A Review of the Latest Developments in ISO/RTOs Across the Country

NARUC Bulk Power System Learning Module

April 2, 2024

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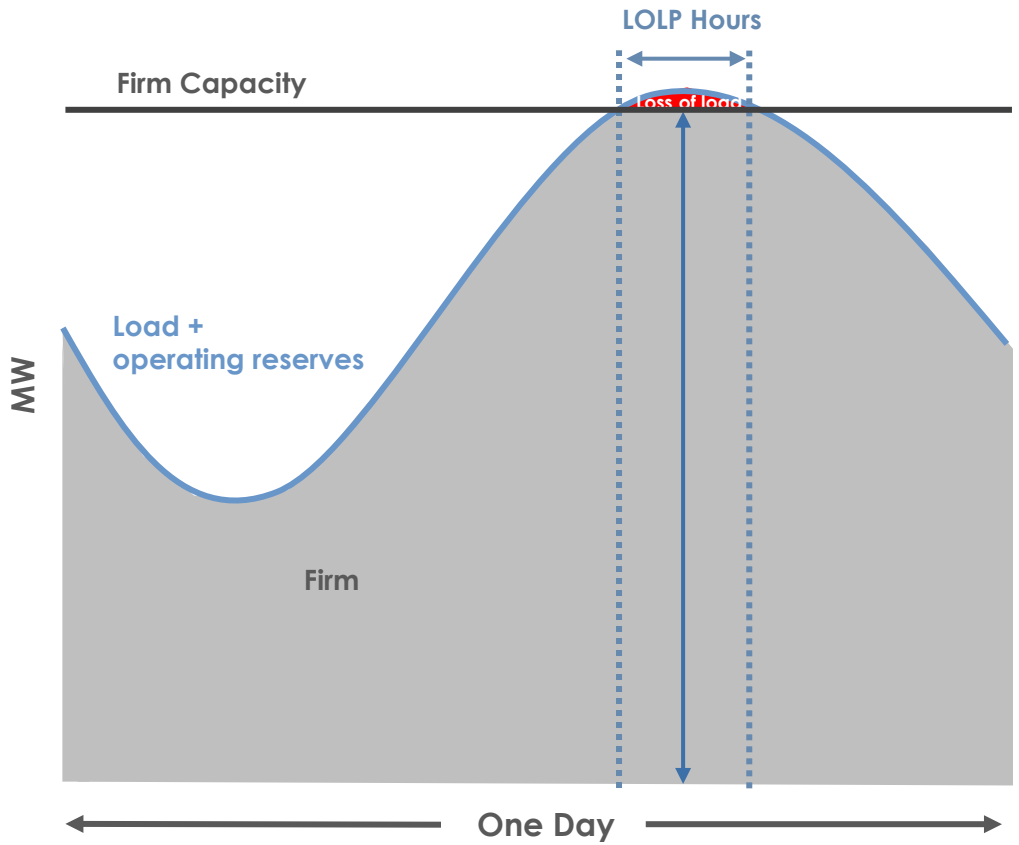
Energy+Environmental Economics

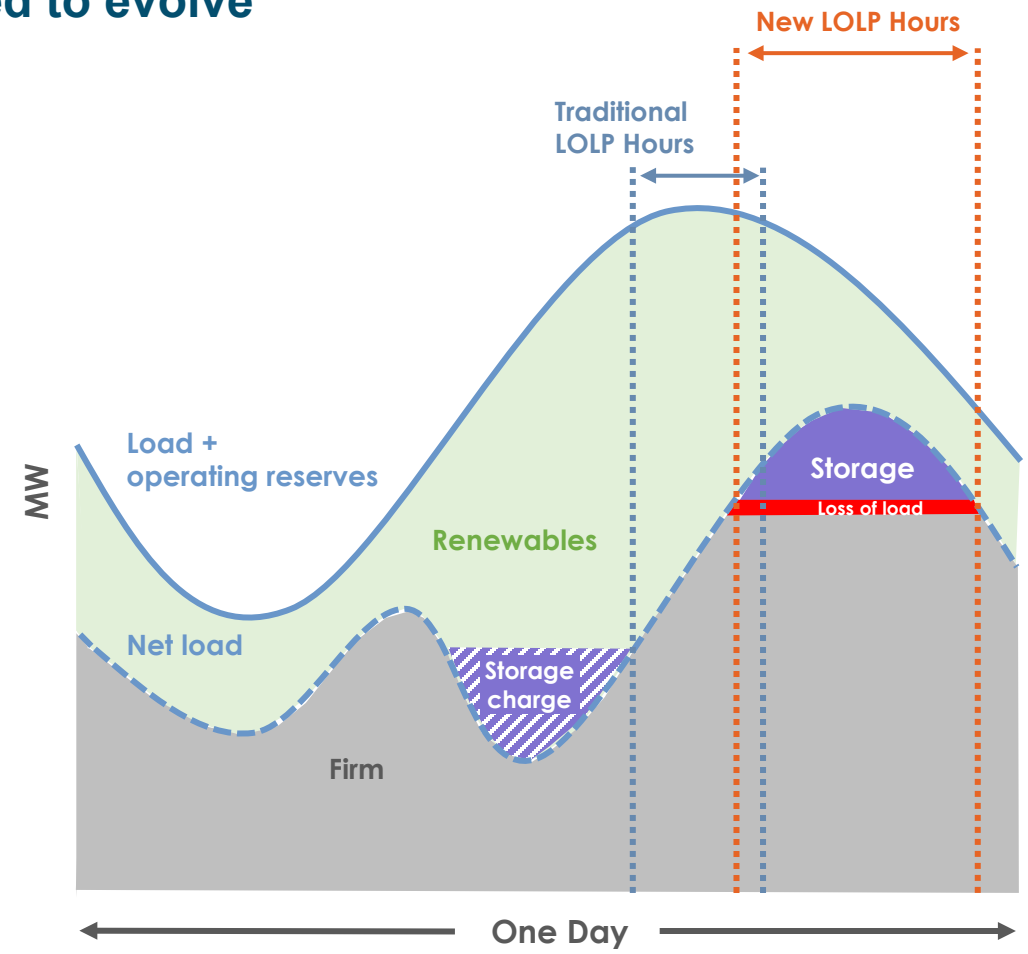
Traditional Reliability Risk

+ When all reliability risk was concentrated in peak periods, simplifications such as “availability during peak” made perfect sense

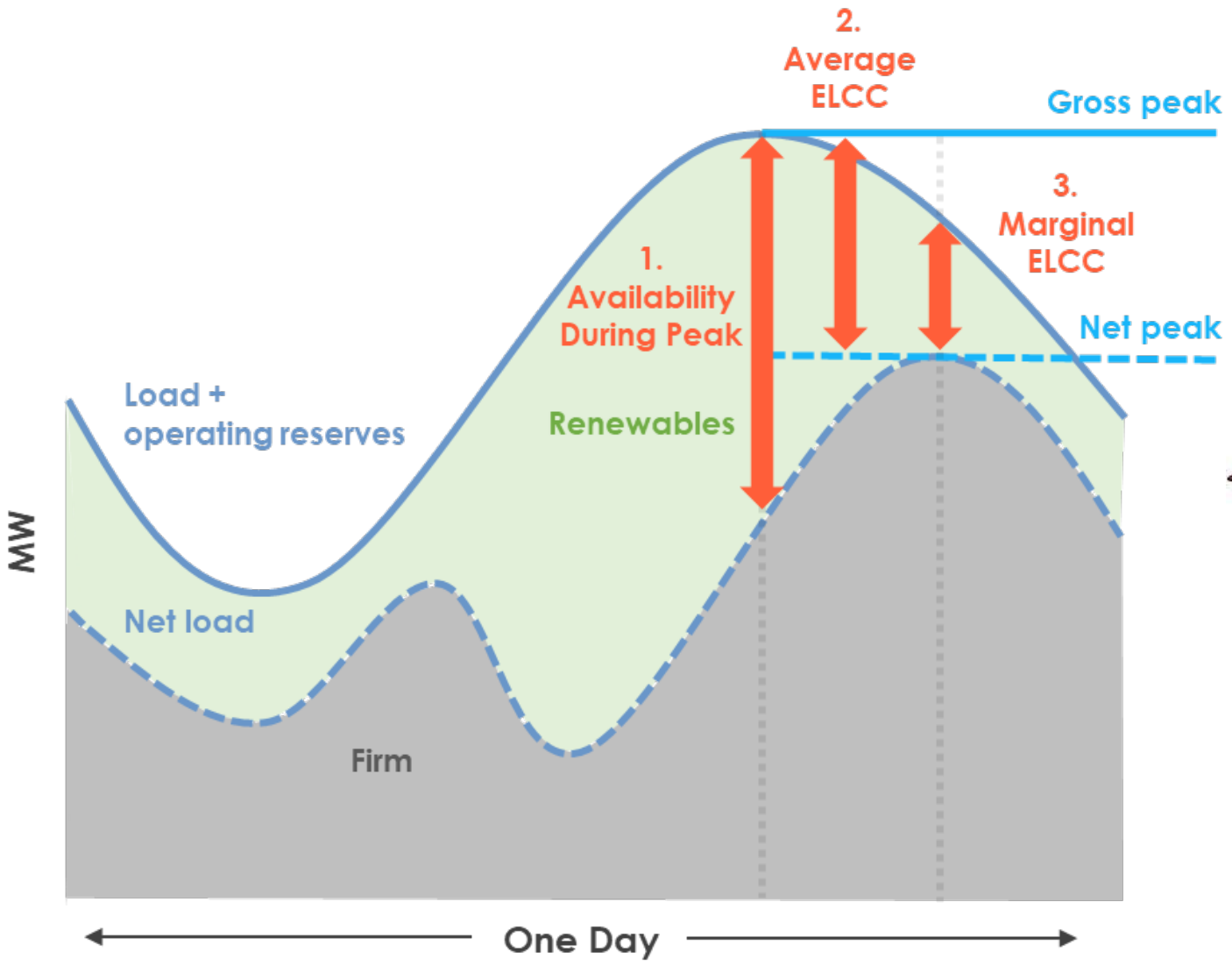


Evolving Reliability Risk

+ As penetrations of renewables and energy storage resources have increased, accreditation methods have needed to evolve



The Three Broad Categories of Resource Accreditation



Texas

Performance Credit Mechanism (PCM)

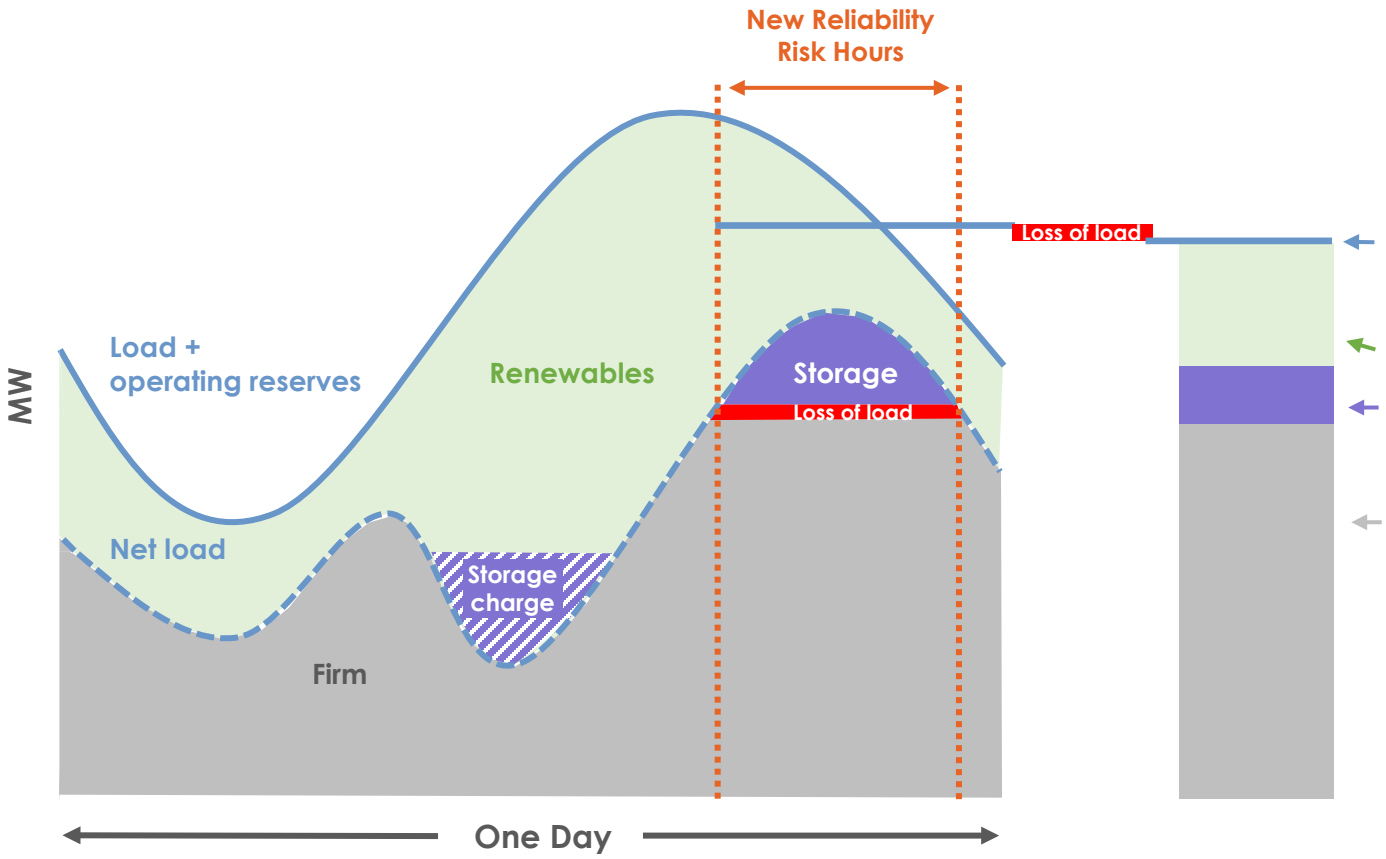
California

Slice-of-Day

… but, they both look a lot like Marginal ELCC …

A Marginal Capacity Market Framework

+ **Resource accreditation is based on availability during highest reliability risk hours**



Total Reliability Requirement =
average load + operating reserve requirements – allowable loss of load during reliability risk hours

Renewable Resource Accreditation =
average renewable availability during reliability risk hours

Storage Resource Accreditation =
average storage availability during reliability risk hours

Thermal Resource Accreditation =
average thermal availability during reliability risk hours

Capacity Requirements are *Lower* Than The Gross Peak

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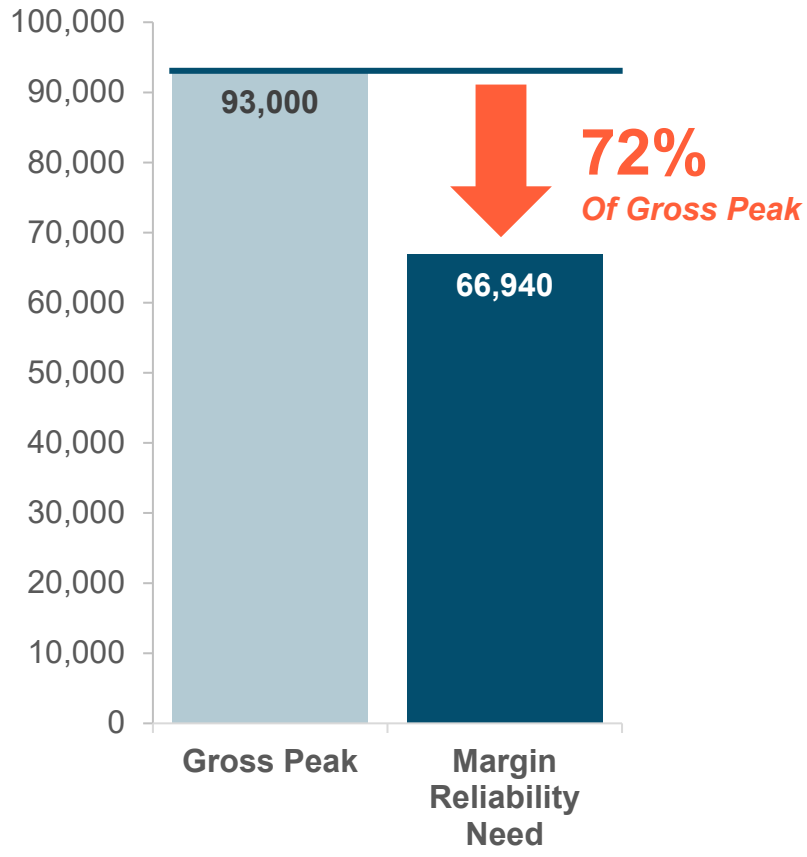
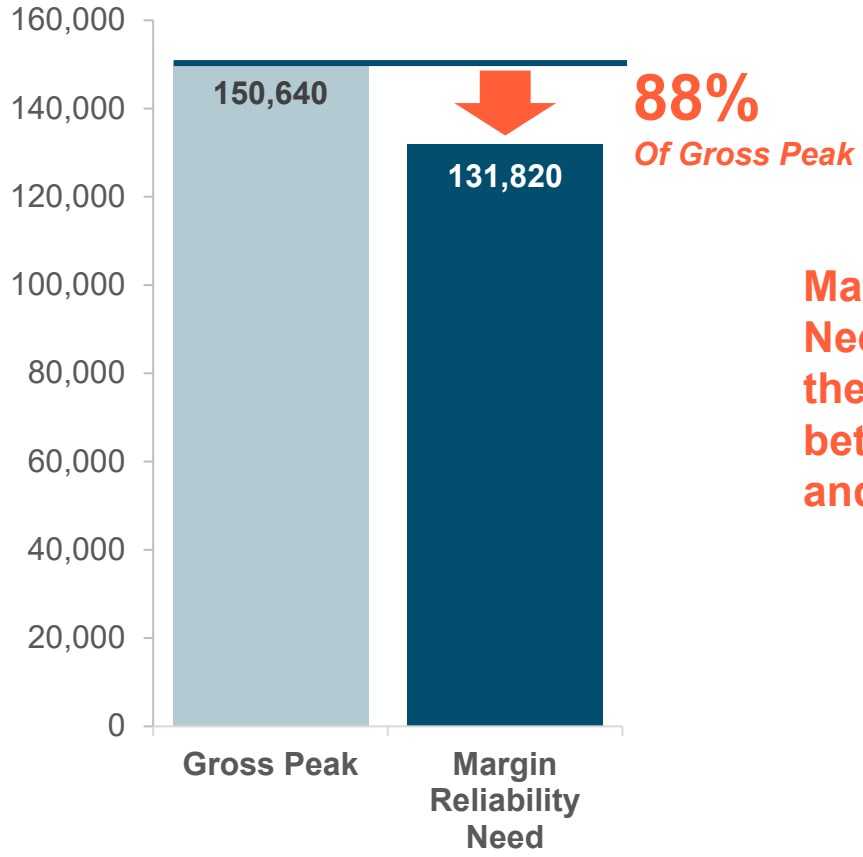
Gross peak and Marginal Reliability Need
MW



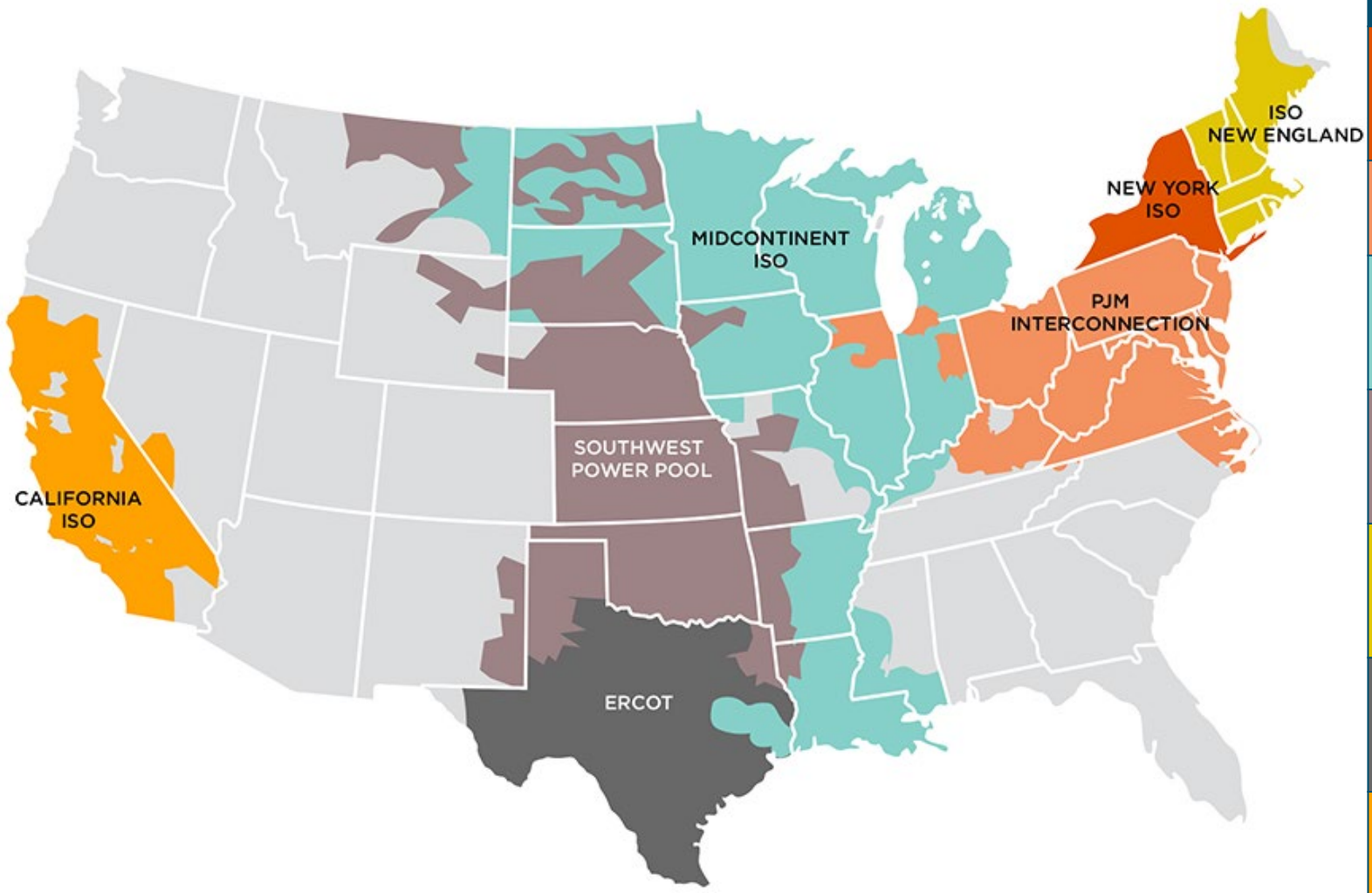
pjm

Gross peak and Marginal Reliability Need
MW



Marginal Reliability Need lower due to the difference between the Gross and Net Peak

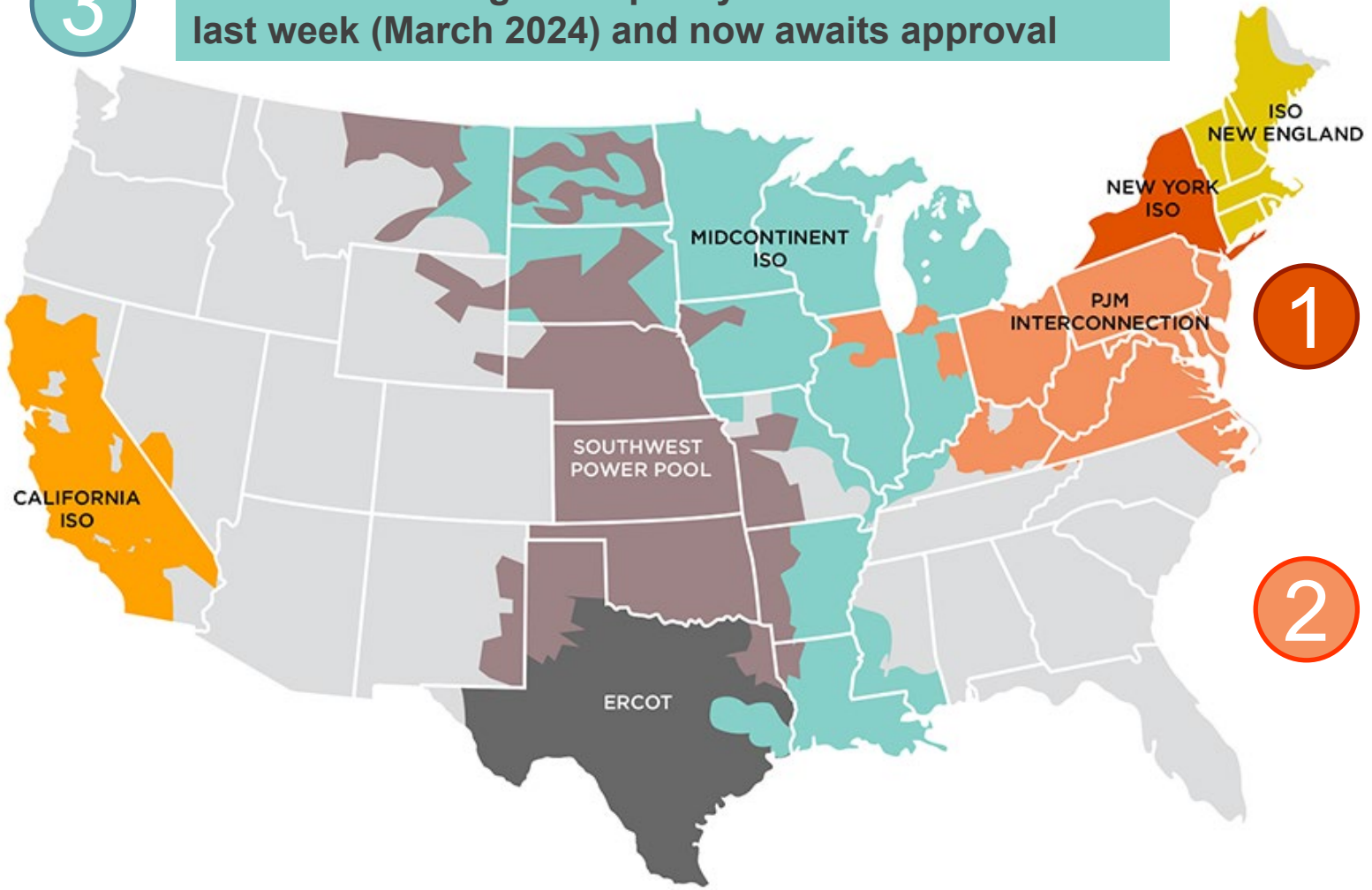
What's Happening in Capacity Right Now?



ISO	Past	Present	Future
NYISO	Availability During Peak	Marginal ELCC	Marginal ELCC
PJM	Average ELCC	Marginal ELCC	Marginal ELCC
MISO	Average ELCC	Marginal ELCC (filed)	Marginal ELCC
SPP	Availability During Peak	Average ELCC (filed)	?
ISONE	Availability During Peak	Availability During Peak	Marginal ELCC?
ERCOT	N/A	N/A	Performance Credit Mechanism
CAISO	Availability During Peak	Average ELCC	Slice of Day?

The Early Movers to Marginal ELCC

3 MISO filed a marginal capacity framework with FERC last week (March 2024) and now awaits approval



1 FERC approved NYISO move to marginal capacity accreditation in late 2022

2 PJM filed to FERC for marginal capacity accreditation Oct 2023 and received approval in 2024

The Budding Consensus on Marginal ELCC Approach

+ **Step 1: Calculate Resource Class Marginal ELCC Values**
+ **Step 2: Calculate Individual Resource Performance Adjustment Factors**

System Unserved Energy

Hour of Year	Weather Year 1			Weather Year 2		
	Sample 1	Sample 2	Sample N	Sample 1	Sample 2	Sample N
1	0	0	0	10	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	20	0	0	0	0	0
5	40	0	0	0	30	0
6	10	0	0	0	10	0
7	0	0	0	0	5	0
8	0	0	0	0	2	0
9	0	0	0	0	1	0
10	0	0	0	0	0	0
...	0	0	6	0	0	0
8758	0	0	10	0	0	0
8759	0	0	2	0	0	0
8760	0	0	0	0	0	0

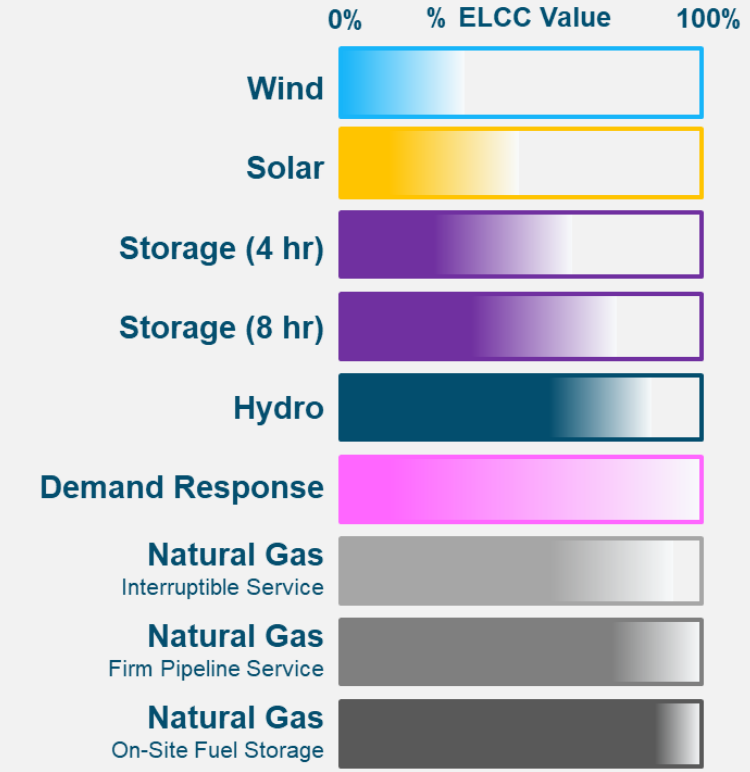
Two weather years, 6 outage samples
LOLE = 0.67 days/year
LOLH = 2 hours/year
EUE = 24.3 MWh/year

Generator Availability*
(installed capacity = 10 MW)

Hour of Year	Weather Year 1			Weather Year 2		
	Sample 1	Sample 2	Sample N	Sample 1	Sample 2	Sample N
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	1	1	1	0	0	0
4	4	4	4	2	2	2
5	8	8	8	3	3	3
6	3	3	3	1	1	1
7	1	1	1	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	1	1	1	2	2	2
...	5	5	5	6	6	6
8758	10	10	10	0	0	0
8759	6	6	6	6	6	6
8760	3	3	3	1	1	1

Average output during events = 3.33 MW
Nameplate Capacity = 10 MW
Capacity Accreditation = 33%

Illustrative ELCC Values Across Technologies



+ **Naming conventions vary by ISO**

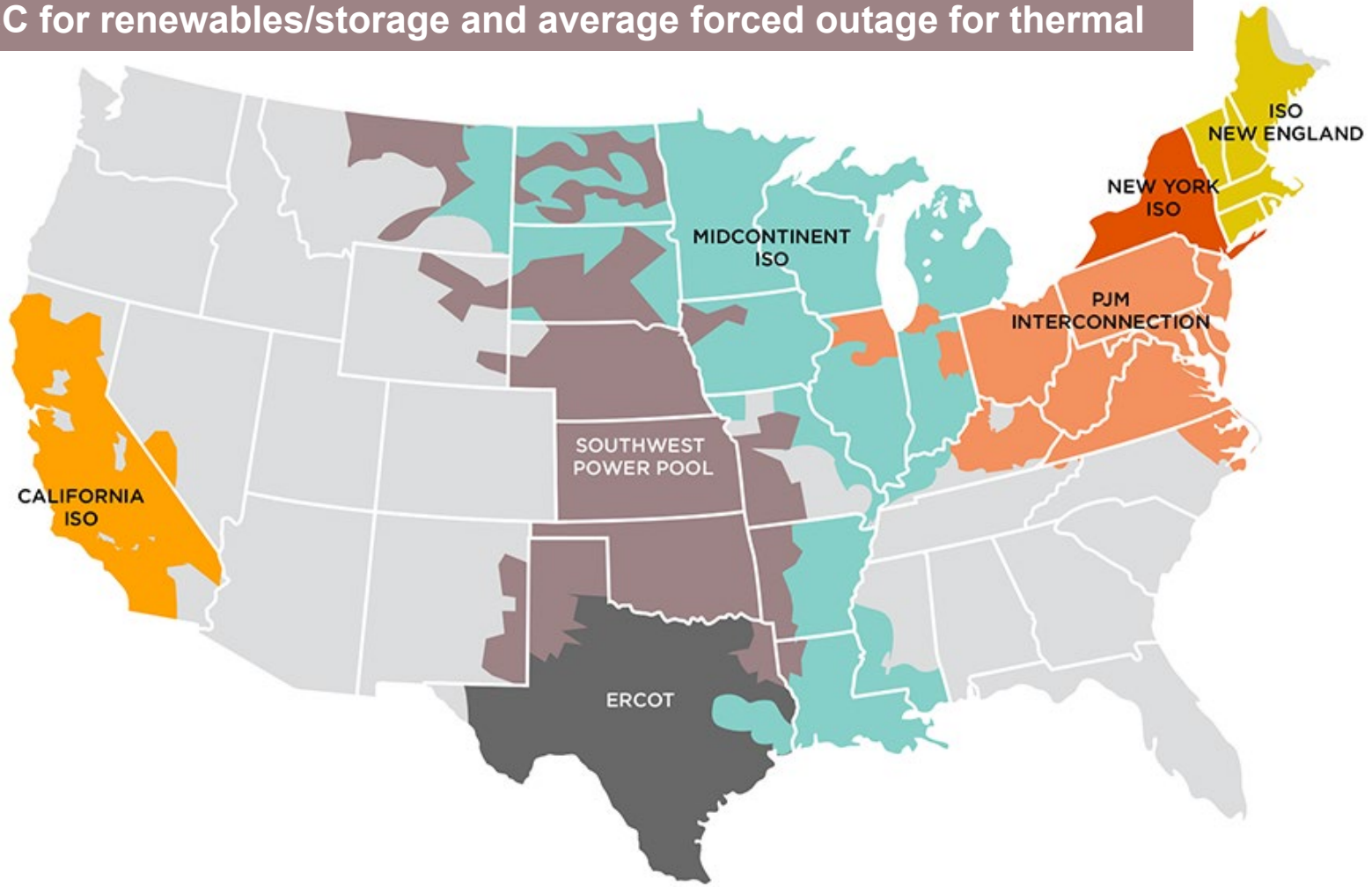
New York ISO Independent System Operator — **Marginal Reliability Improvement (MRI)**

pjm — **Marginal Effective Load Carrying Capability (Marginal ELCC)**

MISO — **Direct Loss of Load (DLOL)**

Next on The List

SPP filed to FERC a proposed update to capacity accreditation in March 2024 for an average ELCC for renewables/storage and average forced outage for thermal



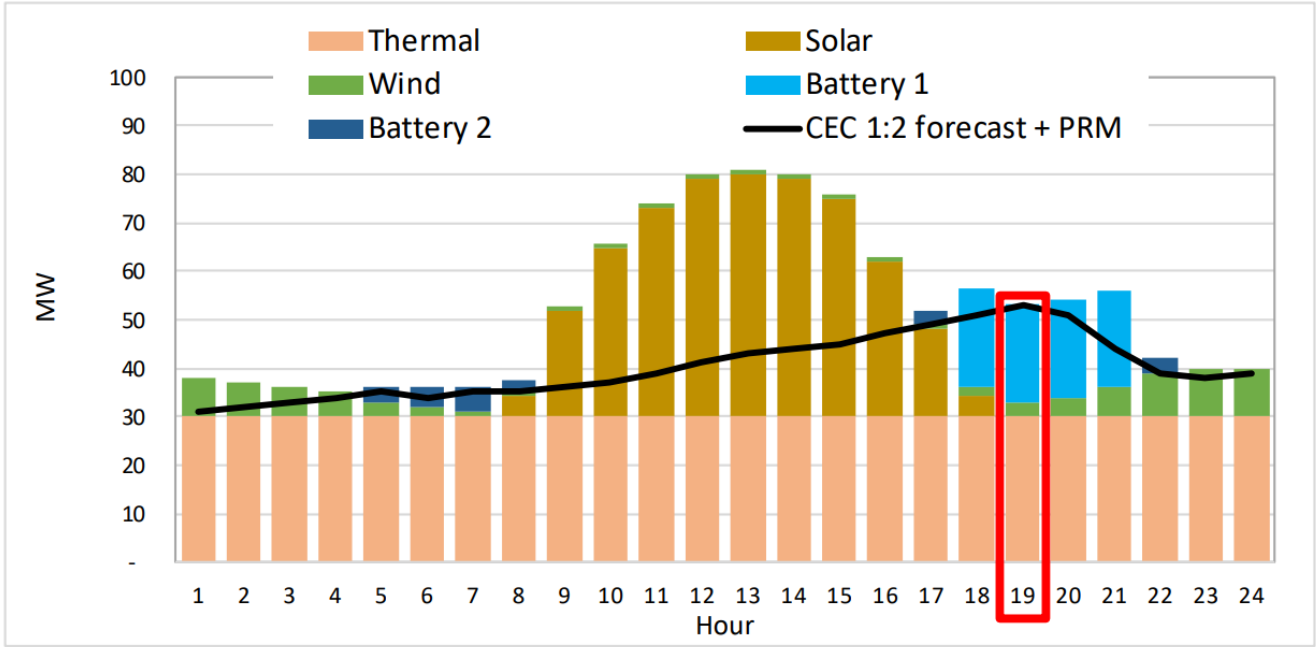
ISONE has previously indicated it is moving toward a marginal framework

An ongoing proceeding is underway regarding capacity accreditation with developments expected in 2024

The process has been hampered by technical modeling issues as well as unique challenges geographic challenges around fuel deliverability constraints

California: Slice of Day

- **Each load-serving entity must procure sufficient capacity with each month/hour "slice"**
  - 12 months x 24 hours = 288 different compliance periods
- **Renewables are accredited using a percentile method "e.g. 80% worst day" that is overall calibrated to achieve 1-in-10 system reliability**
- **Issues**
  - (Unnecessarily) complex
  - Compliance is achieved based on matching one's own load as opposed to providing system value
  - Compliance values almost ensure misalignment (i.e. "worst" load days almost definitionally do not occur on the "worst" solar days)
- **Benefits**
  - But … value will be concentrated in the same hours as marginal ELCC (e.g. net peak hours) yielding similar economic outcomes



- **Next Steps**
  - At the same time as the California Public Utilities Commission (CPUC) is writing detailed rules for the implementation of slice-of-day, the Commission is actively exploring moving beyond this framework through the implementation of marginal ELCC

Texas Performance Credit Mechanism

+ Functions similarly to a marginal ELCC framework with all compensation occurring based on actual availability during tight hours (as opposed to ex-ante modeled availability)

2022: Public Utility Commission of Texas unanimously adopts PCM

2024: ERCOT working to write detailed rules of PCM implementation

2026+: Implementation

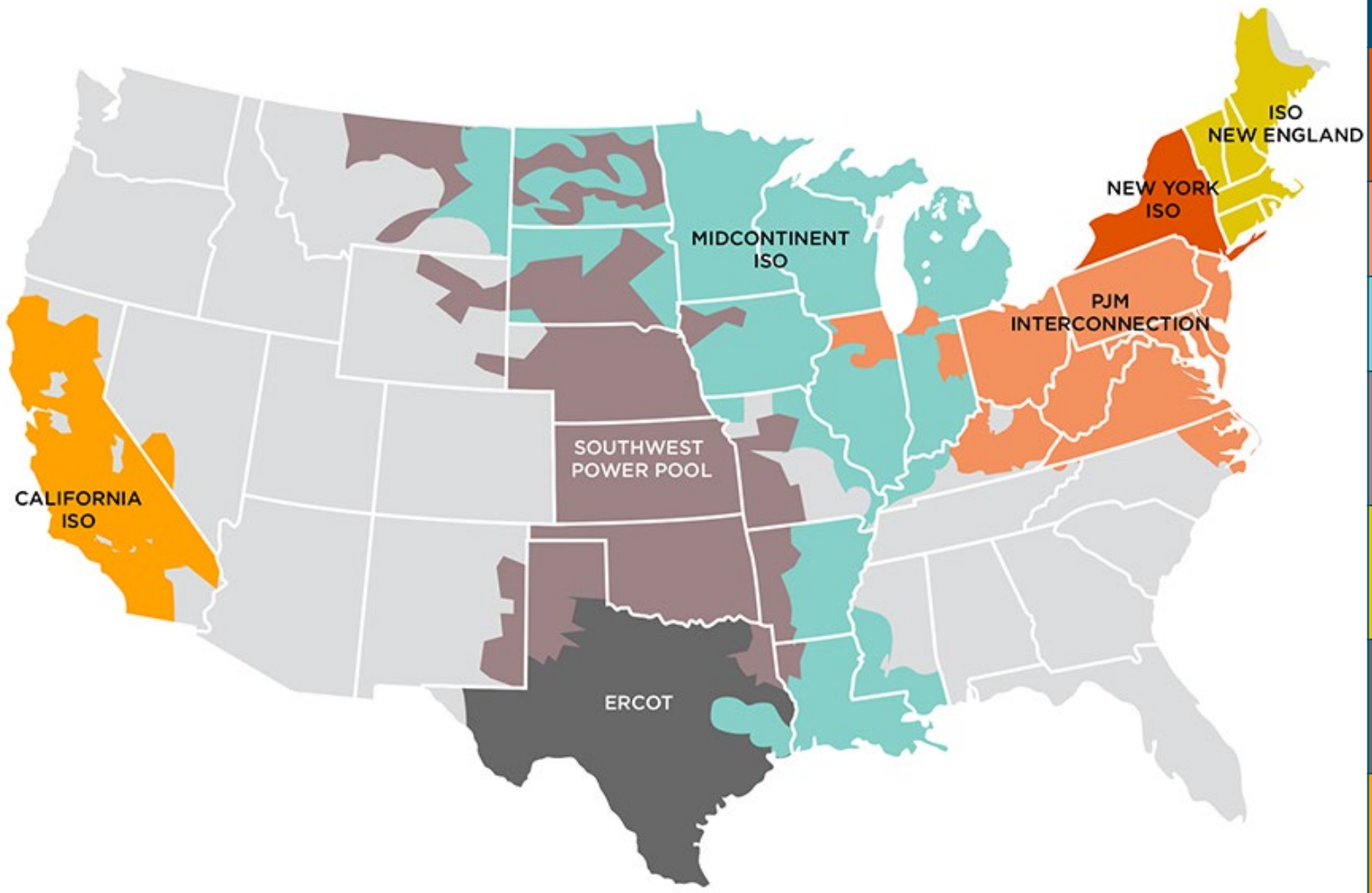
1 year

performance credit hours

Availability during performance credit hours generates performance credits for resources

Demand during performance credit hours generates performance credit obligation for loads

Summary



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Thermal

Traditional

Present

Future

+ Installed Capacity (ICAP)

- Imperfections of thermal were not recognized through a de-rating of these resources but rather through an increase in the total requirement of resources (i.e. planning reserve margin)
- Created relatively little distortion until de-rating renewables led to an apples-to-oranges contribution toward planning reserve margin

+ Unforced Capacity (UCAP)

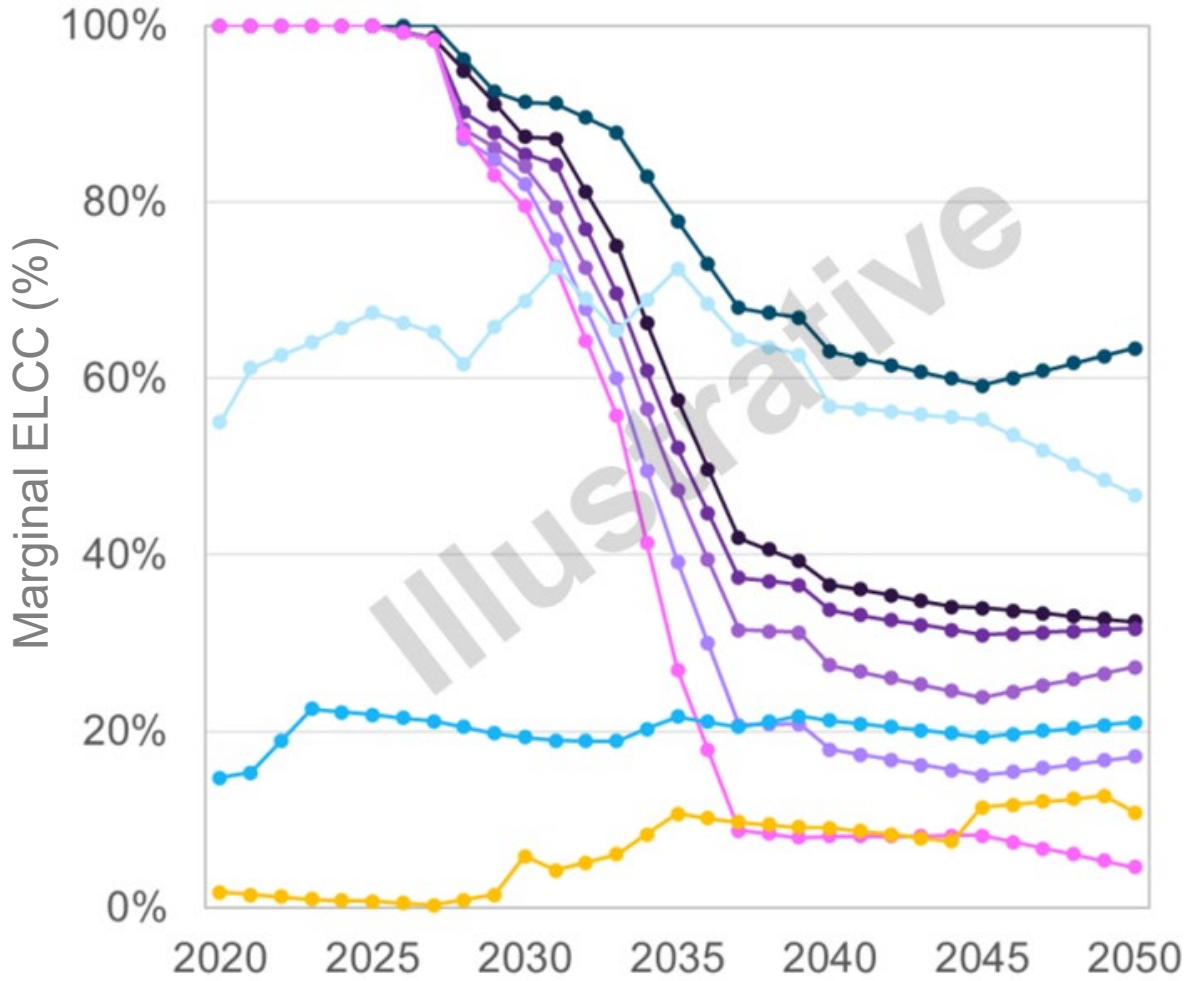
- De-rate thermal plants based on uncorrelated forced outages
- Inconsistent with how renewables are treated (i.e. windless periods affect all wind resources at the same time)

+ Marginal ELCC

- Simulate thermal resources identically to renewable and storage resources

What Do Marginal ELCCs Look Like?

Illustrative Marginal ELCC Values for California



PJM 2025/2026 Marginal ELCC Class Ratings

ELCC Class	Final Rating
Onshore Wind	35%
Offshore Wind	60%
Solar Fixed Panel	9%
Solar Tracking Panel	14%
Landfill Gas Intermittent	54%
Hydro Intermittent	37%
4-hr Storage	59%
6-hr Storage	67%
8-hr Storage	68%
10-hr Storage	78%
DR	76%
Nuclear	95%
Coal	84%
Gas CC	79%
Gas CT	62%
Gas CT Dual Fuel	79%
Diesel	92%
Steam	75%

https://www.pjm.com/-/media/committees-groups/committees/mrc/2024/20240320/20240320-item-05---irm-fpr-and-elcc-for-25-26-bra---presentation.ashx

The Role of Performance Penalties

+ **Strong and consistent penalties ensure that resources perform as they are accredited, mitigating the incentive to sell capacity above actual capability which has the double impact of creating phantom capacity and depressing prices, pushing actual capacity out of the market**

Must-offer Obligation Only

No bonuses and/or penalties for lack of performance

MISO

SPP Southwest Power Pool

Performance bonus/penalties during scarcity events only

*Bonus and/or penalties for performance **during scarcity events**, evaluated after events*

ISO new england

pjm

Performance bonus/penalties during tightest hours each period

*Guaranteed bonus and/or penalties for performance **during a set of hours each season/year,** evaluated after each period*

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***proposed**

Weaker → **Stronger**

Adapted from source, Capacity market design and renewable energy: Performance incentives, qualifying capacity, and demand curves

Ongoing Exploration and Refinements

- **Capacity market design has been an area of ongoing refinements in the two+ decades of their history**
- **Active issues that ISOs are currently exploring include**
  - Setting capacity requirements and accrediting resources on an **annual or seasonal basis**
  - Running capacity market auctions on a **multi-year forward or prompt basis**
  - Accrediting the capacity of resources differently based on their **geographic location** (including transmission deliverability)
  - Allocating capacity requirements to loads based on pro-rata usage during the **gross peak or highest reliability risk hours**

Energy+Environmental Economics

Thank You!

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