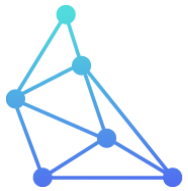
The Resource Adequacy Angle Through a New Lens

ESIG 2021 Meteorology & Market Design Workshop | 6/29/2021



TELOS ENERGY

A Tale of Two Reliability Events

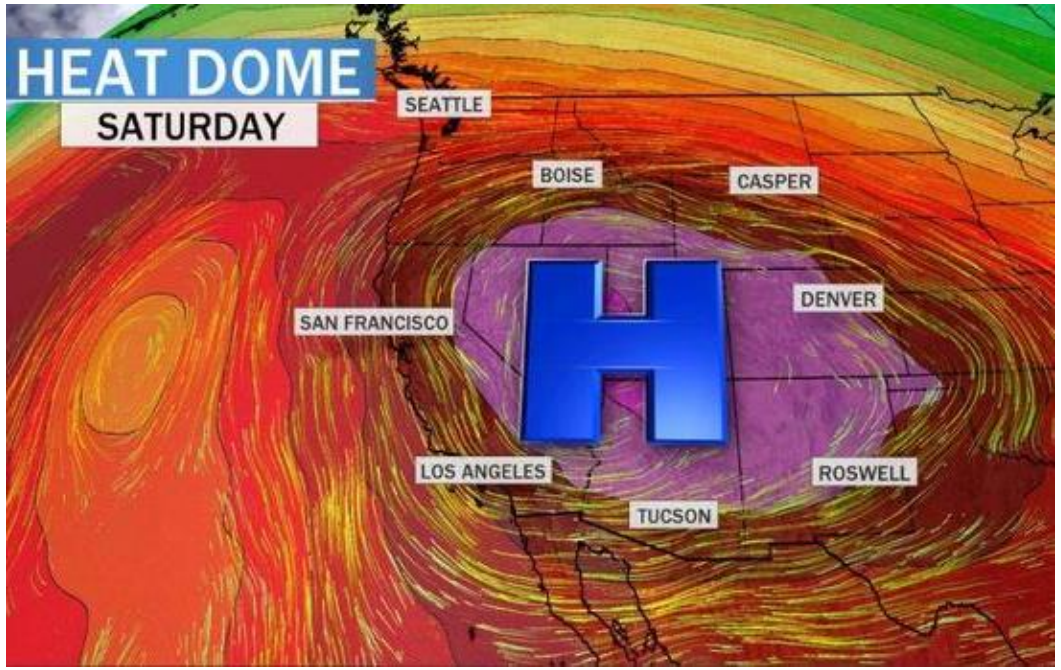
California

August 14-15, 2020
Evening load shedding across two days

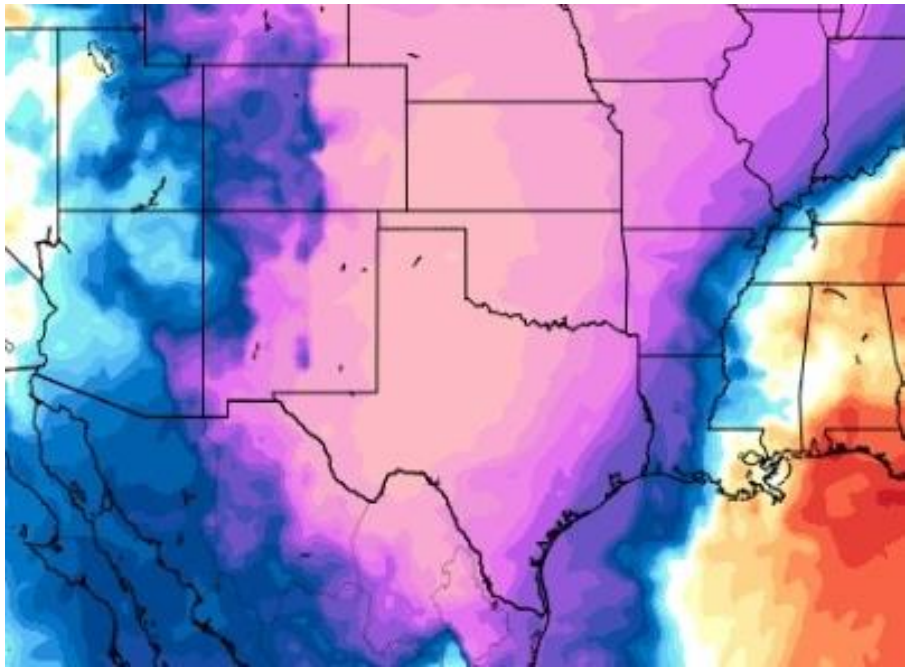
Texas

August 14-15, 2020
Continuous load shedding for 3+ Days

It’s all about the weather!



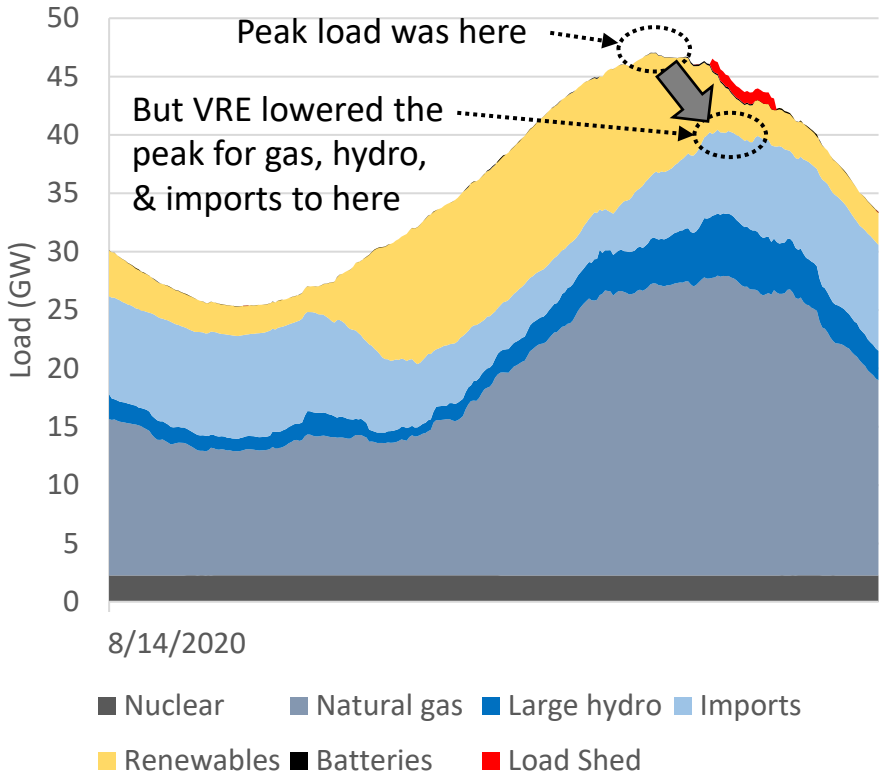
- Record breaking temperatures across the West
- *Regional* event… entire West was challenged
- 1-in-30 year event

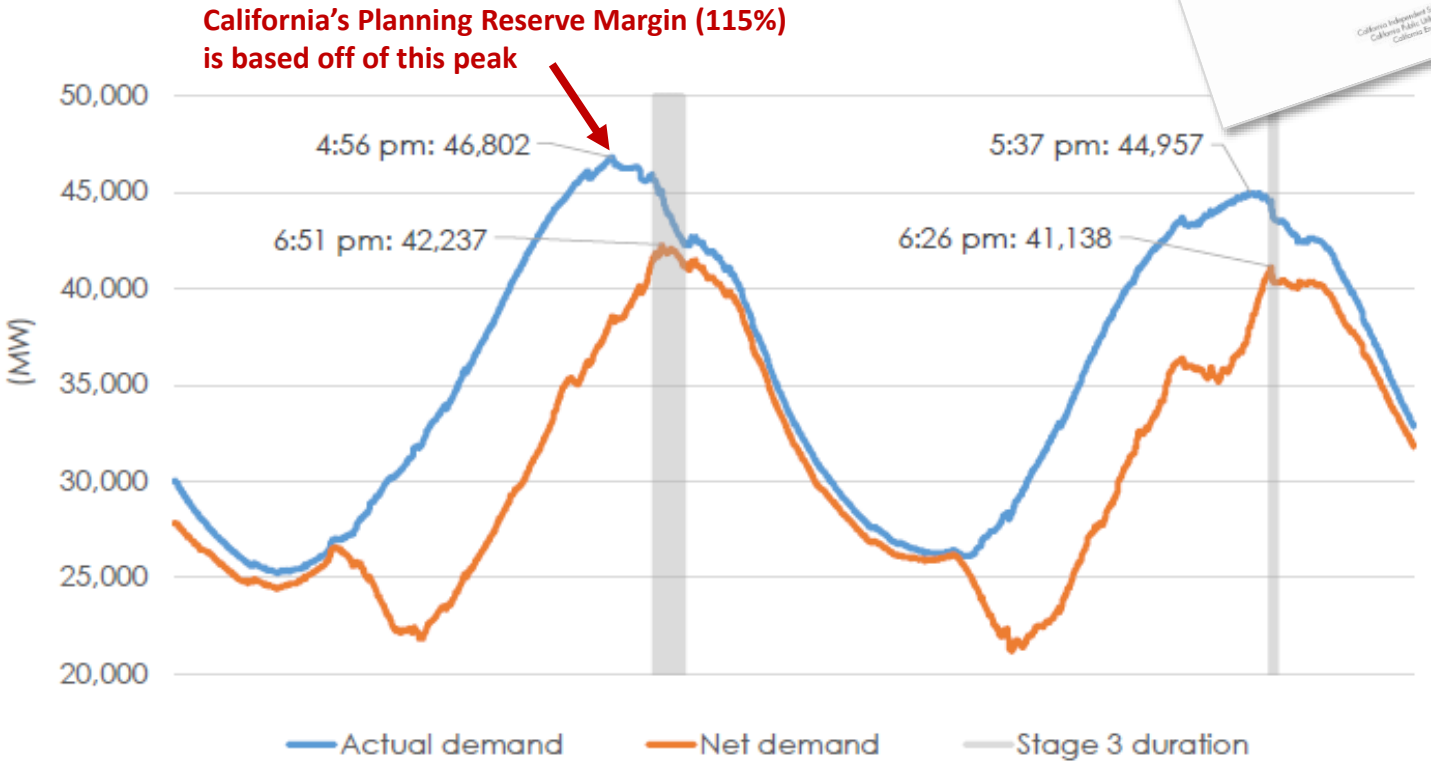


- Record breaking temperatures across the Midwest
- *Regional* event… MISO+SPP+ERCOT challenged
- 1-in-100 year event reasonable to plan for?

Should RA analysis take into account climate trends?
Should we design our grid to withstand a 1-in-30 year event?

What Happened in California?





Source: CAISO Preliminary Root Cause Analysis

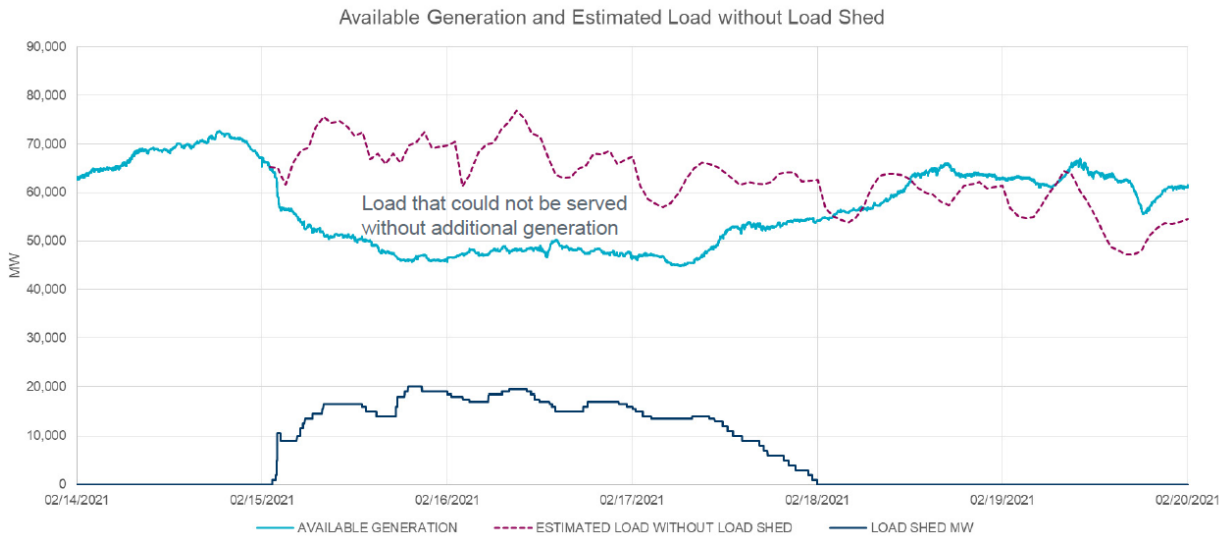
Growing disconnect between planning reserve margin and reliability… all hours, multiple weather years and chronological operations matter

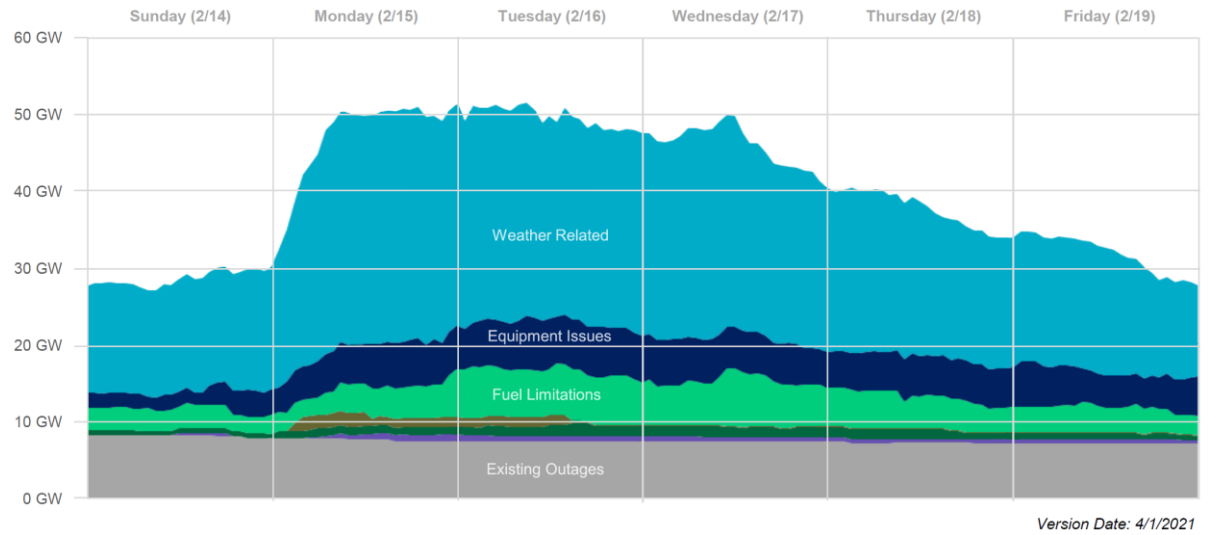
What Happened in Texas?

Cold weather conditions forced additional generation offline:

- ~20 GW of thermal generation (e.g. Natural Gas, Coal)
- Several thousand MW of wind generation due to icing

Deterministic studies missed the reconstituted peak load and did not account for the coincident generator outages





Sources:

- ERCOT Preliminary Report on Causes of Generator Outages and Derates For Operating Days February 14 – 19, 2021 Extreme Cold Weather Event
- Review of February 2021 Extreme Cold Weather Event

Could this have been predicted?

"The base case results show that the **CAISO** has a low probability of experiencing operating conditions that would lead to shedding firm load in summer 2020. However, if summer conditions are less favorable, resulting in **lower levels of imports as assumed** in the sensitivity case, the probability of shedding firm load will increase. The risk in 2020 primarily stems from less than average hydro conditions resulting in reduced energy from hydro resources across the summer, but particularly **impactful in late summer**. Furthermore, the CAISO daily peak period has shifted to **later in the day when solar generation is near or at zero levels,** resulting in the CAISO's highest demand levels being supplied by the remaining non-solar fleet. With lower than normal hydro conditions, the CAISO may have to rely more heavily on imports from neighboring BAs during the CAISO summer peak hours. However, **if a heat wave occurs that impacts a broader area than the CAISO, the availability of surplus energy to import into the CAISO could be diminished**."

-CAISO Summer Loads and Resource Assessment, **May 15, 2020**

"**ERCOT** anticipates there will be sufficient installed generating capacity available to serve system-wide forecasted peak demand this winter season, December 2020 – February 2021.

"In the winter, we're dealing with morning and evening peaks and sometimes **extreme volatility in the weather,"** said Manager of Resource Adequacy Pete Warnken. "We studied a range of potential risks under both normal and extreme conditions, and believe there is **sufficient generation to adequately serve our customers."**

The peak demand forecast for winter 2020-21 was developed using Moody's economic data obtained in April 2020. The winter SARA includes a 57,699 MW winter peak demand forecast, which is based on normal weather conditions during peak periods, from 2004 through 2018. ERCOT's all-time winter peak demand record was set on Jan. 17, 2018, when demand reached 65,915 MW between 7 and 8 a.m.

Nearly 83,000 MW of resource capacity is expected to be available for the winter peak, including 963 MW of planned winter-rated resource capacity consisting of wind and utility-scale solar."

-ERCOT Seasonal Assessment of Resource Adequacy , **November, 2020**

What can we learn from these events?

- **Not all shortfalls are alike**… need to characterize size, frequency duration, and timing of events
- **Risk is shifting**… periods of concern longer occur during gross-peak load, need to look across an entire year of operation
- **Weather** is the single most important driver for resource adequacy…
  - Cross-disciplinary power systems and meteorological expertise is necessary
  - We need a North-American Weather Dataset for correlated wind, solar, and load
  - Climate trends should be considered
  - Correlated events are the issue!
- **Resource sharing** is critical, transmission is a capacity resource

Forward-Looking Words of CAISOs Departing CEO

"There doesn't have to be a tradeoff between reliability and decarbonization… What caused the [August blackouts] was a lack of putting all the pieces together... You have to **rethink these old ways of doing things**, and I think that's what didn't happen."

"The resource adequacy program in California is now not matched up with the realities of working through a renewable-based system, and in a nutshell ... needs to be redesigned,"

-Steve Berberich, CAISO

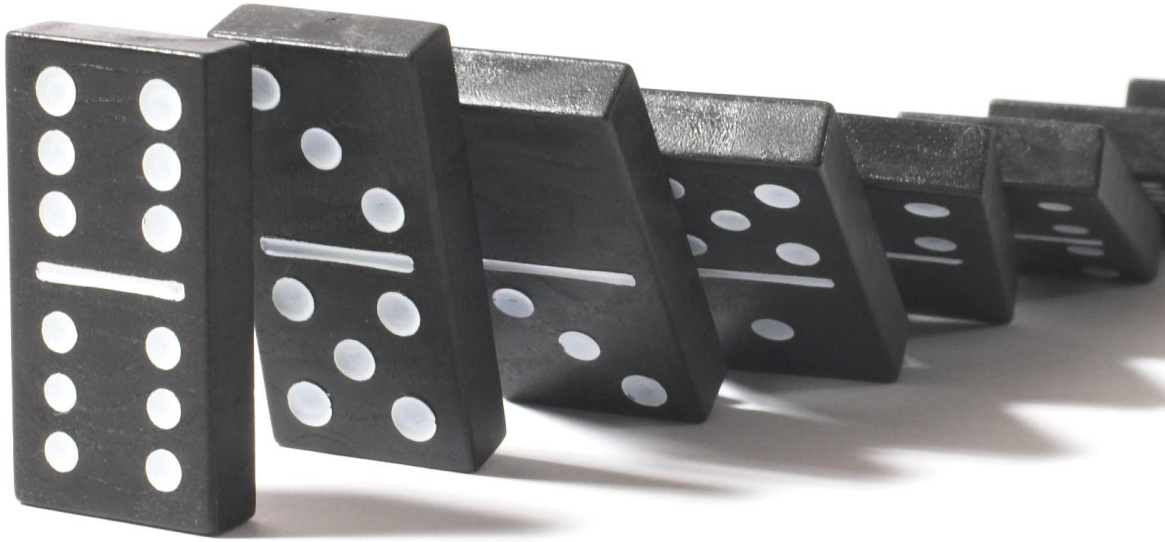
Source: S&P Global, You have to rethink these old ways: Parting advice from CAISO's retiring CEO, September 25, 2020

Why is Resource Adequacy Broken?

CHRONOLOGY + CORRELATION

- ✓ Variable Renewables
- ✓ Energy Storage
- ✓ Load Flexibility
- ✓ Hybrid resources

- ✓ Weather
- ✓ Combined Outages
- ✓ Modular Technology
- ✓ Climate Trends



= fundamental need to rethink RA

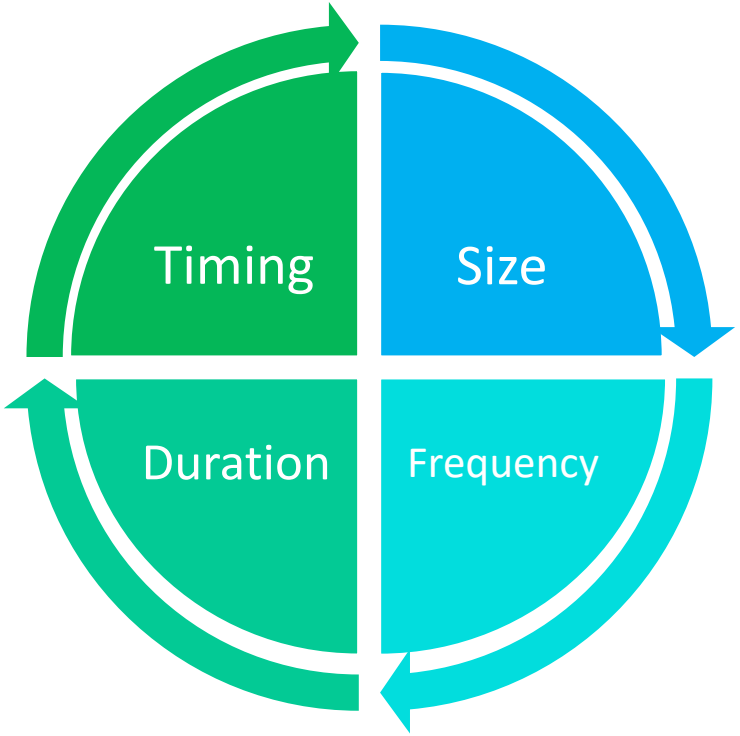
Six principles of resource adequacy for modern power systems

1. Quantifying size, frequency and duration of outages is critical to finding the right resource solutions.
2. There is no such thing as perfect capacity.
3. Modeling chronological operations **across an entire year** is essential for modern power systems.
4. Load participation fundamentally changes the resource adequacy construct.
5. Neighboring grids and transmission are a key part of the RA challenge
6. Reliability criterion should not be arbitrary, but transparent and economic.

1

Our metrics need to go further!

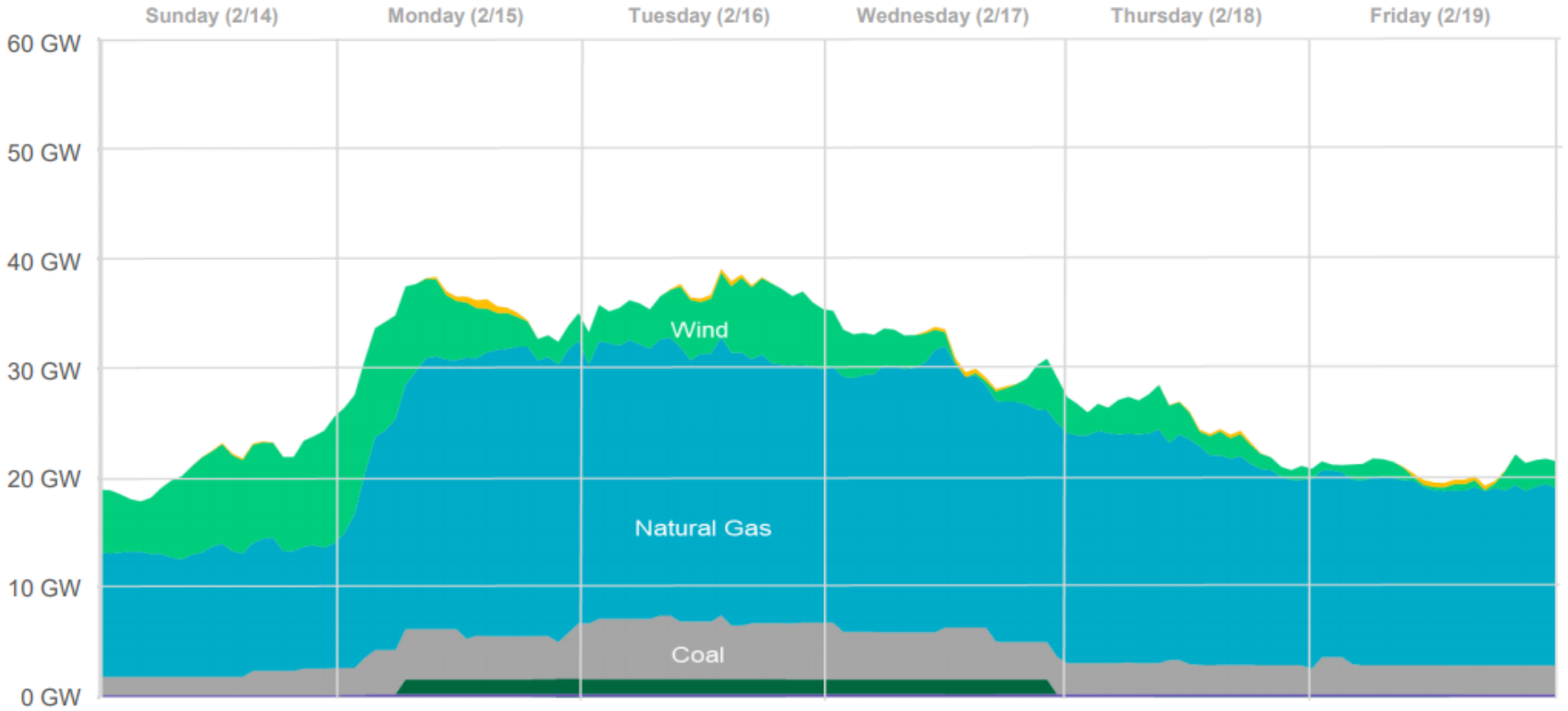
1. Place more emphasis on Expected Unserved Energy
2. Use a suite of reliability metrics, not just one
3. Move beyond expected values and consider tail events
4. Characterize size, frequency, duration, and timing of shortfall events



Event Characteristic	Metric Affected	California Aug 2020	Texas Feb 2021	Delta
Number of Days	LOLE	2 days	4 days	+200%
Number of Events	LOLEv	2 events	1 event	-50%
Number of Hours	LOLH	6 hours	71 hours	+1200%
Unserved Energy	EUE	2,700 MWh	990,000 MWh	+36,700%
Max Shortfall		1,072 MW	20,000+ MW	+1,766%

2

There is no such thing as “perfect capacity”



Sources: [ERCOT Preliminary Report on Causes of Generator Outages and Derates For Operating Days February 14 – 19, 2021 Extreme Cold Weather Event]

ELCC for only wind, solar, and storage is inappropriate

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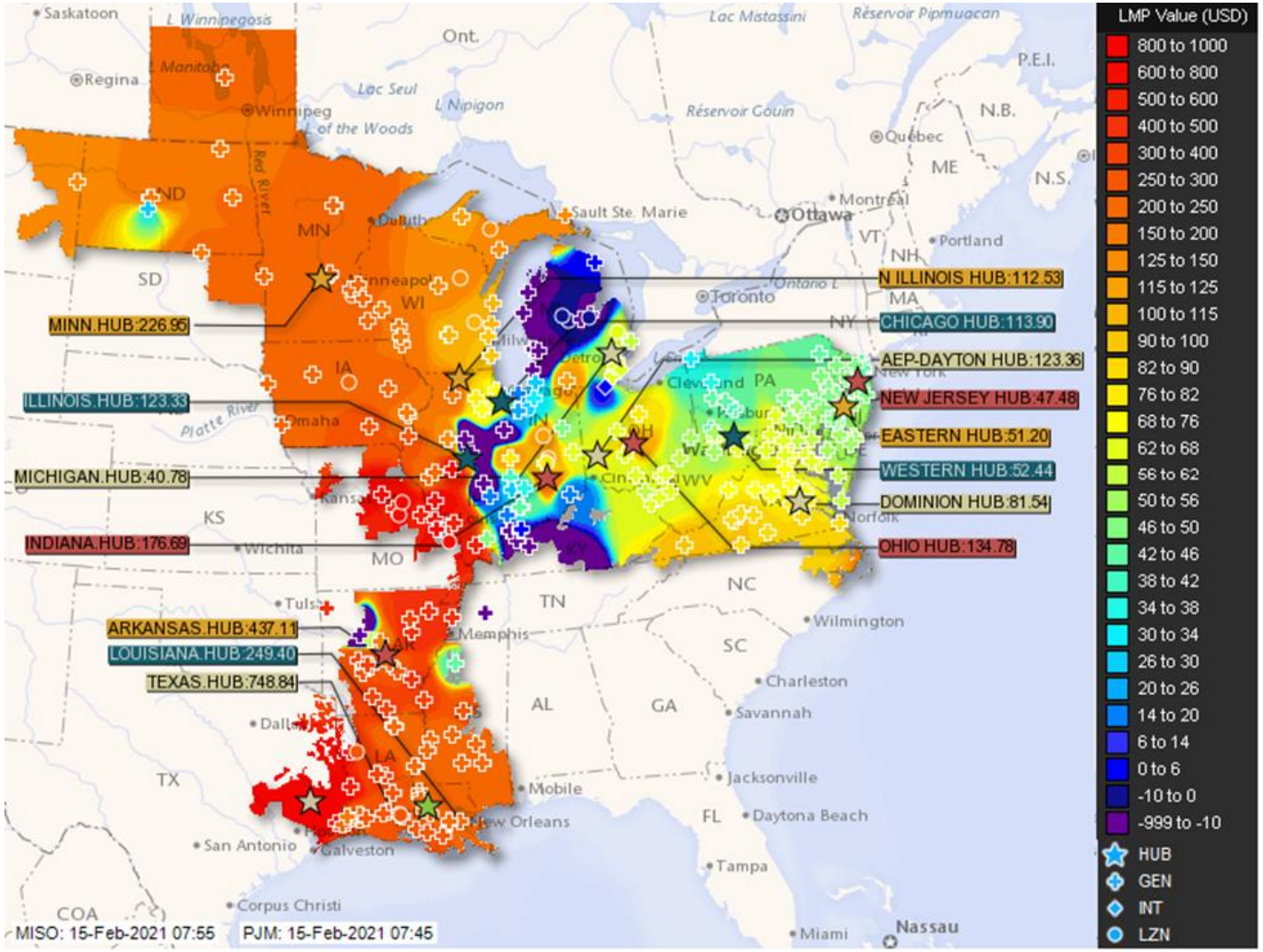
Neighboring grids and transmission are a key part of the RA challenge

- Conventional RA analysis generally does a poor job at modeling neighboring systems
- Reliability is a sensitive topic, you don't want to be reliant on your neighbors…
  but…

- Capacity sharing can be a large, low-cost alternative to procuring new resources
- Extreme weather can't happen everywhere at the same time
- Increased geographic diversity smooths out variability in wind/solar/load/temperature

Transmission can be a capacity resource!



Thank You!

Questions?

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Want to get involved in the ESIG Redefining Resource Adequacy Task Force? Reach Out!

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