# **Flexibility Up Front:** Integrating Large Loads into Resource Adequacy Planning

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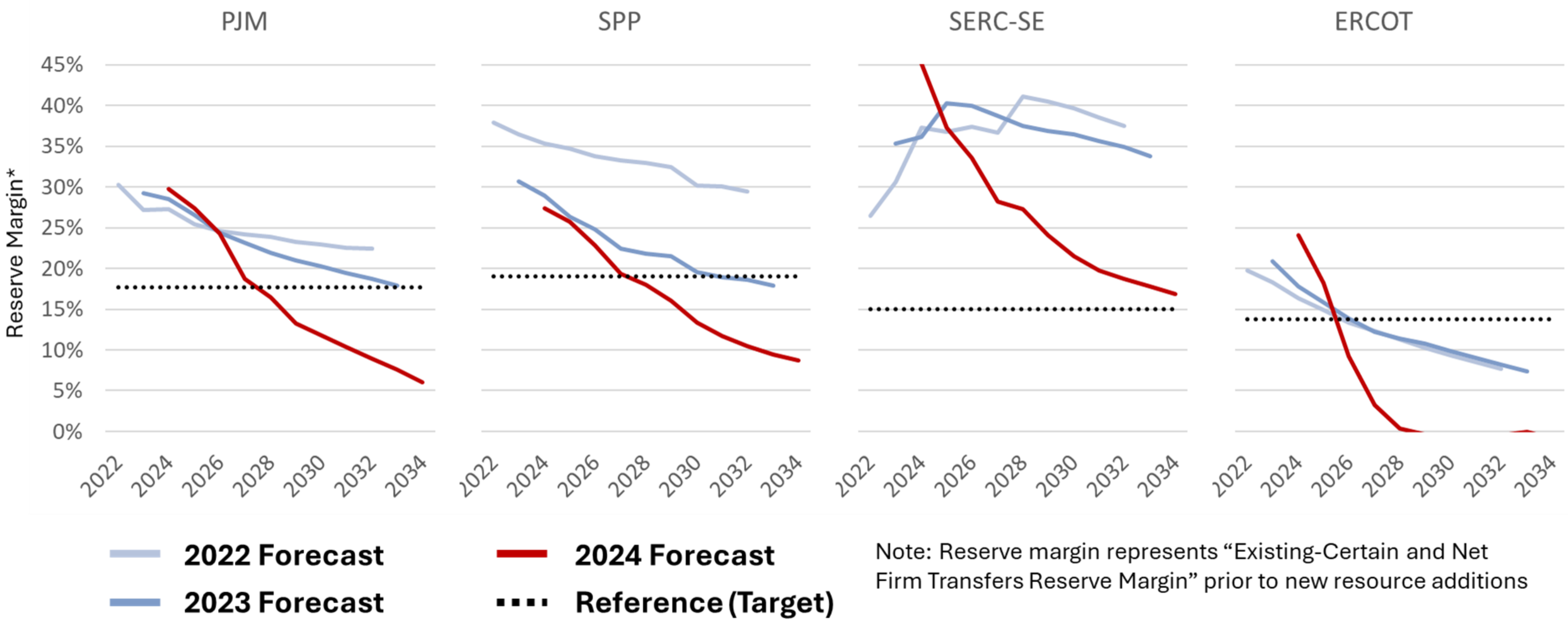
# A surge in data center-driven load growth has begun to tighten reserve margins




Note: Reserve margin represents "Existing-Certain and Net Firm Transfers Reserve Margin" prior to new resource additions

Figure Source: Energy Systems Integration Group. Data Source: NERC Electricity Supply and Demand, 2024.



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# **Reactive** approaches to mitigate **near-term** resource adequacy risks

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**Interconnection Moratorium**
No new interconnections for new large loads until certain reliability requirements are met.

**American Electric Power (AEP).** In March 2023, AEP issued a moratorium on taking new service requests from data center customers in central Ohio in order to give its transmission planning group time to study the impact of pending large-load service requests.

**Load Curtailment Programs**

New large loads may interconnect, on the condition that they may be curtailed to preserve RA.

**Texas Senate Bill 6 (SB6).** Requires mandatory curtailment or deployment of backup generation for large loads with an on-site backup generator.

**SPP Conditional High-Impact Large-Load Service (CHILLS).** CHILLs receive faster interconnection in exchange for interruptible transmission service until upgrades are in place.

**Bring-Your-Own Generation**

New large loads may interconnect, on the condition that they offset their grid impact through self-supplied capacity.

**PJM January 2026 Critical Issue Fast Path Proposal.** PJM to establish a pathway for expedited interconnection for resources through voluntary "Bring Your Own New Generation" (BYONG)



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# Opportunity for **proactive, up-front**, approaches for addressing large load-driven adequacy risks

| | Shortcomings of Near-Term Approaches | Opportunity for Improved Approaches (Like Flexibility) |
|---|---|---|
| **Integrated** | Not integrated with the long-term capacity planning process; solely meets individual large load needs. | Solve for for both large-load and system-wide capacity needs simultaneously. |
| **Customizable** | "One-size-fits-all" approaches to curtailment. | A wide spectrum of flexibly options which tailor the size, duration, and timing of flexibility needs. |
| **Economic** | Do not follow an economic or price signals. | Can follow both short- and long-term price signals. |
| **Long-Term** | Typically are temporary solutions until transmission and generation additions can "catch up." | Can be developed intentionally as sustainable long-term options in the planning toolkit. |



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# Why should we be thinking about flexibility from large loads?

- **Decrease total capacity needs**
- **Utilization of existing behind-the-meter generation for capacity**
- **Key tool for maintaining resource adequacy during scarcity events**
- **Supply chain constraints → delayed timelines/high costs for new capacity**

**Important note for resource adequacy use cases…**

Flexibility is **not required on a regular basis** but can be reserved for exceedingly rare events that may only occur a couple times per year or fewer.

In contrast, flexibility for energy or ancillary markets would require regular, day-ahead and real-time use.



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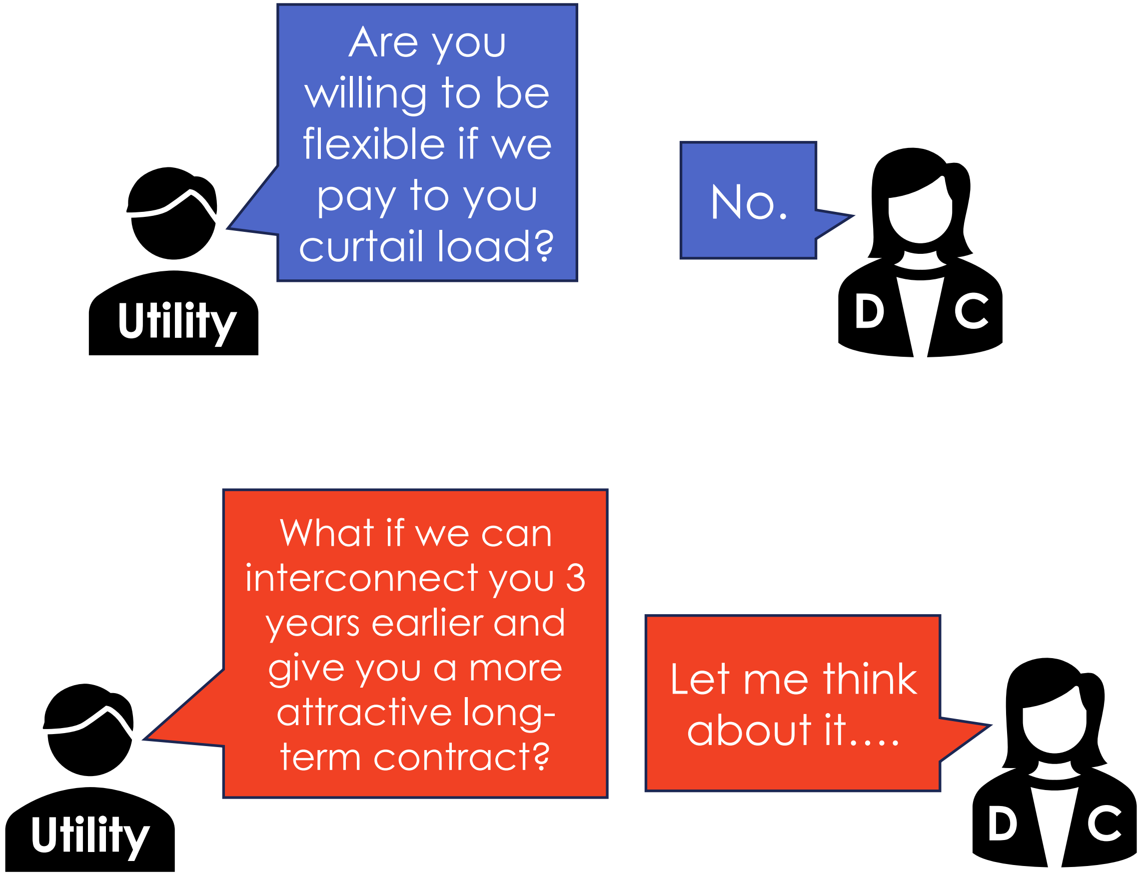
# The benefits of load flexibility must be considered **up front** in the planning process

- Investment deferment in exchange for flexibility can be a **win-win** for data centers, utilities, and ISOs/RTOs.
    - Data centers **interconnect faster** (speed-to-deployment #1 motivator).
    - Utilities can provide **expedited service** while avoiding time consuming and expensive capital upgrades and investments.
    - ISO participants benefit from **less capacity** needing to clear the market.
- To achieve these outcomes, however, **investment deferment must be considered in *planning*** (i.e., IRP procurement or capacity market auctions), where investment decisions are evaluated or incentivized.



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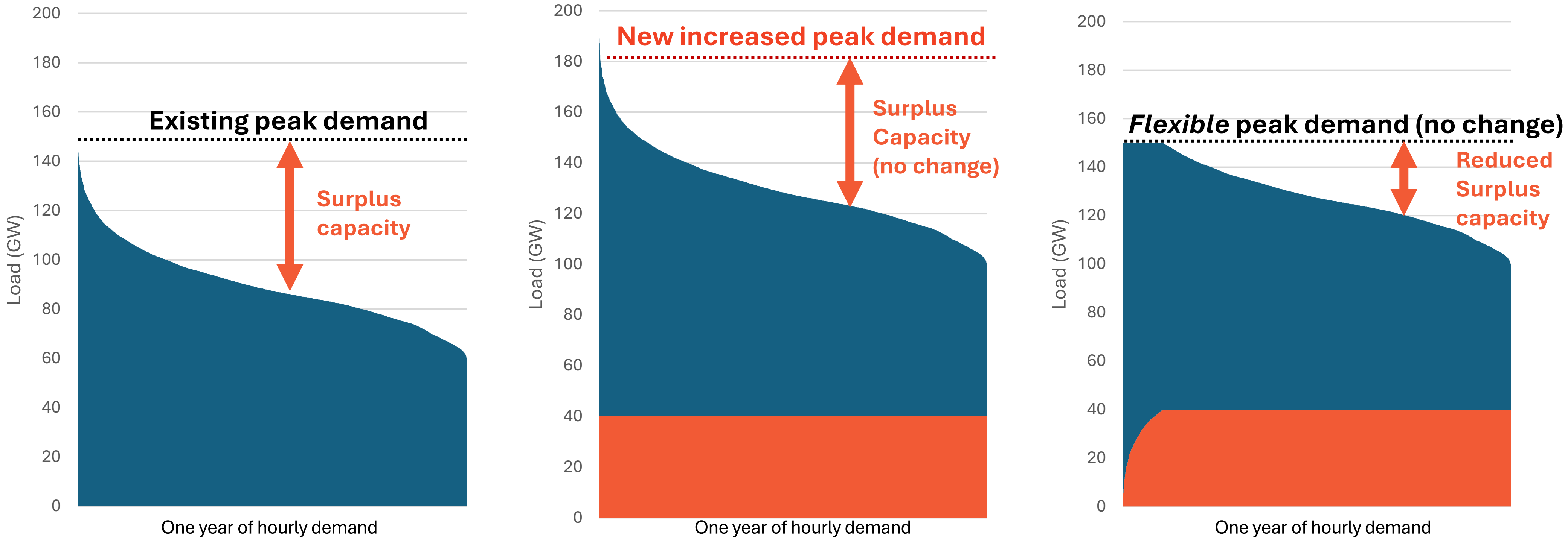
# Modest amounts of flexibility have the potential to significantly reduce capacity needs

Simplified, but illustrative, example of large load flexibility for resource adequacy




Source: Energy Systems Integration Group



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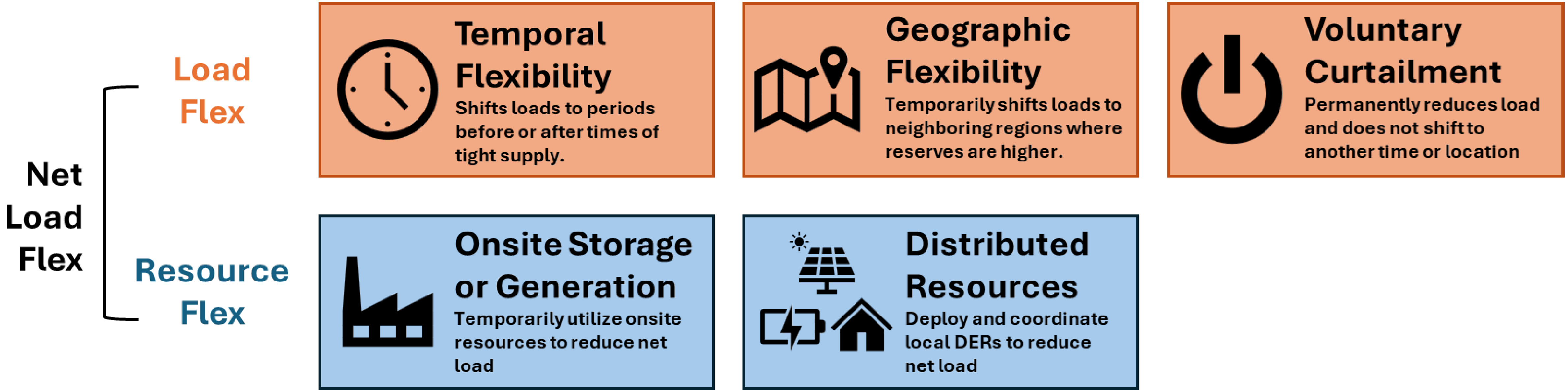
# Five types of large load flexibility

Large load flexibility is NOT just load curtailments, especially if designed **UP FRONT**

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# A Six-Step Process to Plan for Flexibility

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# Six-Step Process to Plan for Flexibility

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- Step 1 — Characterize the Load
- Step 2 — Improve the Forecasts
- Step 3 — Quantify Capacity Requirements of Large Loads Absent Flexibility
- Step 4 — Quantify Capacity Contributions of Large Load Flexibility
- Step 5 — Calculate the Avoided Infrastructure from Large Load Flexibility
- Step 6 — Develop a Regulatory Framework that Ensures Resource Adequacy

**Objective:** Develop a modeling guidebook and methodology that resource planners at utilities and ISOs can implement in their IRP or capacity accreditation framework.

**Key Outcome:** Proactively plan for flexibility **up front** in the capacity procurement process.



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# **Step 1:** Characterize the Load

**Load Size**

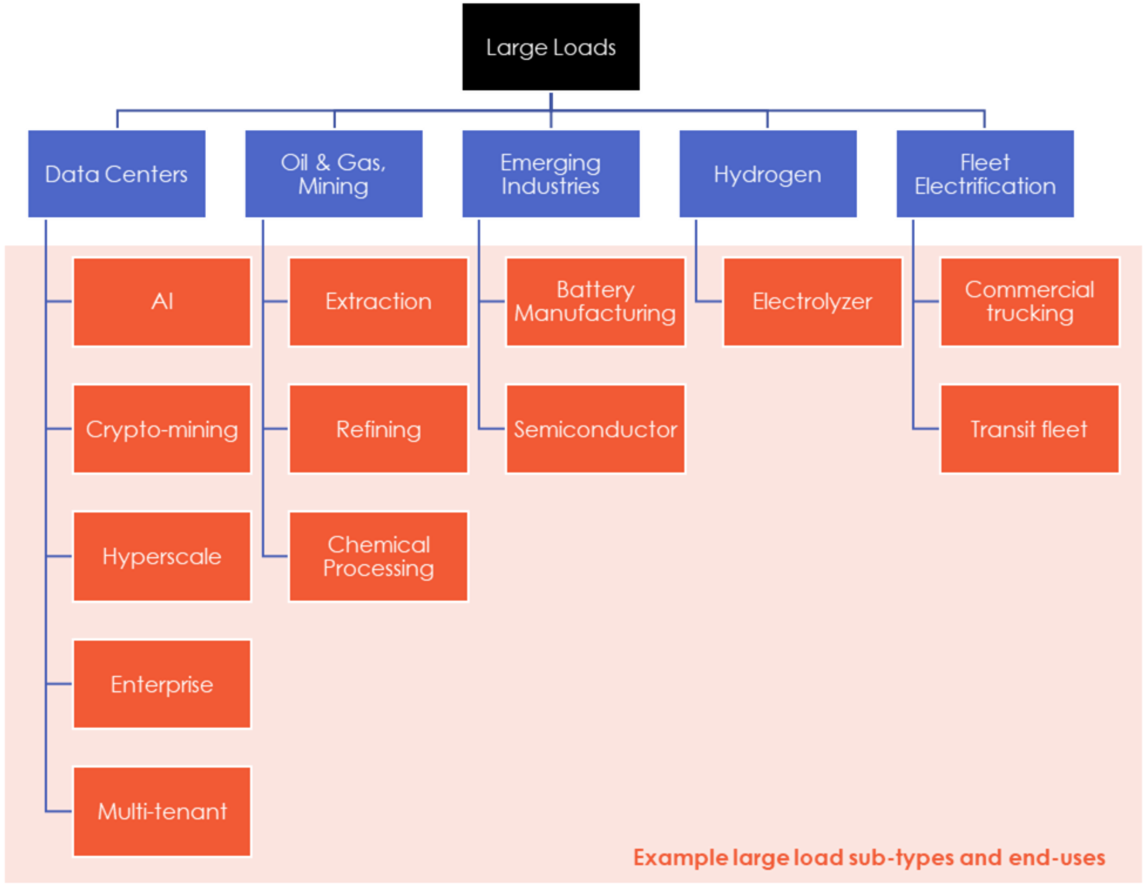
**Backup Generation**

**Flexibility & Demand Response**

**Load Profile and Peak Coincidence**

**Price Responsiveness**

**Outcome:** classification of large loads to improve forecasts (Step 2) and parameters for modeling large load flexibility to differentiate potential resource adequacy requirements and contributions (Step 4).

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# **Step 2:** Improve the Forecasts

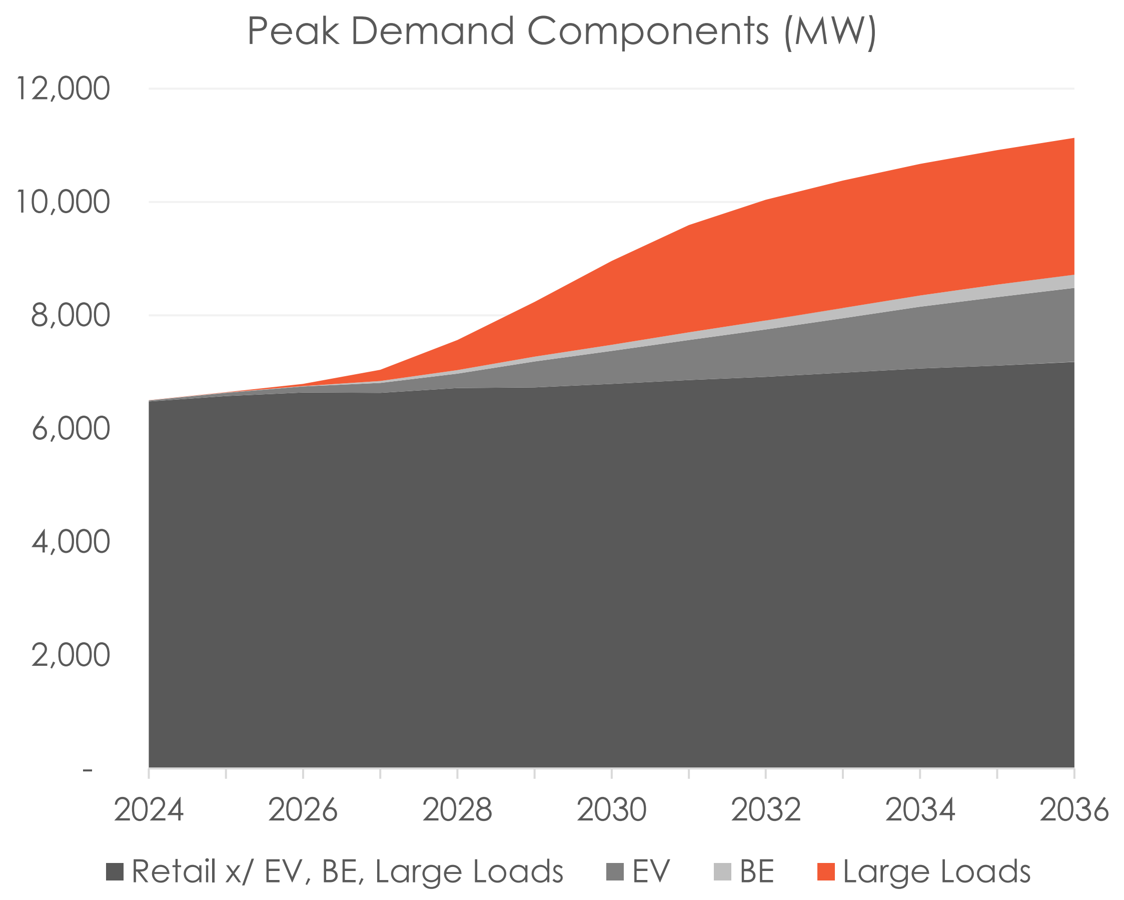


Figure Source; adapted from Public Service Colorado, 2024 Just Transition Solicitation, Section 2.2 Tables and Figures Workpaper.

To support planning for large load flexibility, forecasts should:

1. Split the forecast components and include a large load layer,
2. Evaluate a range of potential future demand,
3. Specify annual energy and seasonal peak demand,
4. Reflect long-term contracts instead of queue requests.

**Outcome:** provide peak (MW) and energy (MWh) forecasts of data center demand as well as 8760 load profiles (weather dependent if available).



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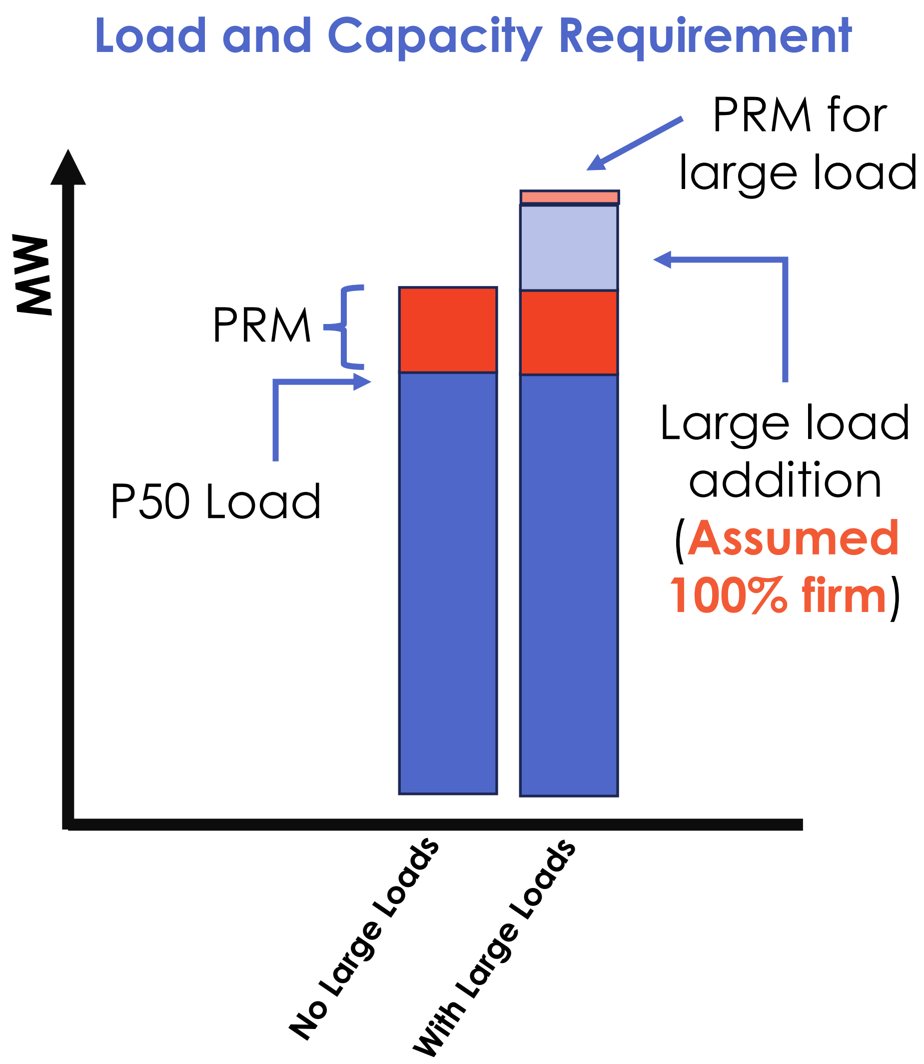
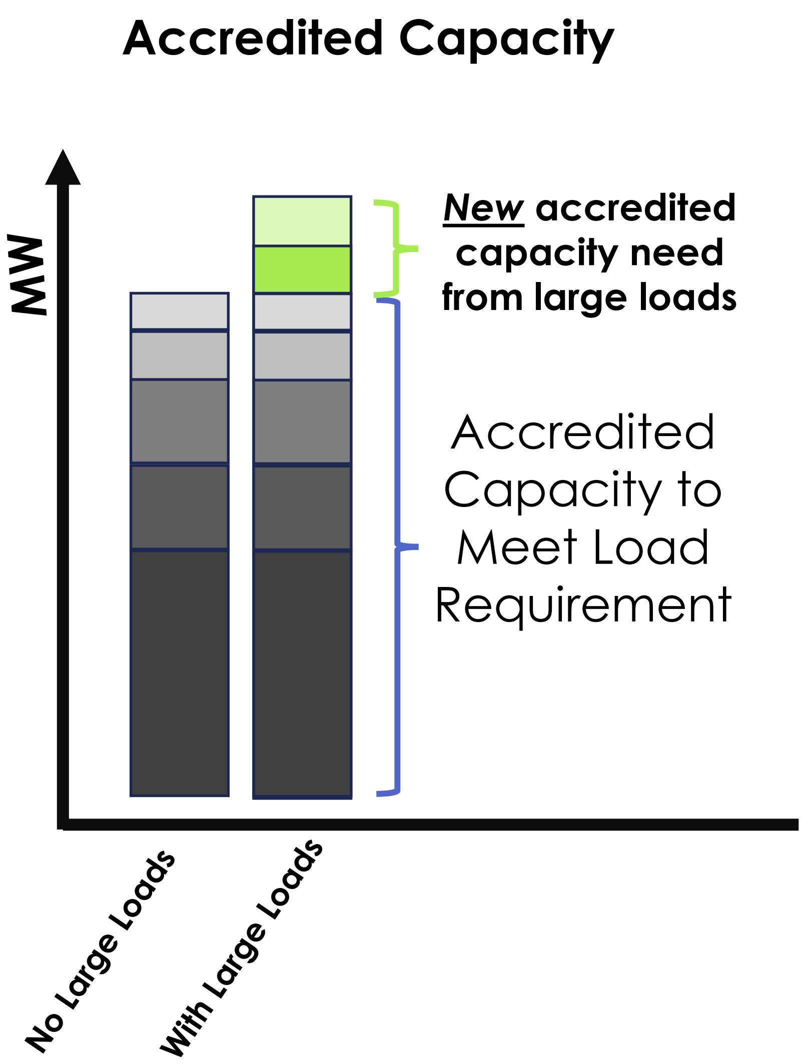
# **Step 3:** Quantify Capacity Requirements of Large Loads Absent Flexibility




- This step identifies incremental needs attributed to large loads ***absent any flexibility***, including:
  - Capacity additions (MW) by resource type
  - Increase to net present value (NPV)
  - Emissions increase
- **Outcome:** capacity requirements (MW) attributed to large load, by forecast year, assuming no large load flexibility.



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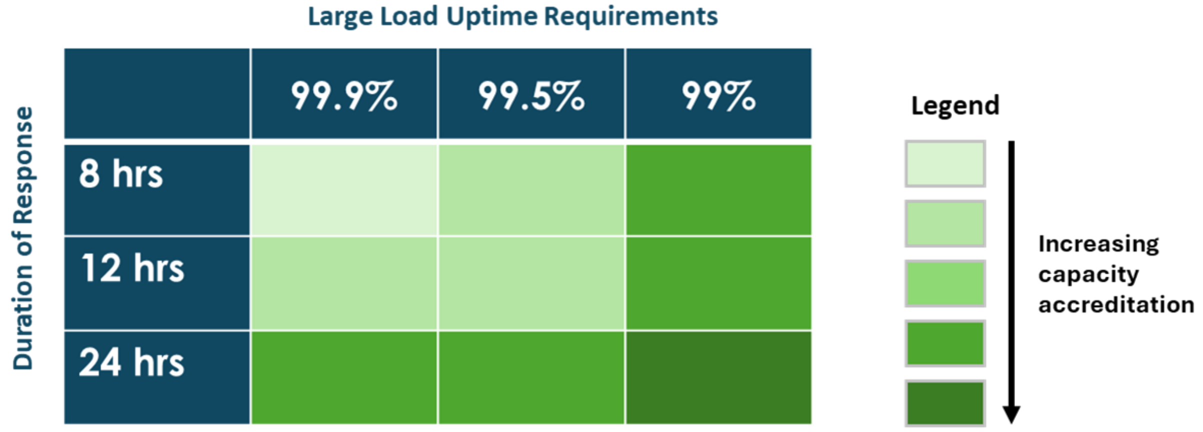
# **Step 4:** Quantify Capacity Contributions of Large Load Flexibility

- This step calculates the *potential* capacity contributions from a large load - *if* it is flexible.
- Can be done one of two ways
    1. Calculate a **reduction to the PRM** (socializes benefit)
    2. Calculate an **ELCC or alternative accreditation** (internalizes benefit)
- **Outcome:** capacity accreditation (MW, %) or contributions from large load flexibility.

**Illustrative capacity accreditation matrix of large-load flexibility**




Source: Energy Systems Integration Group



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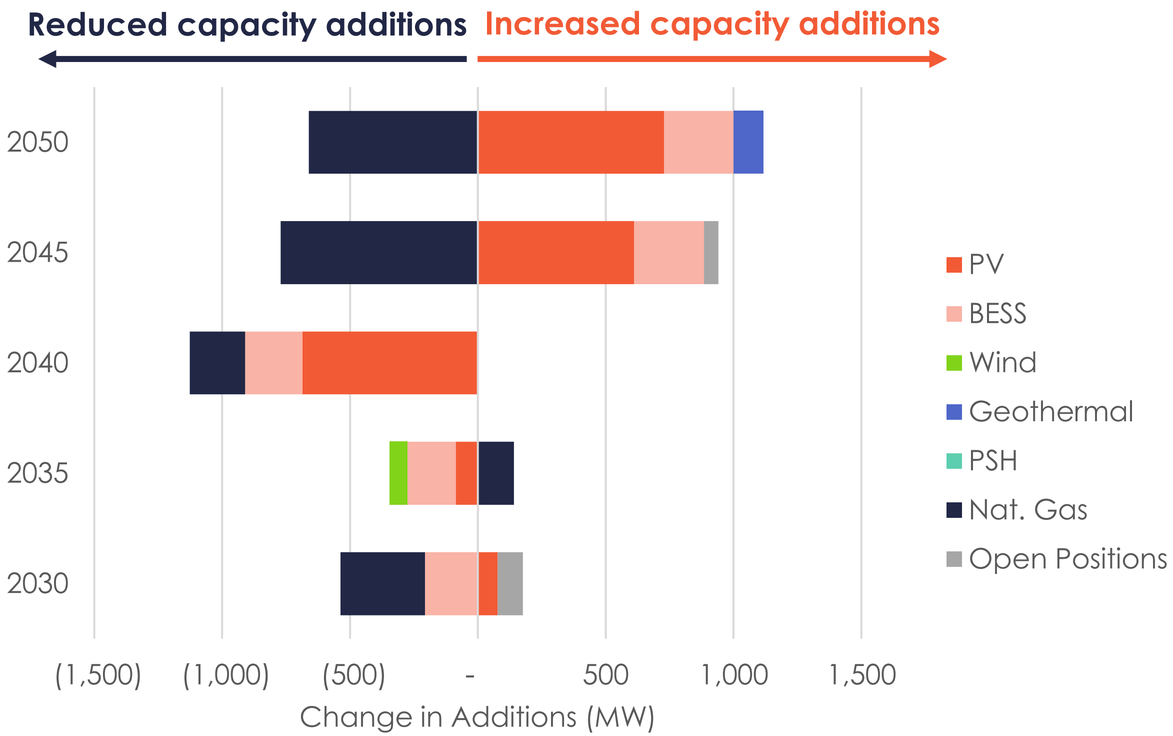
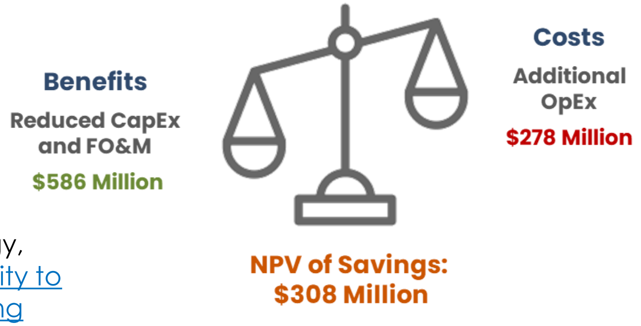
# **Step 5:** Calculate the Avoided Infrastructure from Large Load Flexibility




Source: GridLab, Telos Energy, [Bringing Data Center Flexibility to Resource Adequacy Planning]

- By comparing the outputs from Step 3 and Step 4, we arrive at the **avoided capacity needs (MW and type)**, **avoided costs (NPV)**, and **avoided emissions** that can be realized with large load flexibility across the matrix of options.
- We have now clearly isolated exactly what benefits the flexibility brings, **up front** in the planning process.
- **Outcome:** Quantification of accelerated timeline for interconnection and avoided costs and emissions attributed to large-load flexibility.



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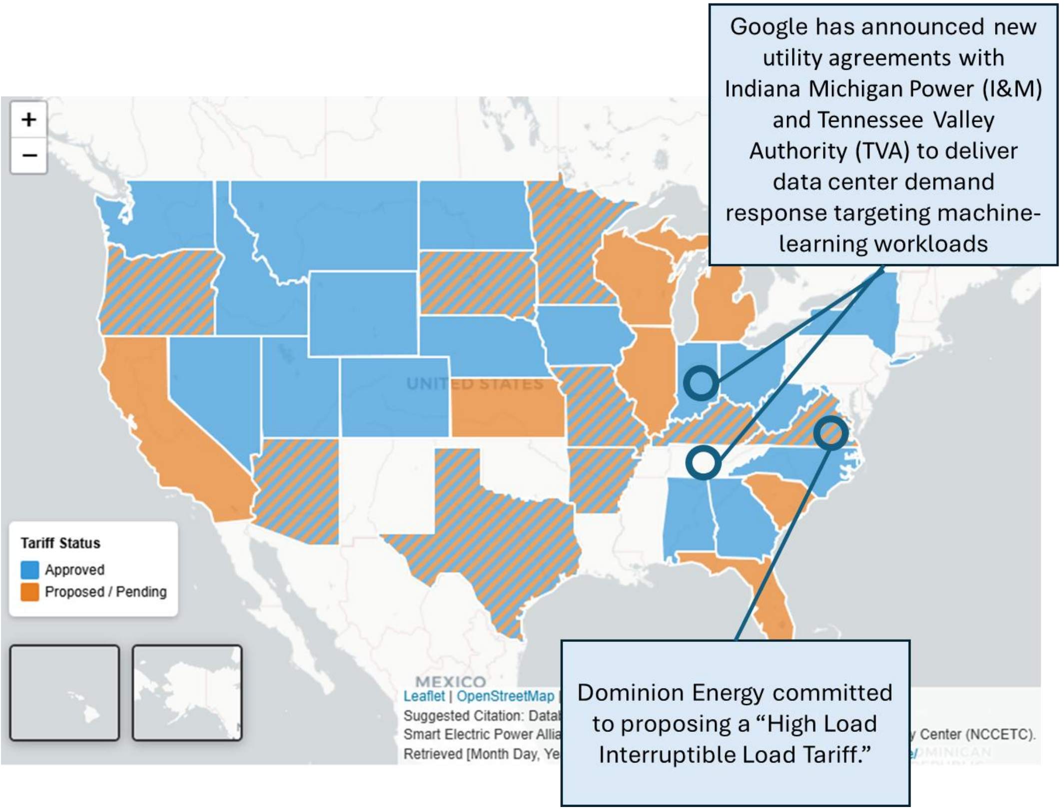
# **Step 6:** Develop a Regulatory Framework that Ensures Resource Adequacy

- Use information (costs, resource builds, and emissions) developed in Step 5 to inform:
  - Utility negotiations with large loads,
  - Procurement strategies (IRP or capacity market), and
  - Capacity requirements.
- Crucially, this information can be used to inform the **interconnection timeline** and **costs** that should be paid for by large loads with and without flexibility.
  - Also develop new rate structures that foster this process.
- **Outcome:** linkage to capacity market design, regulations, and rate structures for large loads.



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# We have a long way to go to improve our resource adequacy analyses with large loads

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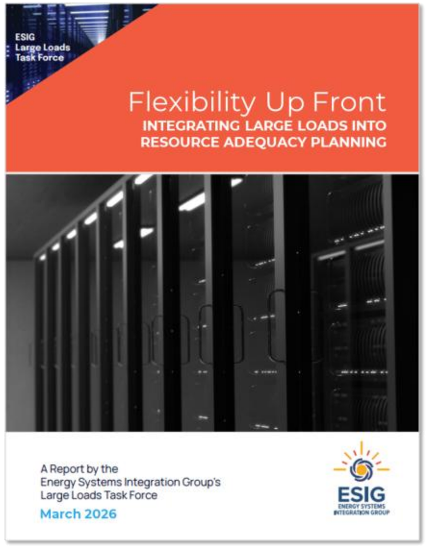
The industry in general, and resource adequacy practitioners in particular, ***need more data***

| Data Need | Current Status | Essential | Preferred |
|---|---|---|---|
| **Size** | ●●●○ | Nameplate Capacity | Annual Ramp Rate |
| **Load Forecast Range** | ●●●○ | Large load layers by end use & scenario without large loads | Load scenarios & probabilities |
| **Location** | ●●○○ | Zonal | Nodal |
| **Hourly Characteristics** | ●●○○ | 8760 Chronological Hourly Loads | Disaggregated Profiles by Large Load |
| **Weather Dependence** | ●○○○ | Exclude large loads from underlying load-temperature relationship | Multiple weather years of large load data |
| **Resource Configuration** | ●○○○ | Load Type, On-site Generator Specs, Run-hour limitations | Market price sensitivity, Flexibility parameters |


New Report
Coming Soon!




# THANK YOU

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