# Resource Adequacy: A Multi-Metric Approach for Assessing Complex Systems

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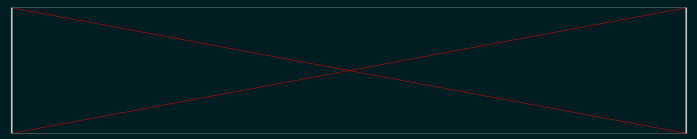
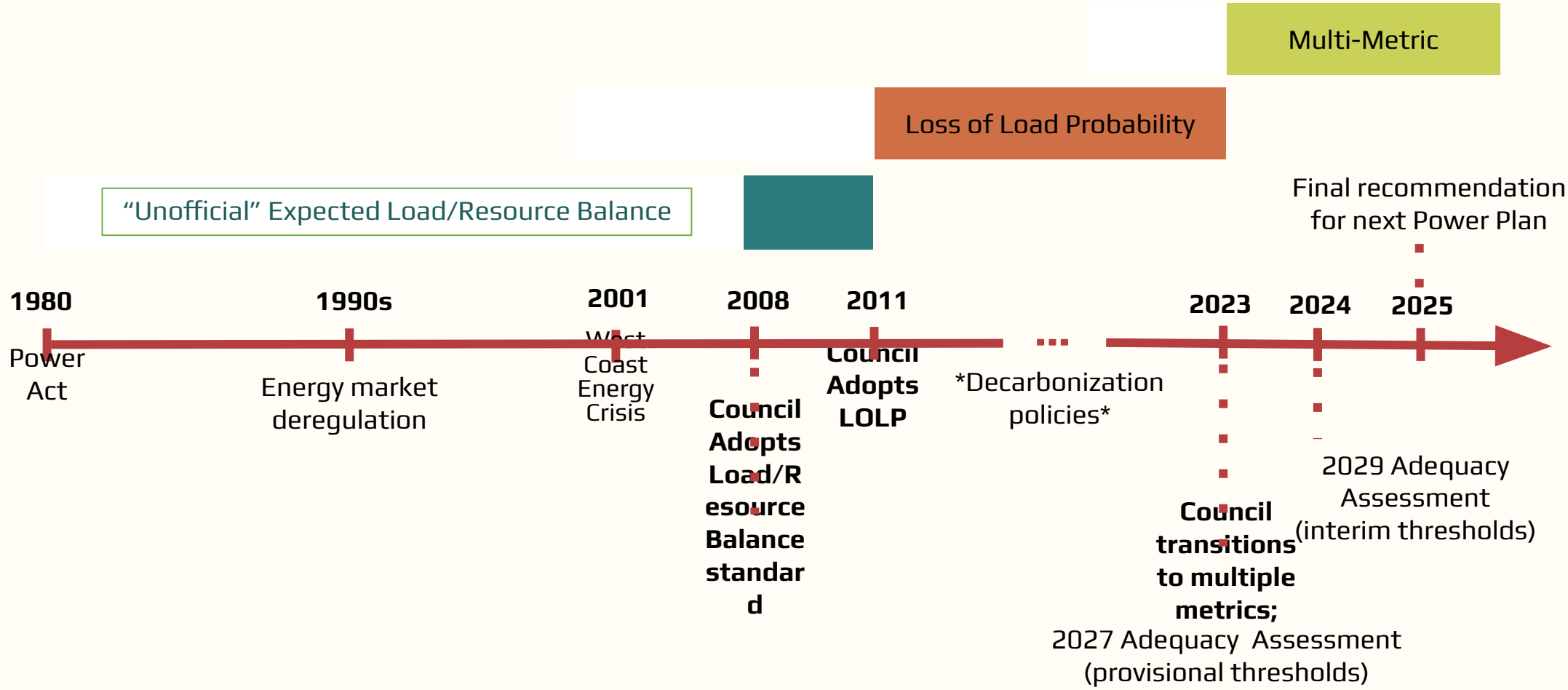
PNREC

Dor Hirsh Bar Gai



# Council's Evolving Approach to Adequacy



# Drivers of Change

Previously, the main risk we worried about was high loads coincident with low water.

Loss of Load Probability was a sufficient risk representation

**Complex System:**

Now we have added risks, including coincidence of fuel availability for resources.

Risk is no longer just a question of frequency, but also duration and magnitude

# Reedifying Philosophical Approach to Metric Thresholds

## Emergency Capabilities

Available emergency capabilities for the region based on lower lift measures

## Risk Tolerance

What level of risk is the aggregate emergency capabilities of the region able to protect?

A shortfall in the model **does not** necessitate an actual curtailment.
Rather, it signals non-modeled emergency measures are necessary to avoid curtailment.
**Adequacy metrics evaluate shortfalls to inform risk of using emergency measures**

# No Single Criteria Tells the Full Story

- How many times would we need to rely on emergency measures? (frequency)
- How long would the emergency measures need to be available for? (duration)
- How big would the emergency measures need to be? (magnitude)
  - Their peak (MW) and energy (MWh)
- What is the risk tolerance of emergency measures to protect against?

**Key takeaway:**
**Using multiple adequacy metrics helps better understand risk in complex systems under uncertainty**

# What are Emergency Measures?

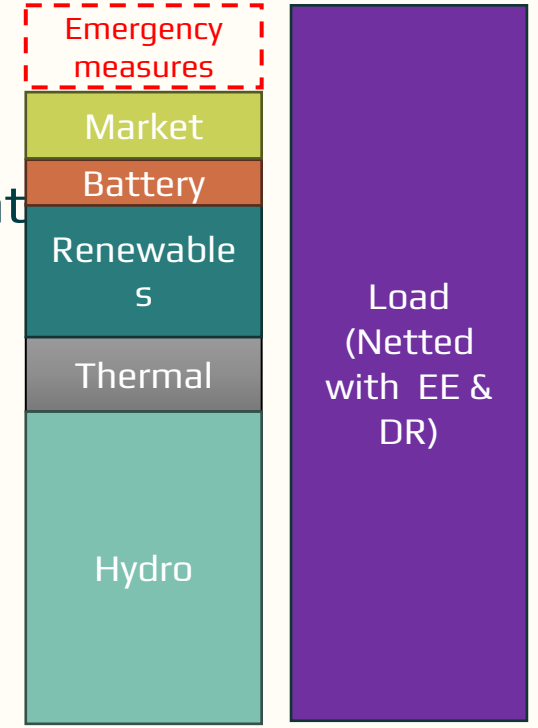
**Within Utility Control (low lift)**

- High operating cost resources not in utility's active portfolio
- High-priced market purchases over max import limits
- Load buy-back provisions
- Industry backup generators

**Outside Utility Control (less desirable, heavy lift)**

- Official's call for conservation
- Reduce less essential public load (e.g., gov't buildings, streetlight
- Utility emergency load reduction protocols
- Curtail F&W hydro operations

Staff engaged with the RAAC on approximating regional aggregate emergency capabilities to inform adequacy framework.




No emergency measure is modeled in Council's adequacy model GENESYS:
a multi-stage production cost model that co-optimizes energy and reserves while accounting for fuel use, forecast error and system constraints

# Major Objectives for a Multi-metric RA Criteria

Prevent overly frequent use of emergency resources

- Emergency resources are contingency actions taken to keep the lights on
- Frequent use of emergency resources indicates a non-cost-effective power supply
- *Objective is accomplished by limiting the frequency of simulated shortfall events*

Limit the risk of low probability, high impact events

- Because no utility plans to cover all contingencies, limits for "real" curtailments (after emergency resources are exhausted) must be set
- *Objective is accomplished by setting limits (based on what customers will tolerate) for the duration, size and frequency of high-impact shortfalls*

# Adequacy Criteria for 9th Power Plan

Protection against frequent deficits

Protection against extreme (tail-end) deficits

**Frequency (LOLEV)**

0.1 in summer
0.1 in winter
0.2 annual

Limit to 1 in 10 years summer and winter events, Limit to 1 in 5 years overall

**Duration**

8-hour

**Peak**

1,200 MW

**Energy**

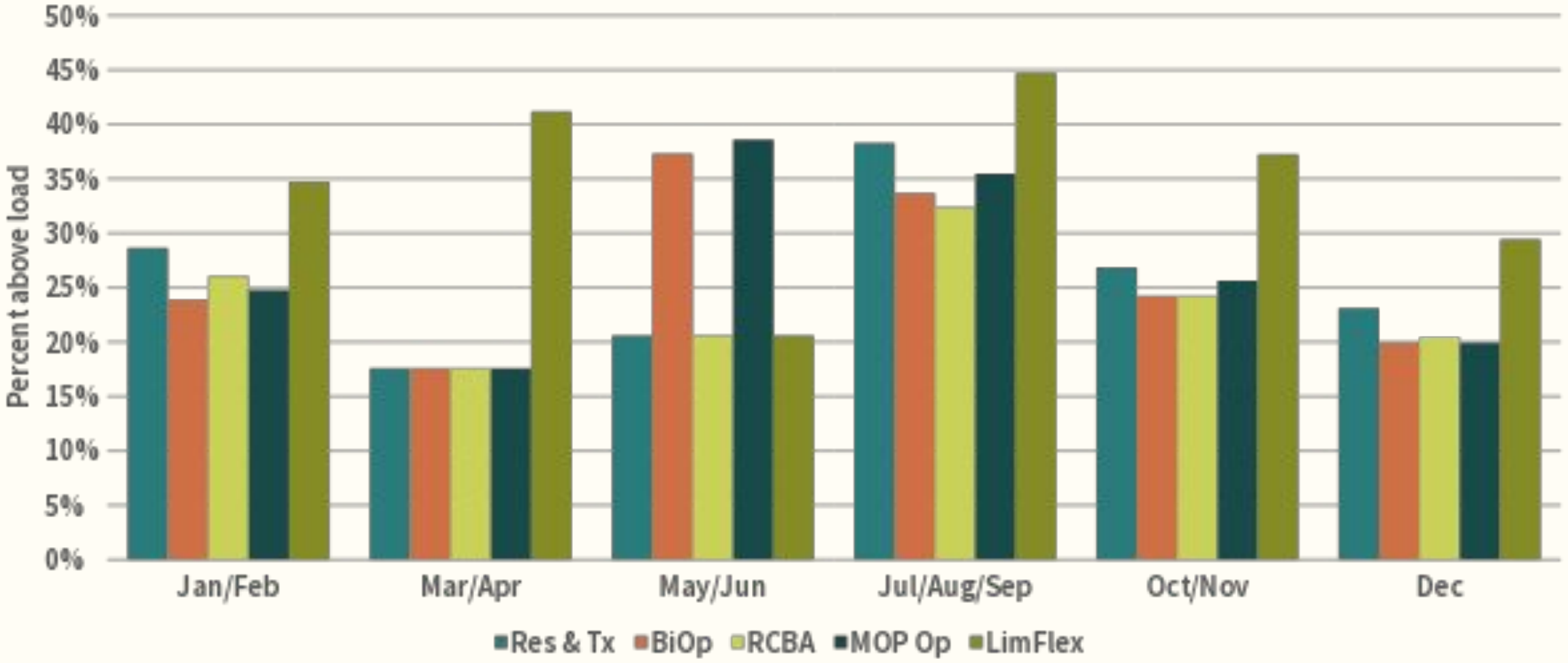
9,600 MWh

39 out of 40 years, protecting against events that are too big or too long

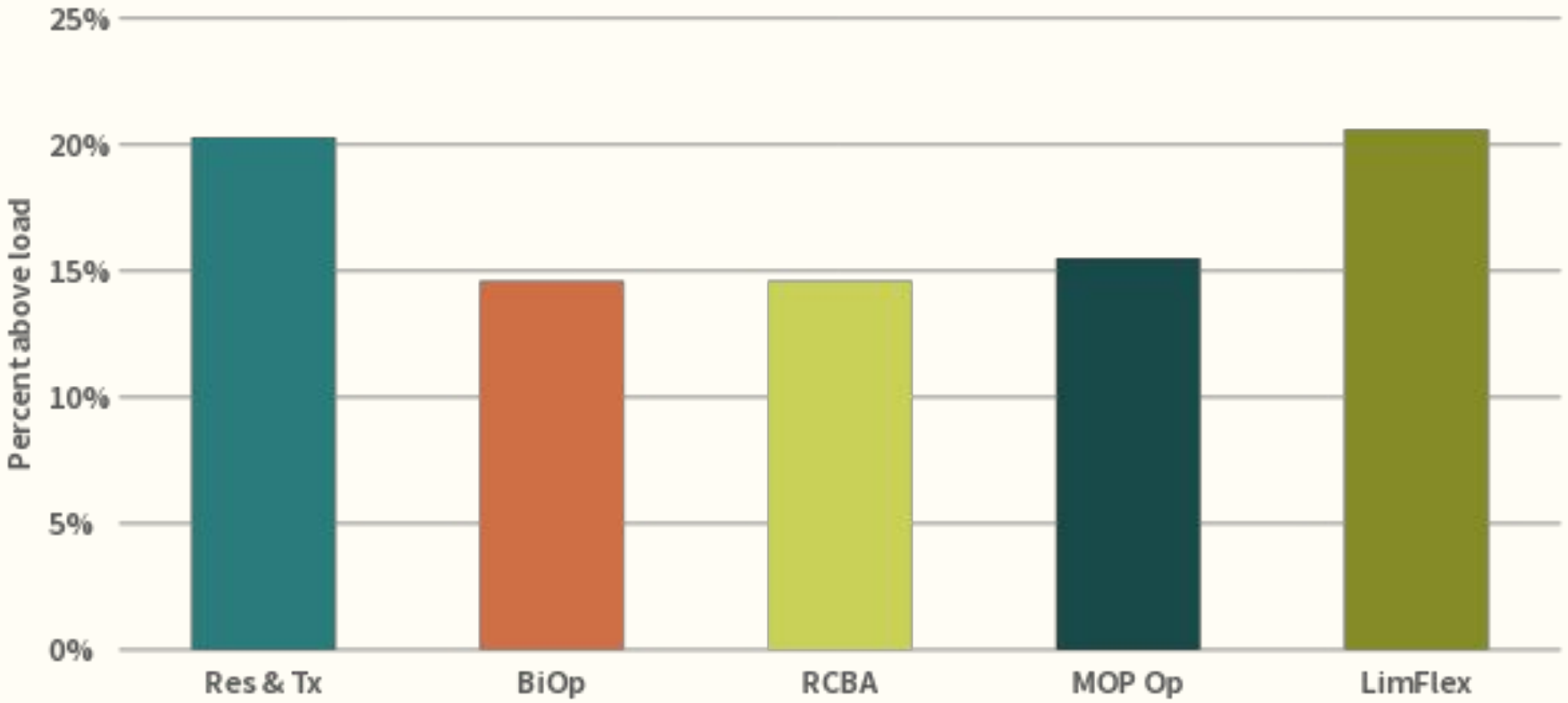
# Connecting Adequacy to Capital Expansion

- With only one adequacy metric, there is only one adequacy need signal
- However, multiple metrics require multiple signals, one for each metric
- The Council developed a reserve margin methodology that focuses on peak and energy needs:
  - The implied need (MW) to satisfy frequency and peak metrics  planning reserve marin (PRM)
  - The implied need (aMW) to satisfy duration and energy metrics  firm energy adequacy reserve margin (ARM)
- Alongside the multi-metric adequacy criteria, the reserve margins also account for load growth and load resource balance considerations
- The resulting capital expansion strategy is one that satisfies the specific adequacy risk to mitigate the frequency, duration, and magnitude concerns (alongside economic and

# 9th Plan Planning Reserve Margins



# 9th Plan Adequacy Reserve Margin (Firm Energy)



# Questions?

Dor Hirsh Bar Gai
dhirshbargai@nwcouncil.org