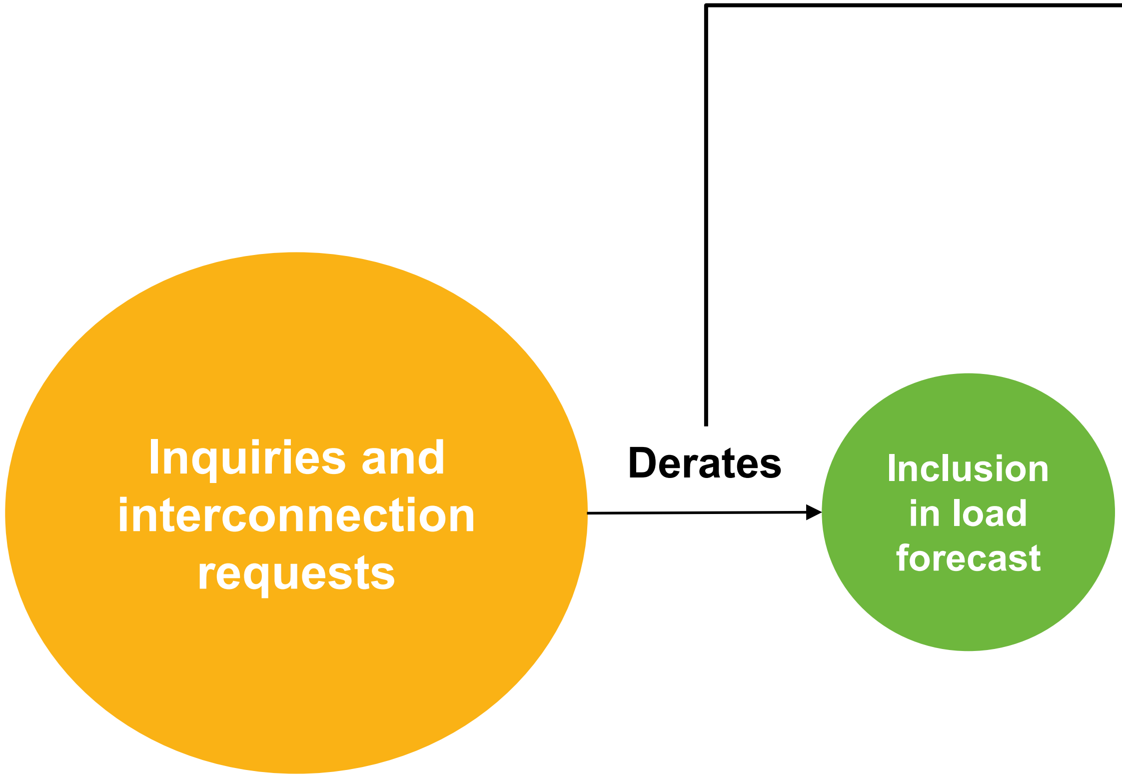
PJM's Large Load Adjustment Process

More information [available](#) on PJM Load Analysis Subcommittee [website](#)



RERRAs = relevant electric retail regulatory authorities; EDCs = electric distribution companies; LSEs = load serving entities

Large Load Forecast Derates



Key derate terms

Delay factor – number of months by which projects are delayed on average

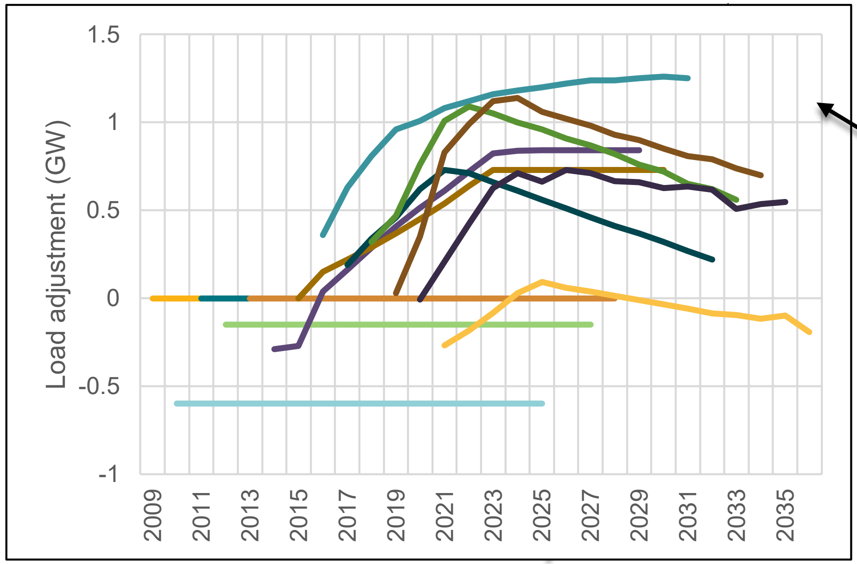
Probability factor – probability that the project will come online

Utilization rate – ratio between actual and requested peak demand

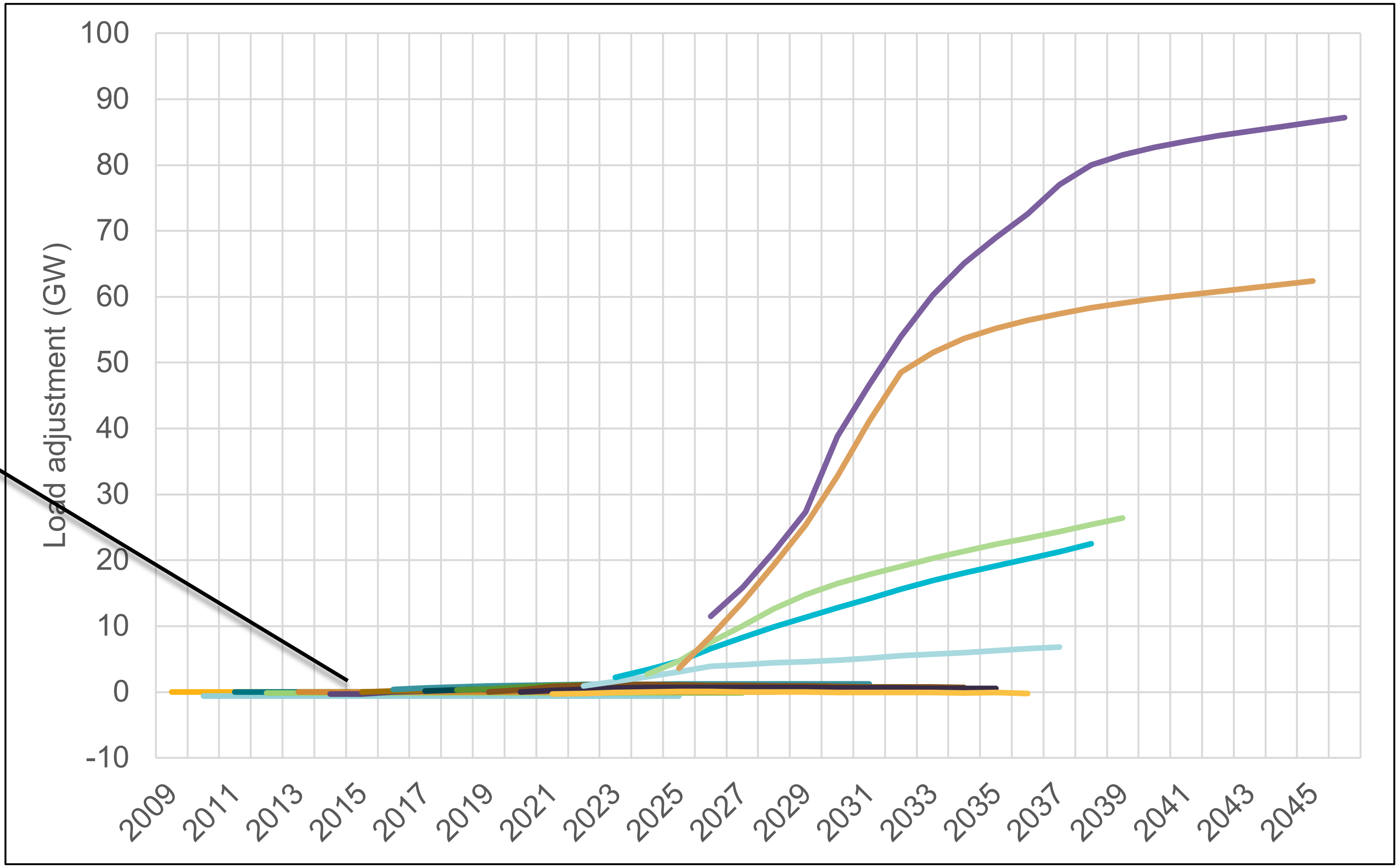
Ramp rate – expected amount of time for projects to reach their full requested capacity

PJM Large Load Adjustments (2026 Forecast)

- Even with derates, large load forecasts are stratospheric
- PJM's large load adjustments (2026 forecast) reach 39 GW by 2030 and 87 GW by 2040, relative to a 154 GW peak system



PJM's Large Load Adjustments, 2009-2026



Outstanding Questions

- **Milestones.** What is the appropriate level of customer commitment to be included in a load forecast? Should it be different for different kinds of forecasts (e.g., short-term versus long-term)?
- **Derate parameters.** How can derate parameters rapidly adapt as more data becomes available? At what point should the derate approach transition to something else (e.g., probabilistic forecasting)?
- **Data transparency.** How can large load connection and performance data be aggregated and shared so that RTOs and utilities can more effectively adapt to a rapidly evolving data center industry?
- **Link to interconnection.** Should interconnection capacity for loads be treated as a firm contractual right, similar to generators, and if so under what conditions?
- **Alignment with existing processes.** How can different large load forecasting processes (e.g., RTO, resource planning, large load registries) be better linked together? What is the role of RTOs, utilities, and state agencies in creating better links?
- **Scenario-based planning.** What does the uncertainty in large load forecasts imply for the use of scenarios in resource and transmission planning?
- **Managing uncertainty.** What are ways in which RTOs and utilities can hedge against the risks of over- or under-forecasts?

Load Interconnection

- Load interconnection solutions focus on interconnection processes, fast-track (curtailable, pay-to-play) interconnection service options, and the option to build

Load Forecasting	
S3. Load interconnection processes	S3.1 Clear thresholds for large load interconnection S3.2 Disclosure rules for similar interconnection requests S3.3 Coordination between load interconnection and planning processes S3.4 Coordinated interconnection for load and paired generation S3.5 Clear disclosure rules for behind-the-meter generation and storage S3.6 Standard interconnection process elements* S3.7 Cluster studies S3.8 Interconnection data and queue transparency
S4. Fast-track transmission interconnection service	S4.1 Provisional interconnection service S4.2 Surplus interconnection service S4.3 BYOG** and pay-for-transmission incentives
S5. ERIS* for loads (transmission)**	S5.1 ERIS-like interconnection service for loads
S6. Flexible interconnection (distribution)	S6.1 Staggered connections S6.2 Static flexible interconnection S6.3 Dynamic flexible interconnection
S7. Large-load construction of transmission and distribution facilities	S7.1 Option to build

* Standard elements include discrete process steps, timelines, financial readiness, fees, penalties, decision points, information requirements, milestones, and pro forma agreements.
** BYOG is bring-your-own-generation; *** ERIS is energy resource interconnection service (“as available” service)

Load Interconnection Process

- Load interconnection processes range from ad hoc to streamlined
- Should they become more standardized and transparent? If so, how?

Steps and timelines

Inquiry → Request → Studies → Inter-connection agreement → Facilities con-struction → In service

Other milestones: site control, deposits, financial commitments, long lead procurement

Fast Tracks and Flexibility

- Load fast tracks allow loads to come online before generation and transmission is in place to reliably serve them, as long as customers are willing to be flexible (reduce loads, or curtail) when needed
- Fast-track flexibility is a load curtailment service
  - Different than traditional demand response
- Load curtailment services can be temporary or permanent; can be based on system operator instructions or pre-determined limits
- Load curtailment services involve challenging questions: jurisdiction, study methods, transmission rates, resource adequacy obligations
  - Generator analogs may or may not be helpful in thinking through how these might work

Temporary with operator curtailment
Customer curtails load based on operator instruction, becomes network customer when upgrades are done

Example: SPP CHILLS
Generator analog: Provisional interconnection service

Permanent with preset operating limits
Customer curtails load based on agreed upon limits

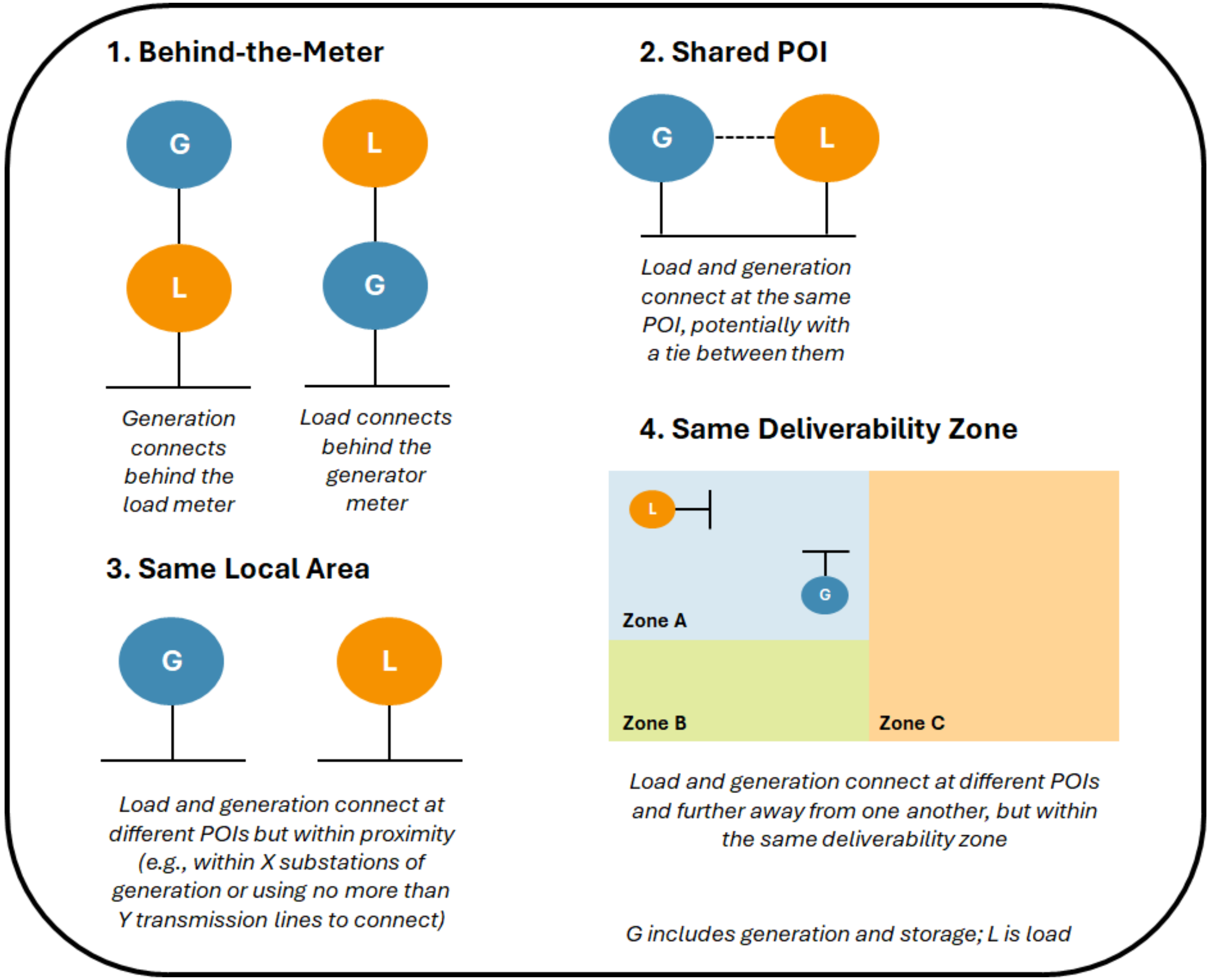
Generator analog: Surplus interconnection service; dynamic operating envelopes

Permanent with operator curtailment
Customer curtails load based on operator instruction, only uses transmission system on an as available basis

Generator analog: Energy resource interconnection service

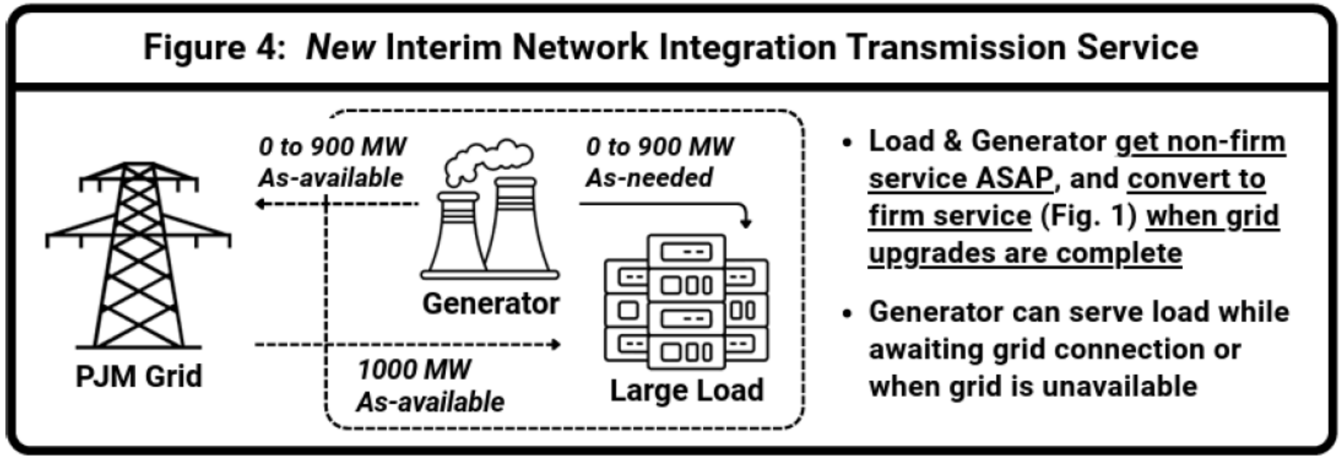
Load and Generation Pairing

- Co-location and other kinds of generation pairing make load interconnection more complex
- Several different load-generation pairing options
  - Behind-the-meter
  - Shared point of interconnection (POI)
  - Same local area
  - Same deliverability zone
- Pairing options have different implications for interconnection study, transmission planning, resource adequacy planning and procurement, transmission service, operations, and regulatory jurisdiction



Non-Firm Transmission Service

- In December 2025, FERC directed PJM to develop firm and non-firm contract demand transmission service (in addition to network service) for co-located large load and generation
- PJM is discussing including interim network service and non-firm contract demand transmission service in its proposal (see figure)
  - In both cases, PJM would curtail non-firm generation and load before pre-emergency demand response.
- Will non-firm interconnection service be standard? Is there demand for it?



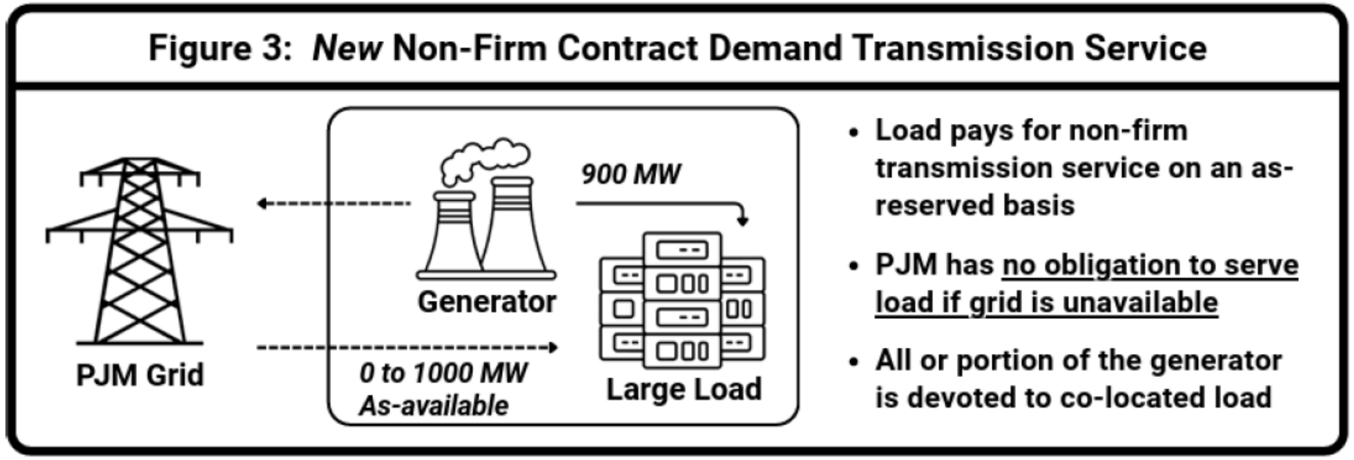


Figure source: PJM

Utility Procurement

- Utility procurement solutions focus on equipment procurement and enabling more flexibility in generation procurement cycles
- Report includes the load forecasting component of resource planning under load forecasting

Utility Procurement	
S8. Utility procurement approaches	S8.1 Advance procurement of equipment S8.2 Flexible procurement for new resources

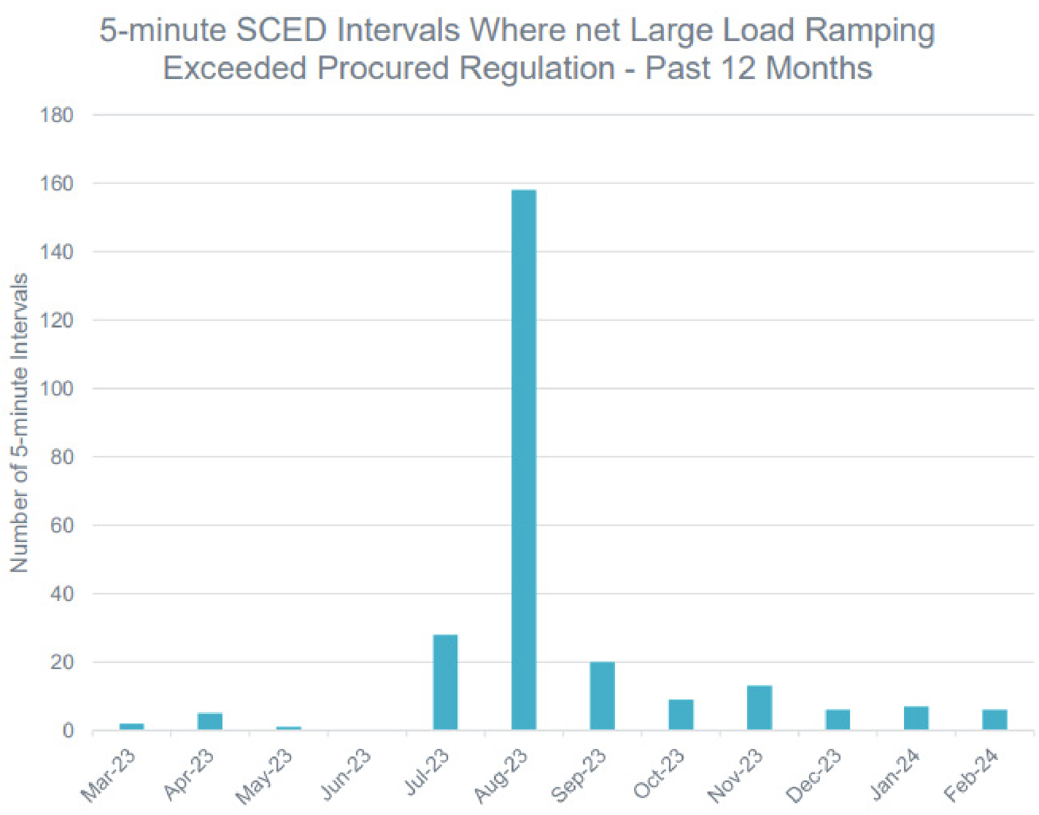
Markets and Operations

- Markets solutions focus on enabling large load flexibility in operations and ensuring that operating reserves are in place to manage large load variability

Markets and Operations	
S9. Energy markets and transmission service	S9.1 Load participation in real-time markets S9.2 Non-firm transmission service for loads
S10. Operating reserves	S10.1 Changes in regulation reserve procurement S10.2 Downward contingency reserves S10.3 Changes in reserve cost allocation

Operating Reserves

- Large loads may increase variability within dispatch intervals, causing load to exceed dispatched generation plus regulation reserves.
- ERCOT has seen a growing number of intervals where large load intra-dispatch interval variability exceeded regulation reserves (figure).
  - Multiple potential reasons, e.g., price chasing, larger than expected intra-interval ramps
- To deal with this issue, transmission providers could procure additional regulation reserves, but who should pay for them?
- Transmission providers could partially address this issue through standards – which approach best balances cost and reliability?



NOTE: This chart does not indicate Regulation was exhausted in all counted intervals. Multiple factors, including net load and IRR output, determine how much Regulation is used during a 5-minuted SCED interval.

Figure source: ERCOT

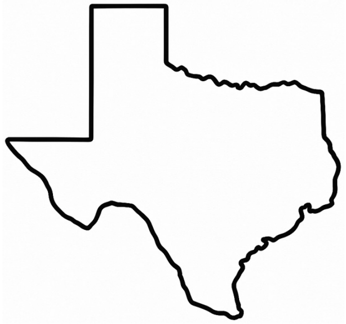
Cost Allocation and Ratemaking

- Cost allocation and ratemaking solutions focus on adjusting cost allocation methods, developing new tariffs for large loads, and creating wholesale or wholesale-like arrangements for large loads

Cost Allocation and Ratemaking	
S11. Cost allocation methods	S11.1 Review and update of allocation factors S11.2 Direct assignment of costs
S12. Large-load tariffs	S12.1 Clear eligibility requirements S12.2 Standard rates S12.3 Risk mitigation measures S12.4 Interruptible service requirements S12.5 Customer choice programs for large loads
S13. Wholesale rates and access for large loads	S13.1 Wholesale rates under utility service S13.2 Direct access programs

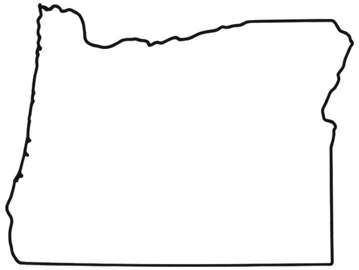
Cost Allocation Methods

Review and update allocation factors



The PUCT is considering if allocating transmission costs based on the highest four coincident peaks (4CP) is still appropriate (Docket 58484). In July, PUCT staff proposed replacing the existing methodology with a 12 CP.

The Virginia State Corporation Commission (SCC) ordered Dominion to explore alternatives to its methodology for allocating generation costs, and to include class cost of service studies in its next biennial rate review. (Case PUR-2025-00058).



The Oregon PUC approved Portland General Electric’s “peak growth modifier” in May. Under this approach, costs are allocated based on both coincident peak demand and peak demand growth (Docket UM 2377).

Cost Allocation Methods

Direct assignment

East Kentucky Power Cooperative requires large loads pay for all costs incurred. (Case 2025-00140)

PG&E's Electric Rule 30 allows customers who voluntarily pay for transmission infrastructure work upfront an accelerated pathway to connect to PG&E's transmission system.

The Michigan PSC required Consumers Energy to consider a direct assignment of costs to a new large load customer rate class in its next rate case. Direct assignment could include transmission, generation, and distribution costs (Case U-21859).

Wholesale Rates for Large Loads

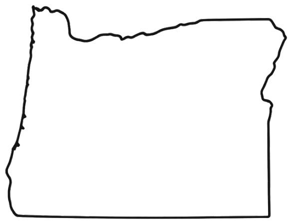
Wholesale rates under retail service

- **Northern Indiana Public Service Company's (NIPSCO's)** GenCo model provides a wholesale service to NIPSCO on behalf of large loads.
  - NIPSCO continues to be retail provider for the large loads
  - New generation assets to serve these loads owned by GenCo rather than NIPSCO
  - NIPSCO will pay GenCo through a PPA

- **Evergy Missouri's Special High Load Factor Market Rate (**Schedule MKT**)** is a retail rate that mimics wholesale pricing.
  - Energy charge is based on an SPP hourly day-ahead market price (LMP) at a specified load node
  - Generation capacity charge is based on wholesale capacity costs
  - Evergy is required to determine whether the incremental costs to service Schedule MKT customers exceed the amount that it recovers from these customers

Direct access programs

- Michigan's Electric Customer Choice program also allows customers to choose suppliers, subject to a cap equivalent to 10% of utility sales that has been reached for most utilities.



- Oregon's direct access program allows all nonresidential customers to purchase electricity from an electricity service supplier other than their current utility. The local service provider is responsible for the distribution of services, and the ESS is responsible for the generation and transmission services.

- Virginia electricity customers with annual demands >5 MW can select their electric supplier from a licensed competitive service provider.

Large Load Tariffs

Clear eligibility

Utility	Customer type	Minimum size (MW)	Load factor (%)
Dominion Energy Virginia Rate Schedule GS-5: High Load/Load Factor Service	Large load customers	25	75%
East Kentucky Power Cooperative (EKPC) Rate DCP	Data center customers	15	60%
El Paso Electric Large Economic Development Service Rate (Schedule 33A) and Medium Economic Development Rate (Schedule 33B)	Data center customers	50 (33A) 0.6 (33B)	Not specified
Florida Power & Light (FP&L) Large Load Contract Service-1 (LLCS-1) and Large Load Contract Service-2 (LLCS-2)	Large load customers	50	85%
Grant County Public Utility District Schedule No. 17 (Evolving Industries)	Crypto-currency miners	0.2	75%
We Energies Very Large Customer (VLC) Tariff and Bespoke Resources Tariff	Large load customers	500	Not specified

Large Load Tariffs Standard rates

El Paso Electric, Schedule 33A: Large Economic Development Service Rate

Schedule 33A is available to data center customers with more than 50 MW of billing demand.

El Paso Electric		
	Summer (Jun-Sep)	Non-Summer (Oct-May)
Customer charge ($ per meter per month)	$500.00	
Demand charge ($/kW)	$13.42	$10.53
On-peak energy charge ($/kWh)	$0.15102	$0.00264
Off-peak energy charge ($/kWh)	$0.00264	$0.00264

Grant Public Utility District, Schedule 17-B: Evolving Industry Service

Schedule 17-B is for retail customers with service of 200 kW contract or actual 15-minute demand.

Grant Public Utility District	
Basic charge ($ per month)	$1,000.00
Demand charge ($/kW per billing period)	$28.18
Energy charge ($/kWh)	$0.00554
Monthly minimum charge ($/mo)	Demand charge × 75% of customer's maximum billing demand during most recent 12-month period

Large Load Tariffs

Risk mitigation

Upfront payment and exit fees

Source: Giorgio Trovato on Unsplash

Credit rating and collateral requirements

MOODY'S	S&P	FITCH	DESCRIPTIONS	GRADE
Aaa	AAA	AAA	Highest credit quality, minimum credit risk	INVESTMENT
Aa	AA	AA	Very high credit quality, very low credit risk	
A	A	A	High credit quality, low credit risk	
Baa	BBB	BBB	Good credit quality, moderate credit risk	
Ba	BB	BB	Issuer faces adverse conditions and uncertainty, substantial credit risk	HIGH YIELD (or "junk")
B	B	B	High credit risk, issuer able to meet financial commitments	
Caa	CCC	CCC	Vulnerable and default likely	
Ca	CC	CC	Issuer is highly vulnerable or near default	
C	C	C	Lower ratings, issuer in default	
	D	RD	Lower ratings, issuer in default	
		D	Lower ratings, issuer in default	

Source: Financial Edge

Contract duration, sizing and resizing

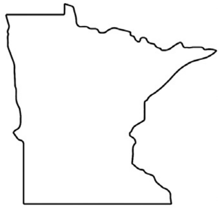
Source: FreePik

Minimum load requirements and demand charges

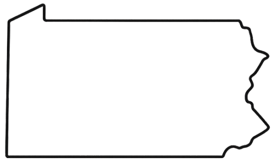
Total Contract Cap. (MW)	Min. Demand (MW)	Percentage
113	95.50	84.51%
114	96.50	84.65%
115	97.50	84.78%
116	98.50	84.91%
117	99.45	85.00%
117+	85.00%	

Large Load Tariffs Interruptible service

- Idaho Power can call interruption events and remotely disconnect electric service to Speculative High Density Load customers up to 225 hours annually.



- Minnesota PUC required Xcel Energy to develop rate classes, sub rate classes or a tariff to address super-large loads.
  - Xcel Energy proposed the Large General Time of Day Service and Large Peak Controlled Time of Day Service (Docket 25-289)



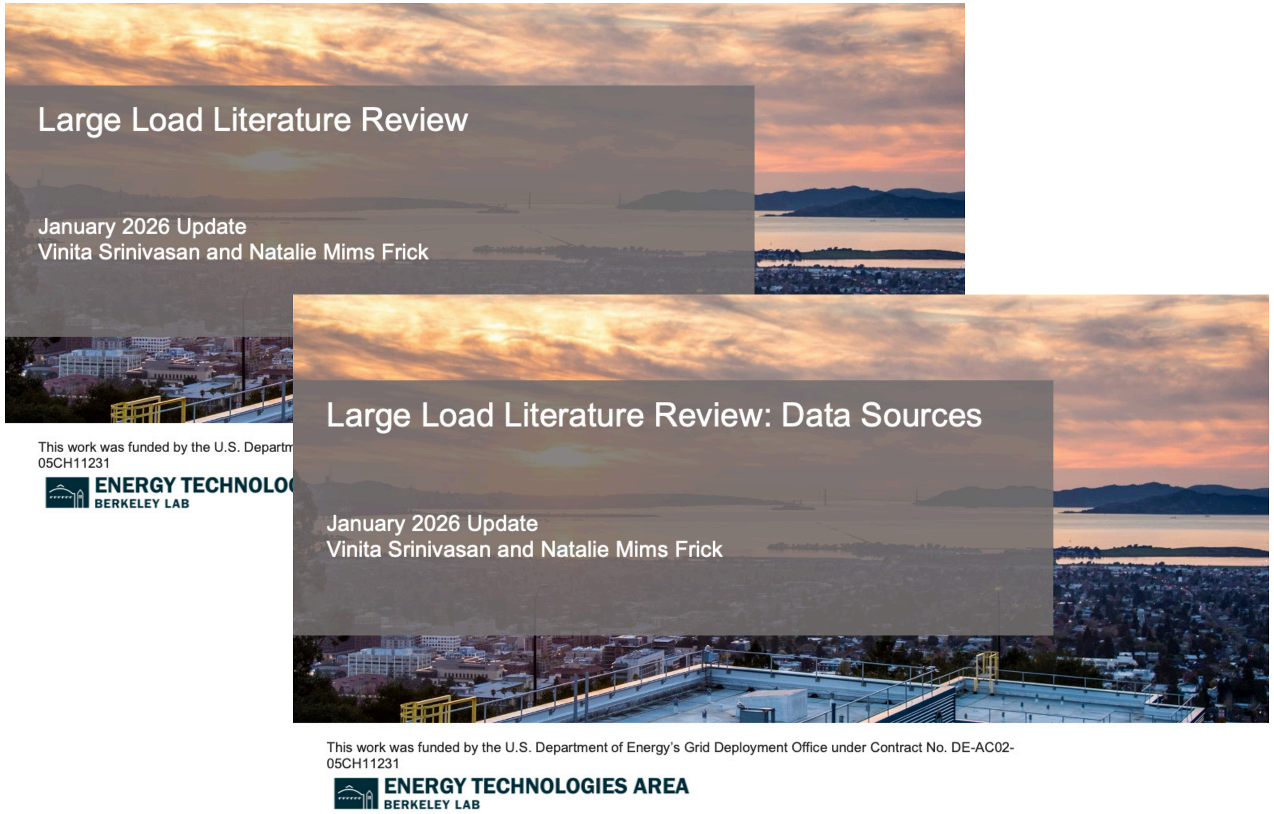
- The Pennsylvania Public Utility Commission adopted their large load model tariff in April.
  - Utilities can offer large load customers electricity service with mandatory capacity interruptions, which include penalties for non performance.
  - Large load customers with onsite generation that do not use their full interconnection service request can be offered lower minimum demand charges at the utility’s discretion.

Resources

Large Load Literature Review

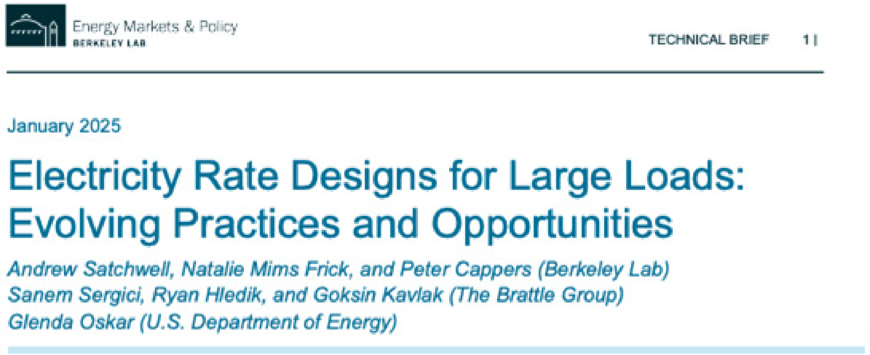
- The monthly 2025 Large Load Literature Reviews ultimately summarized more than 90 reports in 12 categories:
  - Load forecasting
  - Artificial Intelligence (AI) and infrastructure
  - Reliability and resource adequacy
  - Load interconnection
  - Demand flexibility
  - Generation
  - Co-location
  - Tariffs
  - Policy options
  - Maps and tools
  - Design and operations
  - Data source

- In 2026, data sources for reports with quantitative analysis will be provided in a separate document.



Regulatory Analysis: Large Load Tariff Elements and Trends

- LBNL published a [technical brief] on large load rate design in January 2025. More than 15 utilities have proposed large load tariffs since then.
- A forthcoming technical brief will update information about common elements in proposed and approved tariffs.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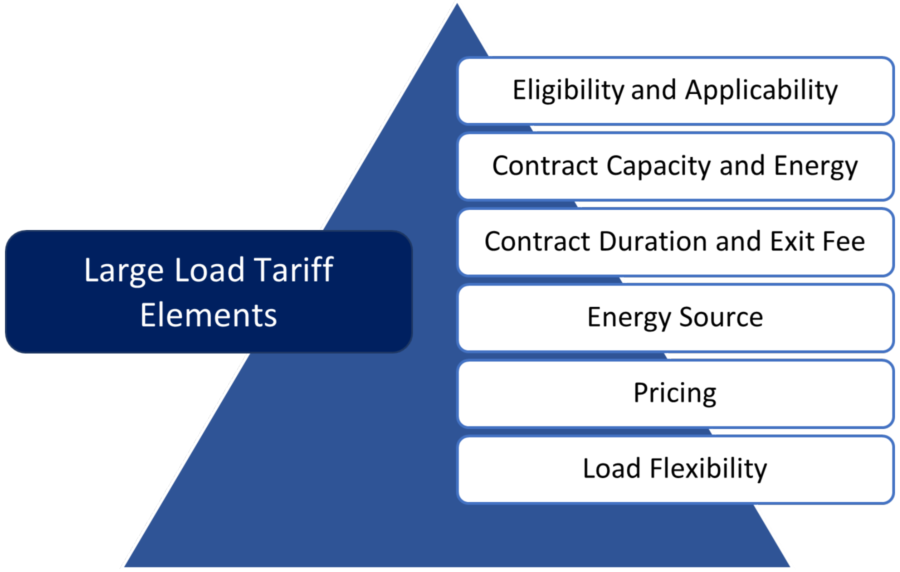
January 2025

Electricity Rate Designs for Large Loads: Evolving Practices and Opportunities

Andrew Satchwell, Natalie Mims Frick, and Peter Cappers (Berkeley Lab)
Sanem Sergici, Ryan Hledik, and Goksin Kavlak (The Brattle Group)
Glenda Oskar (U.S. Department of Energy)



- The update also will explore trends observed. For example:
  - The range for size eligibility is extremely wide, from no minimum size to 500 MW.
  - While contract durations for new tariffs are coalescing to a range of 10–15 years, concerns about stranded assets remain.
  - Regulators are addressing large load demand flexibility both in tariffs and the interconnection process.

Energy Systems Integration Group: Large Load Task Force

Convening of industry experts and stakeholders by Energy Systems Integration Group (ESIG) to identify practical solutions and develop harmonized practices to ensure reliable and efficient grid integration while supporting industry growth.

- Data collection
- Load forecasting
- Interconnection processes
- Dynamic modeling
- Transmission planning
- Wholesale market options
- Large Load Disturbance Events
- Large Load Performance Requirements: Current Practices and Recommendations
- Large Load Modeling for Dynamic Studies: Current Practices and Recommendations
- Resource Adequacy with Large Loads: Planning for Flexibility to Accelerate Integration
- Historical and Modern Large Loads: Characteristics, Context, and Industry Actions to Meet Grid and Customer Needs
- Impacts of Large Loads on Electricity Rates: A Primer

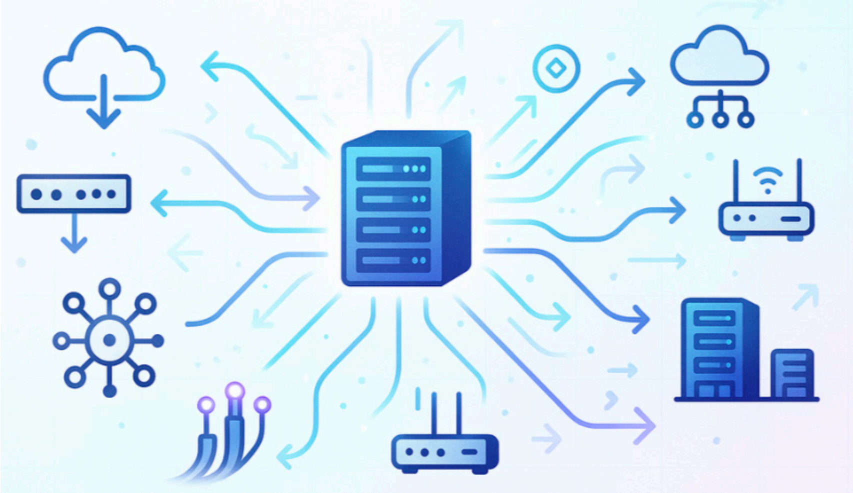
Voices of Experience: Data Centers

- The project uses a discussion based approach to identify and summarize key challenges and solutions to meeting data center industry needs.
- The steering committee has representatives from 15 national organizations with diverse perspectives (e.g., NARUC, ISO/RTO Council, Data Center Coalition), and will inform meeting topics, assist in identifying key participants, advertise the meetings and disseminate the final work product.

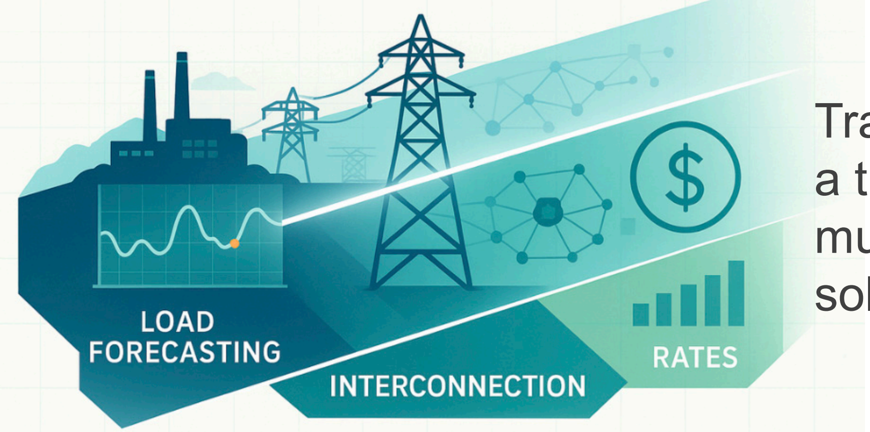
- Each call will have a different focus (e.g., attracting and serving data centers, cost allocation and ratemaking) and will be designed to elicit information from diverse perspectives.
- The final work product will be a DOE report summarizing findings from the calls, anticipated in FY26 Q4.

Learn more about the project here

Conclusions

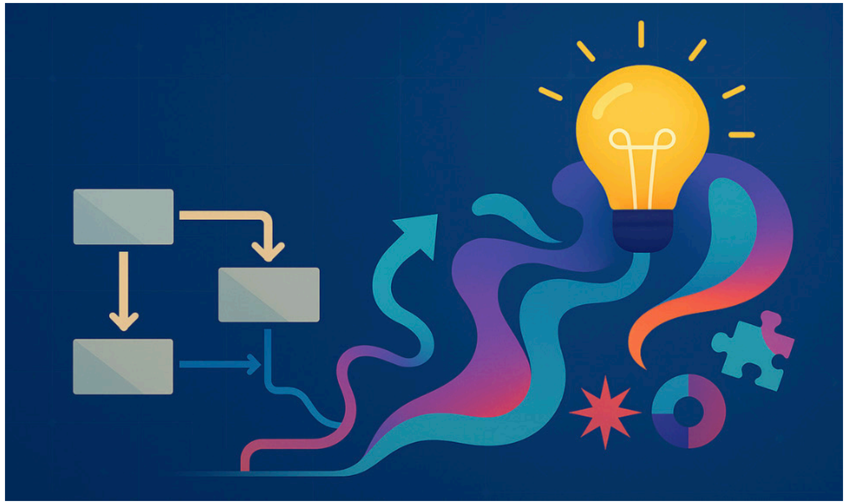


- Solutions emerge and adapt quickly
- Tracking solutions will remain important

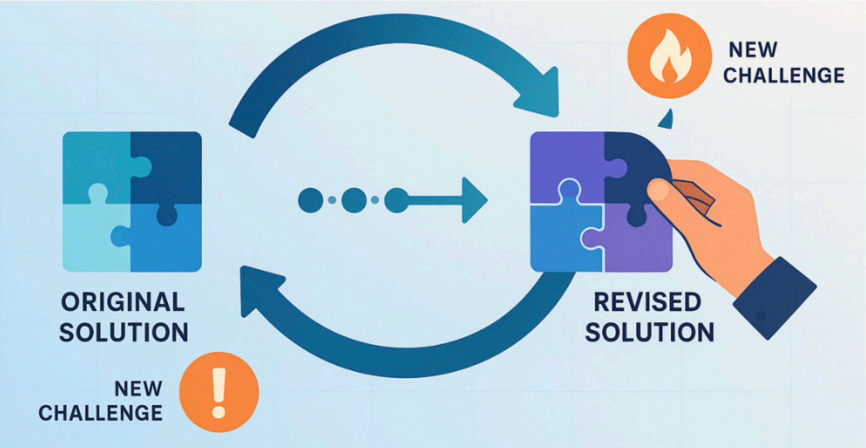


Transparency is a theme across multiple solutions

There is room for creative solutions to resolve challenges to serving large loads



Solutions will need to be revisted and adapted



Questions

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For more information

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