Committees on Energy Resources and the Environment and Electricity

Electric Reliability and Capacity: What's the Role of Resource Adequacy for Keeping the Lights On?

February 11, 2020

Resource Adequacy Overview

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Astrapé Consulting

2/11/2020

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Topics

- Define Resource Adequacy
- Resource Adequacy Drivers
- Physical Reliability Metrics
- Economic Optimal Reserve Margin
- Modeling Practices

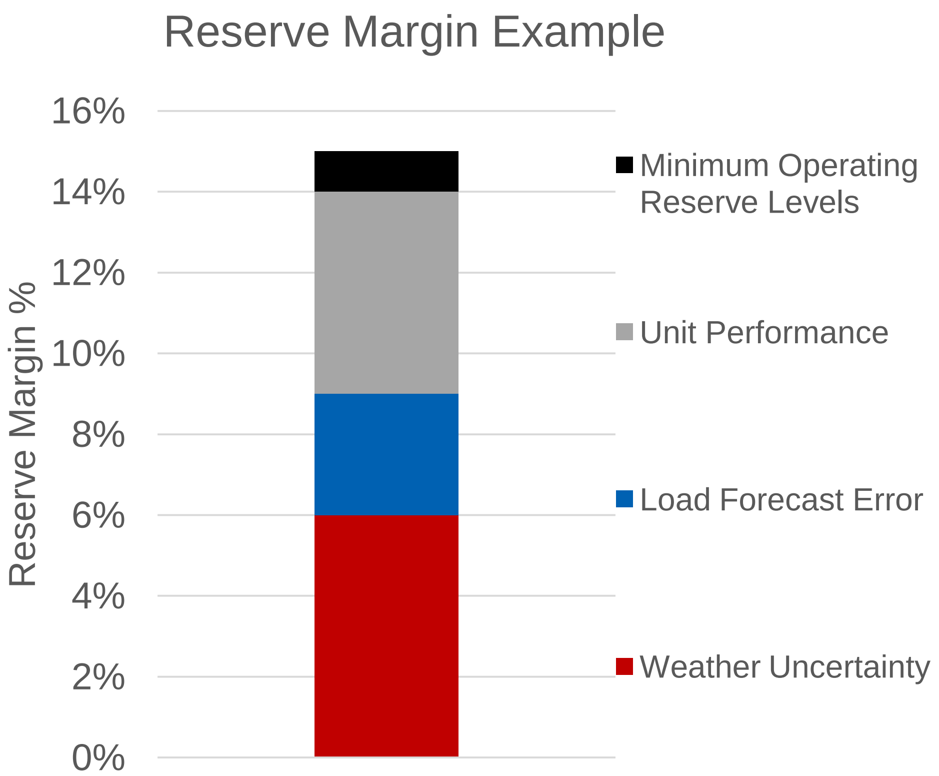
Resource Adequacy

- **The ability of supply-side and demand-side resources to meet the aggregate electrical demand (including losses)**
  - Traditionally refers to balancing authorities maintaining enough generating capacity during peak periods to keep the lights on
  - Planning reserve margins are determined by regulators in individual regions or balancing authorities based on resource adequacy studies
- **Different from distribution customer outages caused by storms or trees falling which are much more frequent than customer outages caused by capacity shortages**

Resource Adequacy Drivers

- **Why do entities need to carry more capacity then their peak load forecast?**
  - Weather Uncertainty
  - Load Forecast Error
  - Unit Performance
  - Minimum Operating Reserves

- **Outside external assistance, if modeled, decreases the above calculation depending on the amount modeled**
  - For example, PJM allows for up to 3,500 MW of import capability in its Resource Adequacy Study.



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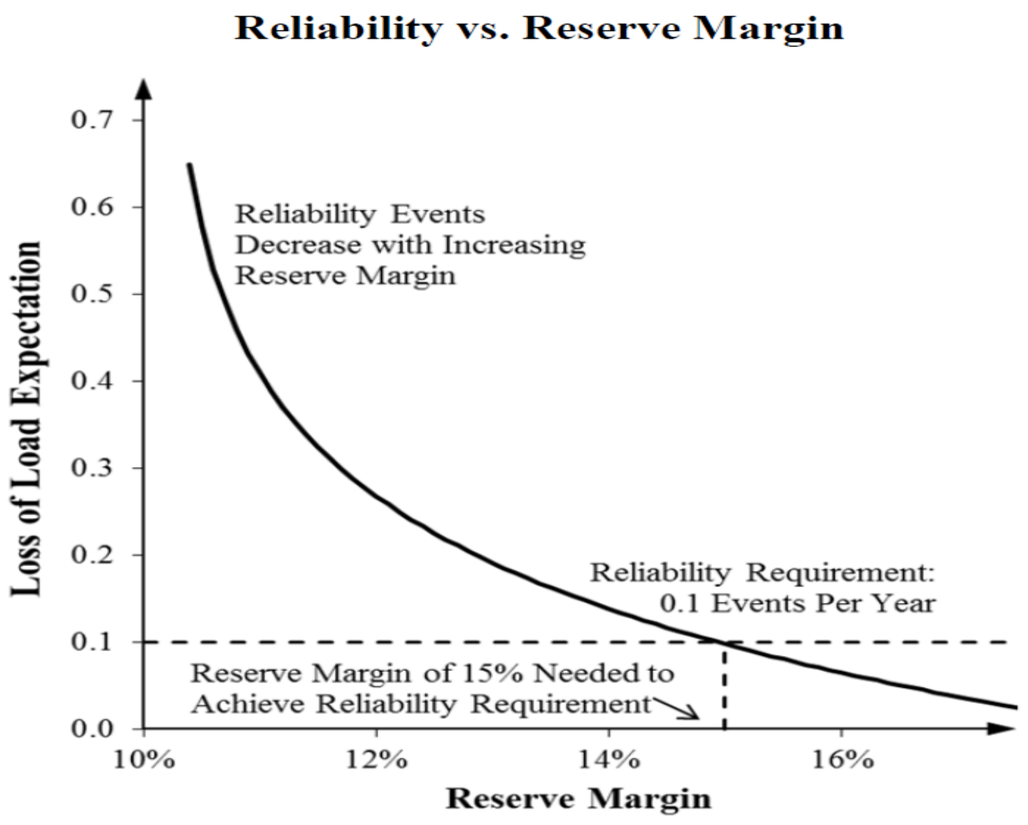
Physical Reliability Metrics

- **Loss of Load Expectation (LOLE)**
  - Counts the number of days load was not met
  - 1-day-in-10-year Standard
    - Most used metric by RTOs, Utilities, and Commissions
    - Equates to 0.1 days per year for modeling purposes
    - Allows 1 day (1 event) every 10 years

- **Additional Metrics**
  - Loss of Load Hours (LOLH)
    - Counts the number of hours load was not met
  - Expected Unserved Energy
    - The amount of load in MWh not met



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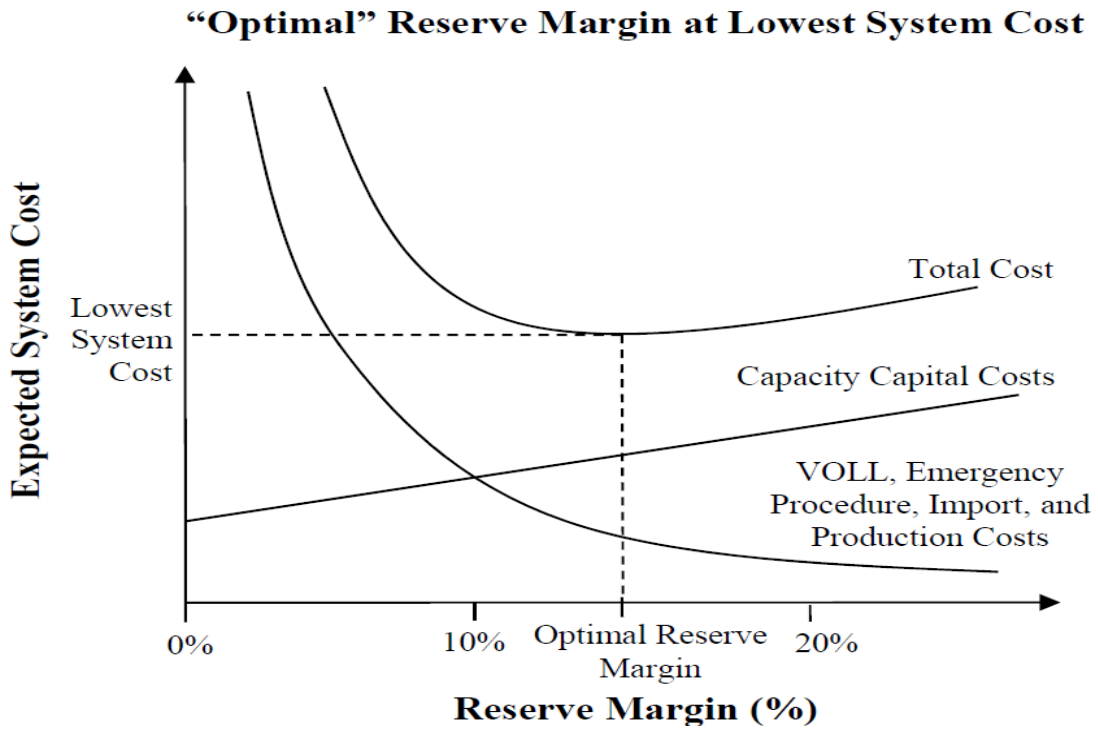
Economic Optimal Reserve Margin

- **Recognizes the marginal benefit of adding capacity to the system**
- **Driven by the following:**
  - The cost of new capacity
  - System production costs
  - Costs of an emergency event, such as emergency purchase costs or dispatching of emergency resources
  - Cost of unserved energy or the Value of Lost Load (VOLL)



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Probabilistic Modeling Framework

- Modeling captures the following distributions for a future year and typically consists of running 1000’s of simulations for a single year.
  - Weather Distributions
    - Impact on Load and Resources
  - Load Forecast Error (LFE)
    - Typically done with load multipliers
  - Stochastic Generator Outages
- In Astrapé’s SERVM Modeling, below is a typical representation for a single Study Year:

40 **Weather Years** (Equal Probability)	x	**5** **LFE Points** (Associated Probabilities)	=	**200** **Load Scenarios** (Associated Probabilities)
200 **Load Scenarios**	x	**50** **Unit Outage Draws**	=	**10,000** **8760 Hour Simulations**

Resource Adequacy is Evolving Due to Intermittent and Energy Limited Resources

- **Intermittent resources**
  - Wind and solar resources modeled with hourly shapes
  - Not always available during peak periods
- **Energy limited resources**
  - 2-hour, 4-hour storage/battery resources
  - Solar/battery hybrid resources with charging restrictions
  - Demand Response resources with limited number of calls per year or per day
- **Resource Adequacy analysis has become more complex**
  - Capacity accounting for wind, solar, and storage resources
  - Economic commitment and dispatch models are required to understand battery storage
  - Expansion planning models and resource adequacy models are working more in an iterative process to ensure resource adequacy is met

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Energy+Environmental Economics

Resource Adequacy in the Pacific Northwest

NARUC Winter Policy Summit

Electricity Committee Panel on Resource Adequacy and Capacity

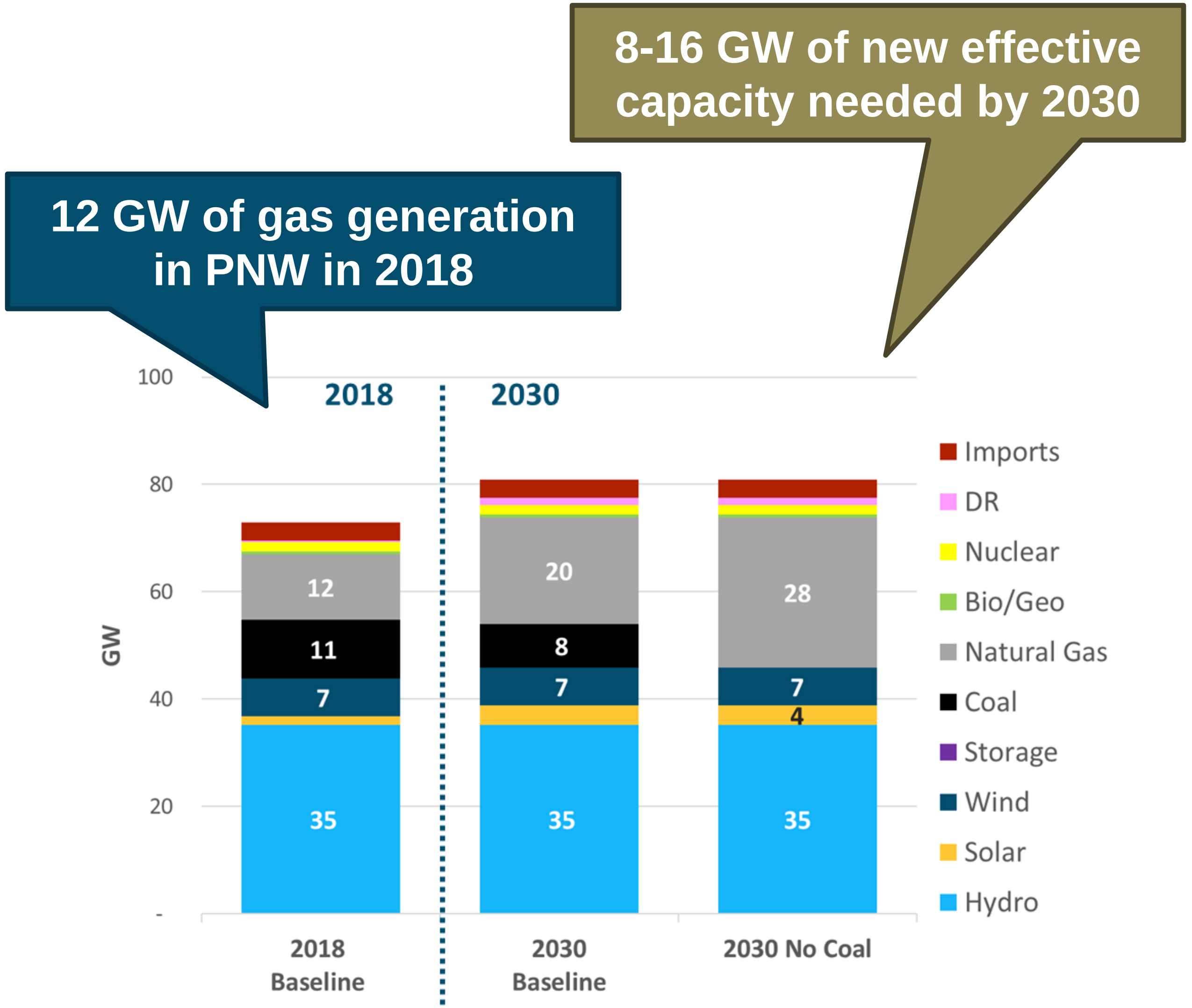
February 11, 2020

Washington, DC

Arne Olson, Senior Partner

1. The Pacific Northwest will need new capacity in the near term to ensure resource adequacy

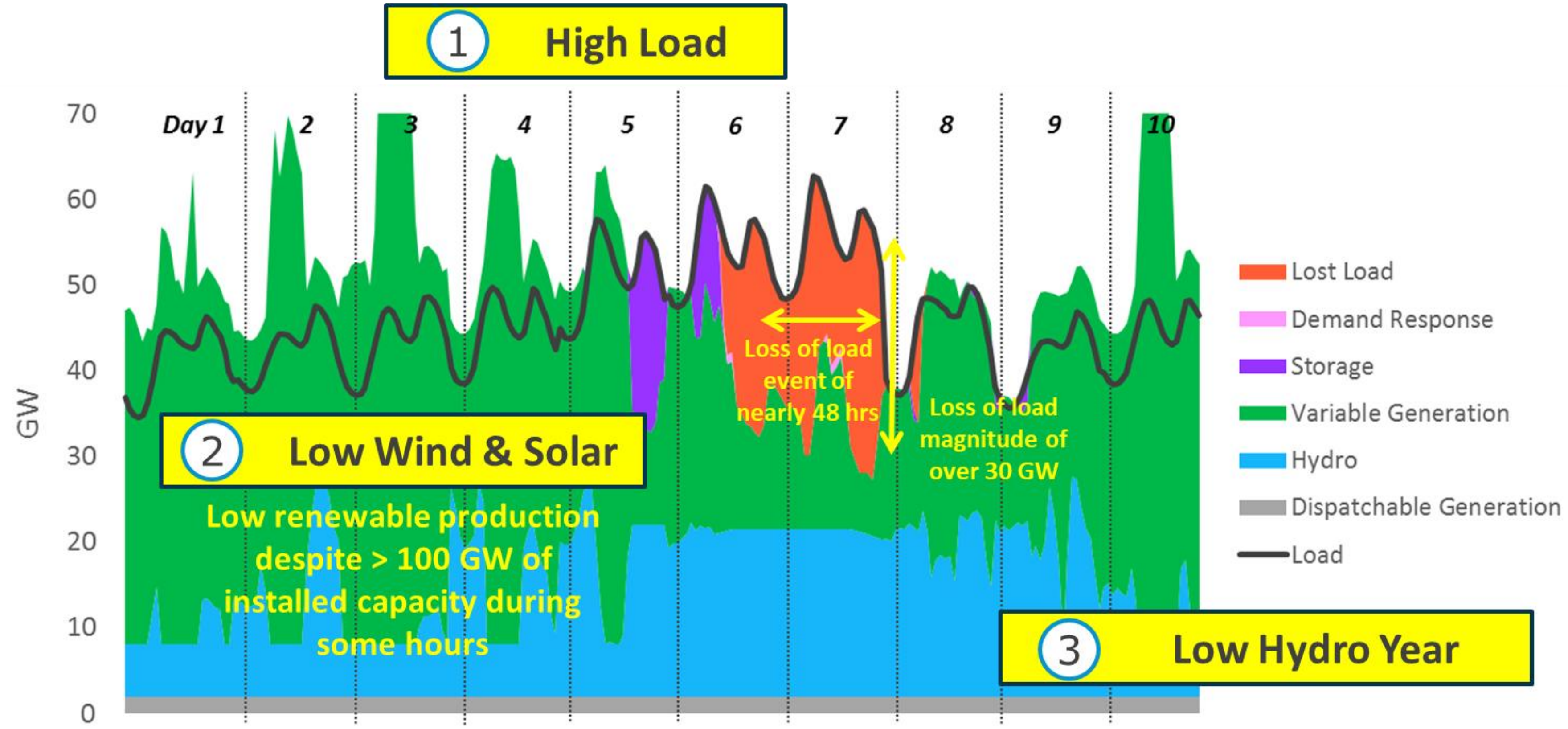
- Several studies indicate the region is in rough load-resource balance today
- Load growth and coal retirements will lead to a significant shortfall in the 2020s
- Shortfall could exceed 10 GW by 2030 if more coal is retired

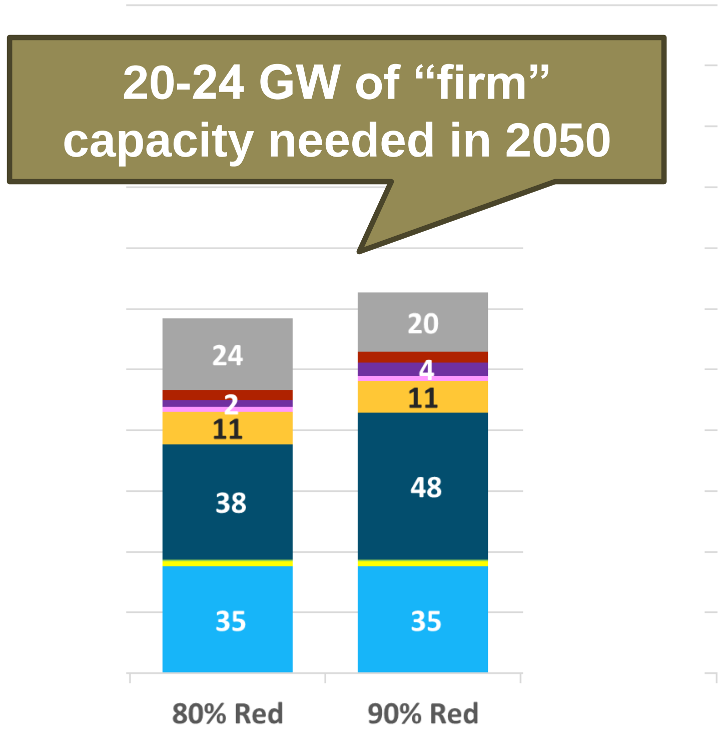


2. Ensuring reliability in the long run under aggressive carbon reduction goals will be a significant challenge

+ Some form of “firm” capacity is needed to ensure reliable service during multi-day events with high loads and low wind/solar production

+ In the absence of a zero-carbon alternative, gas may still be needed in 2050





3. The Northwest is pursuing a regional Resource Adequacy program through the Northwest Power Pool

- Current practice relies on 16 states & provinces to adopt practices that maintain reliability of the regional grid
- Longstanding surplus has led many utilities to rely on "front office transactions" to fill gaps
- A regional program could have significant reliability and efficiency benefits

NORTHWEST PowerPool

https://www.nwpp.org/resources/

Energy+Environmental Economics

Thank you!

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Duke Energy Resource Adequacy Within an Integrated Resource Planning Process

Glen Snider
Director, Integrated Resource Planning & Analytics
Duke Energy Carolinas

Resource Adequacy and Resource Planning

Comprehensive Reliability Assessment Study	→	Seasonal Reserve Margin or Capacity Margin	→	Integrated Resource Planning Process

<u>Conducted Every Few Years</u>

- Load Response to Extreme Weather
  - Changing consumer usage (EE, electrification, appliance saturation, building stock etc.)
- Changes to resource portfolio
  - Retirements, additions, updated outage history
- Economic Forecast Uncertainty

<u>Annual IRP Process</u>

- Three Pillars of an IRP:
  - Economics / Affordability
  - Reliability
  - Improved Environmental Footprint
- Reliability is constant across planning sensitivities and scenarios

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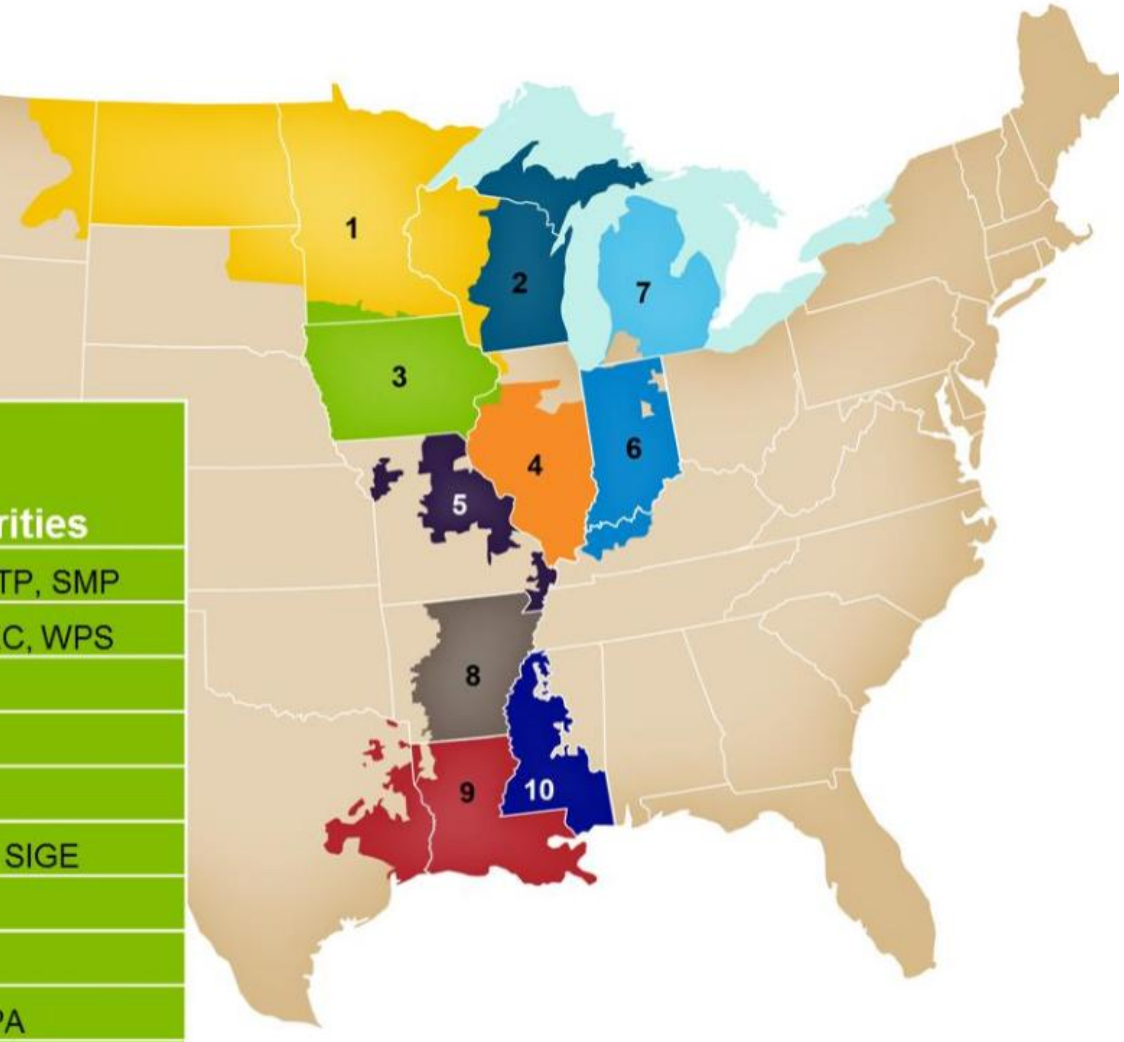
Electric Reliability and Capacity

Marcus Hawkins
Executive Director
Organization of MISO States

Organization of MISO States

MISO Local Resource Zones



Local Resource Zone	Local Balancing Authorities
1	DPC, GRE, MDU, MP, NSP, OTP, SMP
2	ALTE, MGE, MIUP, UPPC, WEC, WPS
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, CIN, HE, IPL, NIPSCO, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	EMBA, SME

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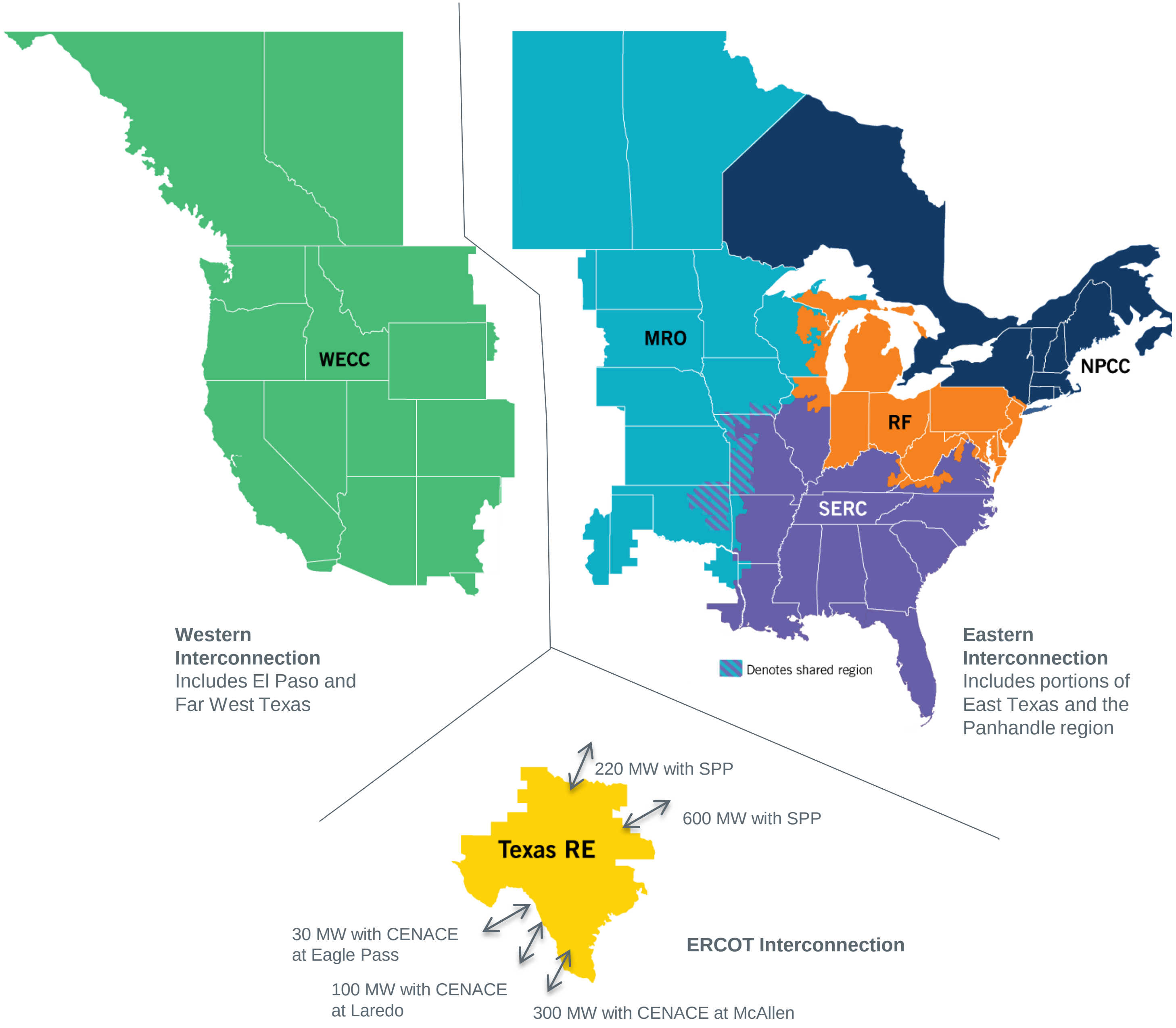
The ERCOT Region

The interconnected electrical system serving most of Texas, with limited external connections

- 90% of Texas electric load; 75% of Texas land
- 74,820 MW peak, Aug. 12, 2019
- More than 46,500 miles of transmission lines
- 650+ generation units (excluding PUNs)

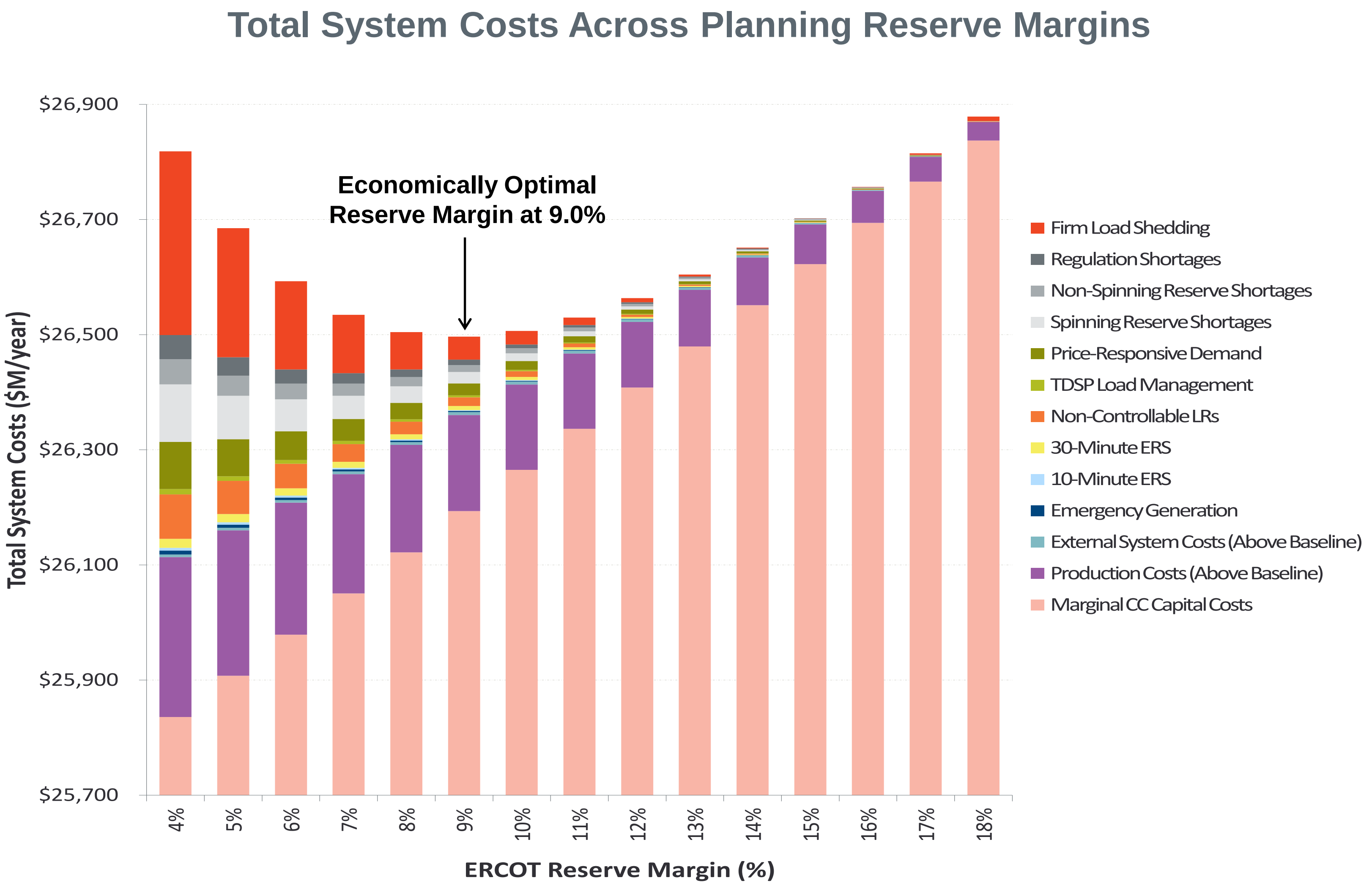
ERCOT connections to other grids are limited to ~1,250 MW of direct current (DC) ties, which allow control over flow of electricity



Impact of Reserve Margin on Consumers

A recent study indicates that a 9.0% reserve margin results in the lowest system cost to consumers.

This study also indicates that the current market design should support an 11% reserve margin as a long-run equilibrium.



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