Understanding Capacity Resource Accreditation for New England's Clean Energy Transition

PRESENTED BY

Sam Newell

John Higham

Kathleen Spees

PRESENTED TO

Massachusetts Attorney General's Office Webinar

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Agenda

1. Resource Adequacy Basics
2. ISO-NE: Current Approach
3. ELCC Design Concepts
4. Opportunities to Improve Resource Accreditation
5. Appendix: Jurisdictional Review

Resource Adequacy = Enough Resources to Reliably Serve Load

The grid must have **enough resources to essentially always meet demand** in both “normal” and “extreme weather” years

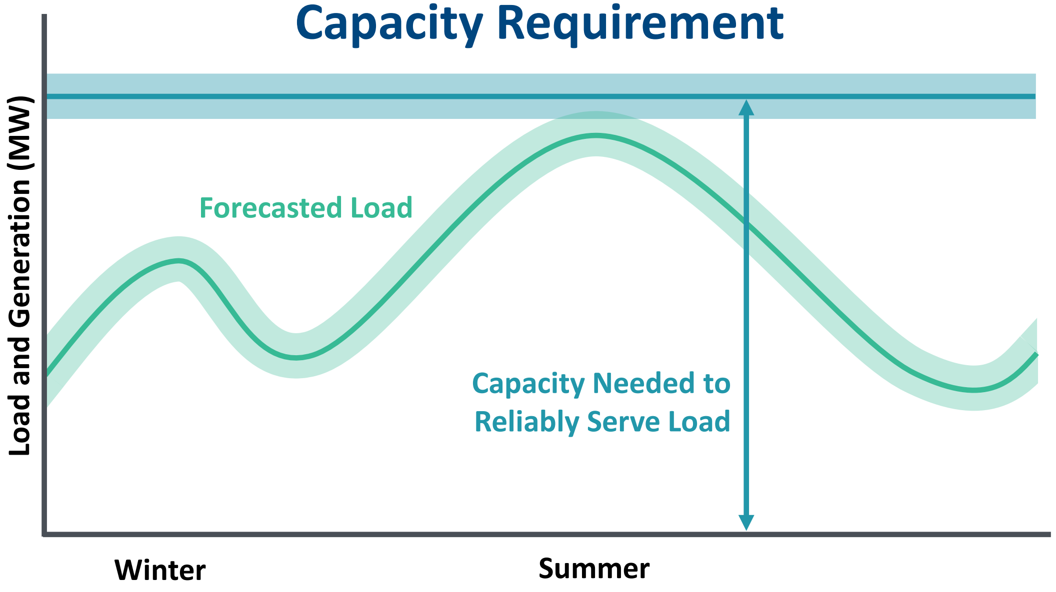
RTOs such as ISO-NE may achieve reliability by:

- Establishing a **resource adequacy standard**, i.e., *how* reliable the system must be
- Probabilistic modeling to determine the amount of supply needed to meet that standard, expressed as a **reserve margin** of accredited capacity / normal peak load;
  - Starts with current fleet and **adjusts until RA target is met**
  - Includes distribution of weather-driven load conditions
  - Includes representation of resources’ unavailability patterns
- Implementing target through planning requirements or (in ISO-NE’s case) a capacity market

Example: ISO-NE Resource Adequacy Standard[1]

No more than 1 supply shortfall event in 10 years, or **“1-in-10” reliability standard.**

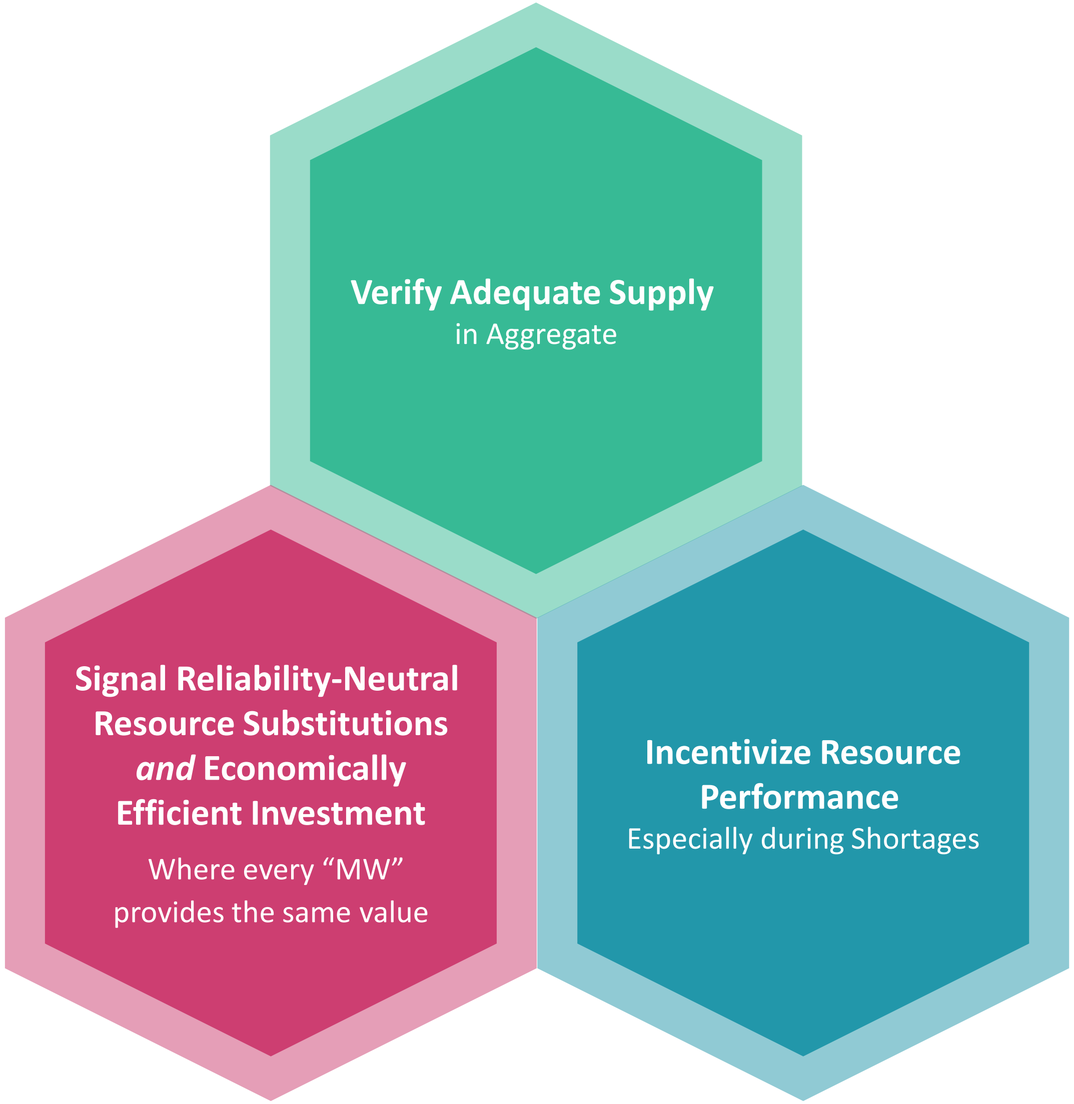
Determining Installed Capacity Requirement



1. *N.B.,* ISO-NE considers two additional reliability metrics, Loss of Load Hours (LOLH) and Expected Energy Not Served (EENS), in developing its capacity demand curves.

Resource Accreditation Goals

Accurately accrediting resources for their contribution to resource adequacy is necessary for the whole supply side of the resource adequacy equation



ISO-NE's Current Resource Accreditation Approach

Thermal, Storage, and Demand Response

- **Tested max capacity**, not derated for EFORd

Wind and Solar

- **Capacity factor** in defined peak hours: 5-7 pm in winter and 1-6 pm in summer

Hybrids

- Component parts evaluated **separately**
- Accreditation constrained by interconnection limits

For all resource types, ISO-NE calculates a summer and winter capacity value and accredits resources at whichever value is lower

Resource Adequacy and Accreditation in a Transforming Grid

- Rapid expansion of correlated, intermittent wind and solar resources, and of energy-limited storage
- Reliance on natural gas-fired generation without onsite fuel
- Growth of demand response and distributed energy resources
- Load growth and changing load shapes with electrification
- A changing climate with more severe and more frequent extreme weather events

These trends are changing resource adequacy in every region

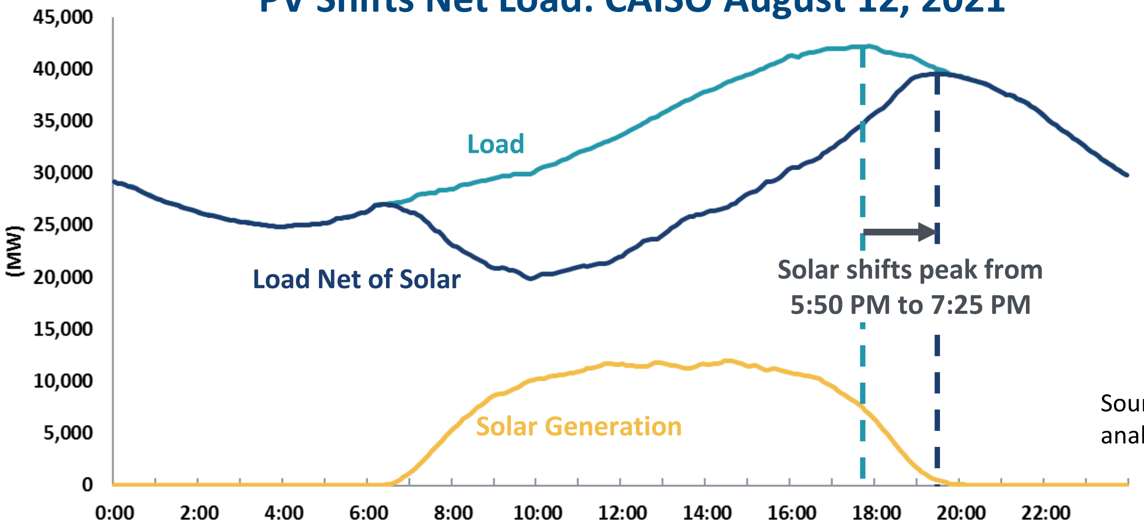
- The nature and timing of shortage risk
- The ability of various resources to mitigate those risks, as part of a diverse, complementary fleet
- Hence, the need to refine resource accreditation for all resource types

In ISO-NE, the most immediate concern is winter fuel availability. Renewables are growing but still provide less than 5% of energy.

Accreditation Challenges Vary by Resource Type

Wind and solar resources fundamentals

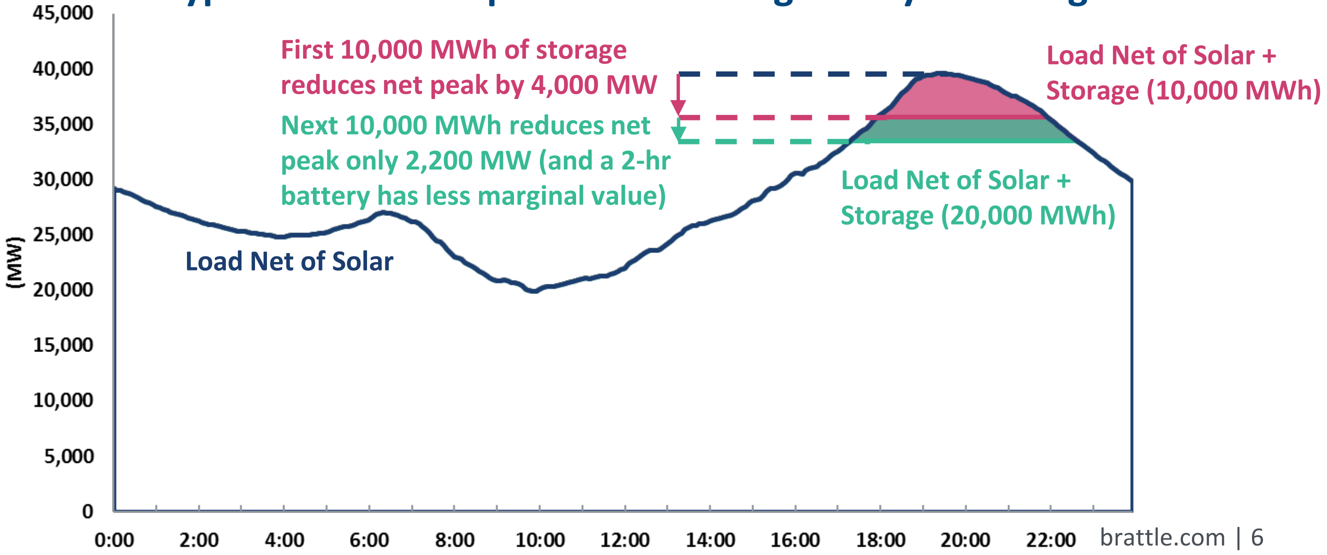
- Primarily **weather-driven intermittent performance** suggests a need to consider many years' conditions
- **Correlations among like resources** means marginal value declines with penetration
- **Also need to recognize complementarities** such as between solar/wind and storage



Source: Brattle analysis of CAISO data

Energy-limited resources (storage and DR)

- Can meet narrower peaks, and marginal value declines with penetration, as residual peaks widen
- Value depends also on how they are operated



Hybrids have attributes of storage and solar/wind

Accreditation Challenges Vary by Resource Type (cont.)

Conventional thermal resources

- Reliability value depends on **correlated outages, common mode failures, fuel availability**
- A 5% EFORd is far less consequential if outages occur randomly than if outages systematically occur on the **hottest/coldest days** of the year
- Additional gas-fired generation capacity provides **zero incremental reliability value** when fuel supply is limited

Gas-Fired Generation Outages:
ERCOT Winter Storm Uri

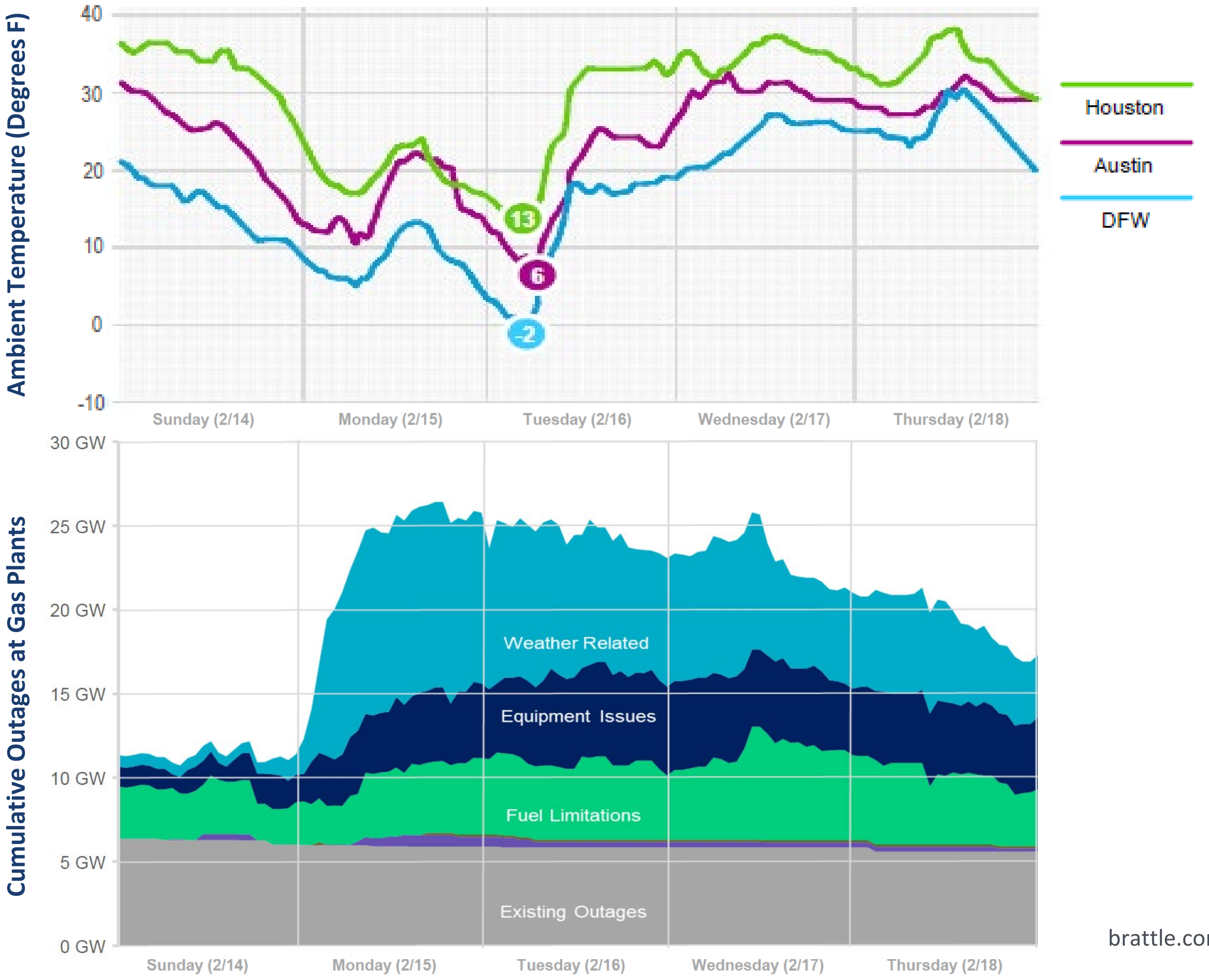


Figure Sources: ERCOT, "Update to April 6, 2021 Preliminary Report on Causes of Generator Outages and Derates During the February 2021 Extreme Cold Weather Event," April 27, 2021, p. 18.
ERCOT, "Review of February 2021 Extreme Cold Weather Event – ERCOT Presentation," February 24, 2021, p. 18.

Key Concept: What is ELCC?

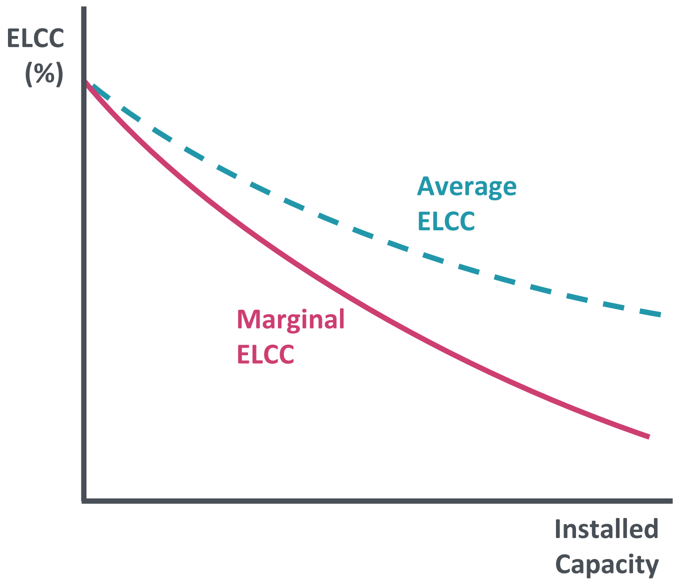
Effective Load-Carrying Capability (ELCC) expresses a **resource's reliability contribution** relative to a "perfect" resource; calculated using simulations similar to those used to determine the resource adequacy requirement

Many resources types have **diminishing marginal ELCC**, especially those with **correlated** unavailability

Average ELCC is a concept derived by averaging the marginal ELCCs of all resources along the curve. Average ELCC declines more gradually with penetration, so tends to be higher than marginal

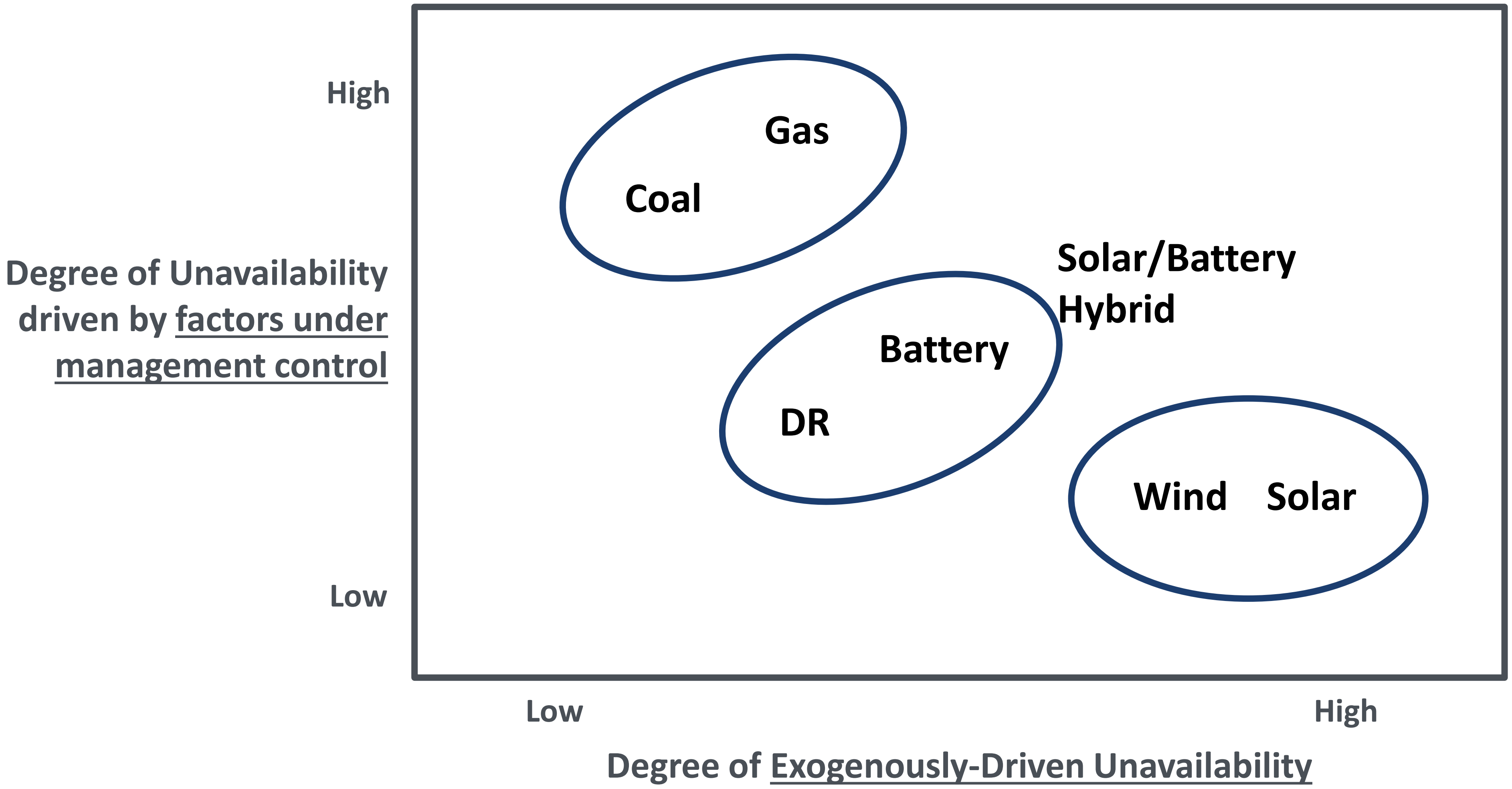
Choice of Marginal vs. Average accreditation will impact:

- **Reliability of substitutions**: marginal ELCC provides a reliability-neutral exchange rate for substitutions on the margin
- **Investment incentives**: efficiency could be maximized if all resources had accurate marginal ELCC
- Average ELCC may seem more fair because it compensates resource types for the **infra-marginal benefits** of earlier deployments



Varying Resource Adequacy Value Drivers

Matrix of Drivers of Resource Adequacy Value, by Resource Type



Key Concept: Empirical and Modeled Approaches

EMPIRICISM	MODELING
APPROACH: PERFORMANCE IN TIGHT INTERVALS Average observed availability or capacity factor during **intervals with low supply cushion**	**APPROACH: AVERAGE OR MARGINAL ELCC** Probabilistically simulates resources' contributions to reliability over broad distribution of weather years
ADVANTAGES • Relies on **real-world data**, not imperfect models • **Simple** and **transparent** • Incentivizes **resource performance**	**ADVANTAGES** • Accounts for **weather-driven performance** over a broad distribution of weather patterns • Enables **risk weighting** for expected reliability value
LIMITATIONS • **Not risk-weighted,** biases accreditation upward for resources that are more unavailable in the tightest conditions • Tradeoff between using few hours (more reflective of shortage conditions) vs. more hours (insulates resources from bad luck) • Tradeoff between having more years of data (broader distribution of weather) vs. just recent years (reflects current asset conditions)	**LIMITATIONS** • Electricity systems are complex, and modeling is imperfect. • Challenging to model thermal resource performance under stress conditions not recently or often observed • Sensitive to modeling judgements