Northwest **Power** and
Conservation Council

December 6, 2022

MEMORANDUM

TO: **Power Committee**

FROM: **John Ollis, Manager of Planning and Analysis**
John Fazio, Senior Power Systems Analyst

SUBJECT: **Preliminary Resource Adequacy Assessment for 2027**

BACKGROUND:

Presenters: John Ollis, John Fazio, Dor Hirsh Bar Gai

Summary: This presentation summarizes the preliminary resource adequacy assessment for the 2027 operating year and proposes a new regional adequacy standard for the Council to consider. Using the Council's enhanced GENESYS model, a set of new adequacy measures were used in conjunction with the Council's current standard to assess the adequacy of the region's power supply.

Staff will present findings and initial observations from this year's assessment. These initial observations show that with no new resource or energy efficiency acquisitions, the power supply will not be adequate in 2027. However, implementing the resources and energy efficiency savings interpreted from the plan's resource strategy will result in an adequate supply by then. But those resources alone are not sufficient to maintain adequacy under a high-demand scenario (such as a fast path to decarbonization) or if regional coal plants are retired earlier than anticipated. The power plan analysis indicates additional resource and energy efficiency acquisitions would likely be necessary under those scenarios. Staff will work with the Power Committee to finalize an Executive Summary for review at a future Council meeting.

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Bill Edmonds
Executive Director

503-222-5161
800-452-5161

Relevance: Resource adequacy is a critical component of the Council's mandate to develop a regional power plan that "ensures an adequate, efficient, economic and reliable power supply." To test the efficacy of the plan's resource strategy, the Council – in cooperation with regional stakeholders – annually assesses the adequacy of the power supply with planned resource additions. The annual assessment is based on a resource adequacy standard established by the Council in 2011.

Background: An adequate power supply can meet the electric energy requirements of its customers within acceptable limits, considering a reasonable range of uncertainty in resource availability and in demand. Resource uncertainty includes forced outages, early retirements and variations in wind, solar and market supplies. Demand uncertainty includes variations due to temperature, economic conditions, and other factors. Resource availability and demand are also affected by environmental policies, such as those aimed at reducing greenhouse gas emissions.

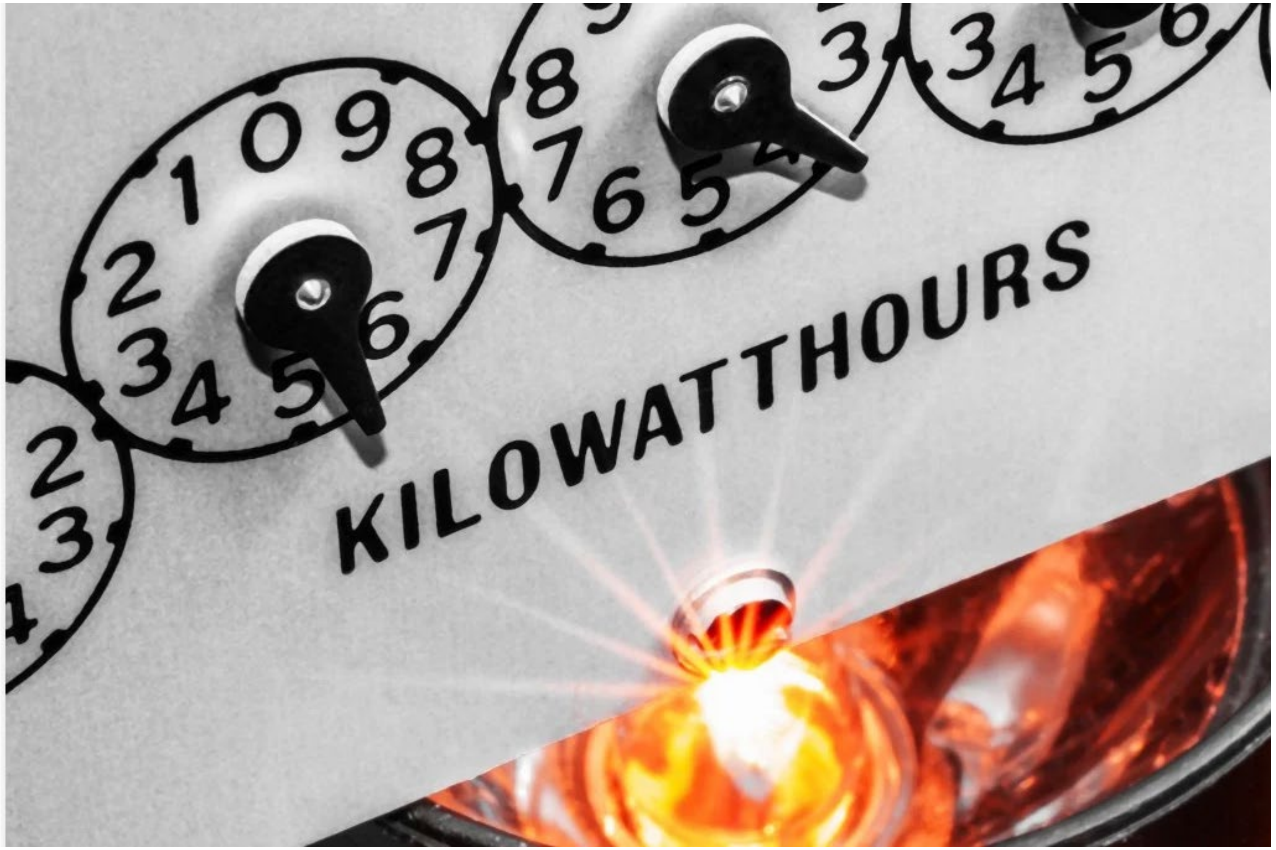
The Council uses a Monte-Carlo simulation model to assess the likelihood of a future year having one or more disruptions to service, when considering the many different combinations of future resource availabilities and demands described above. The metric used, referred to as the annual loss of load probability (LOLP), has been instrumental in the development of the Council's power plans since the early 2000s. However, due to increasing complexities (e.g., significant development of renewable and distributed resources, adoption of clean-air laws and a more dynamic market environment), LOLP is no longer sufficient to accurately measure the adequacy of the region's power supply.

An enhanced adequacy standard that includes metrics related to the frequency, duration, and magnitude of potential shortfalls is proposed for the Council to consider. The objectives for the new standard are to:

- Prevent high use of emergency measures
- Limit occurrences of very long shortfall events
- Limit occurrences of big capacity shortfalls
- Limit occurrences of big energy shortfalls

Staff will brief the committee on the set of proposed new adequacy metrics for a new standard, associated provisional thresholds, and will present the justification for their selection. Final thresholds for the new adequacy metrics will be set after further review and stakeholder feedback. Staff will also brief the committee on the results of the analysis against these new metrics and provide some high-level observations.

Preliminary 2027 Resource Adequacy Assessment



NW Power and Conservation Council
Power Committee Meeting
December 13, 2022

Objectives for the Adequacy Assessment

- The two primary objectives for the 2027 Adequacy Assessment are as follows:
  1. Provide the first look of whether the 2021 Power Plan continues to provide appropriate direction to ensure an adequate system 5-years out
  2. Move towards a multi-metric approach for characterizing system adequacy

To facilitate achieving those objectives:

- **Staff will share modeling results** relative to the new metrics
- **Staff is seeking member discussion** on what the results mean relative to the 2021 Power Plan strategy

Proposed New Adequacy Standard

- ***LOLEV** – Prevent overly frequent use of emergency measures*
  - Expected number of shortfall events/year, counting all shortfall events
  - Adequacy Limit = TBD, possible range 0.1 or 0.2 shortfall events/year
- ***Duration*** $\boldsymbol{VaR_{97.5}}$ *– Limit the risk of long shortfall events to 1/40 years*
  - Longest shortfall event for the 97.5th worst simulation year
  - Adequacy Limit = TBD, possible range 8 to 12 hours (e.g., start of a cold snap or heat wave)
- ***Peak*** $\boldsymbol{VaR_{97.5}}$ *– Limit the risk of big capacity shortfalls to 1/40 years*
  - Highest single-hour shortfall for the 97.5th worst simulation year
  - Adequacy Limit = TBD, possible range 2,000 to 3,000 MW
  - Limit set to aggregate emergency capacity or acceptable amount of single-hour demand at risk
- ***Energy*** $\boldsymbol{VaR_{97.5}}$ *– Limit the risk of big energy shortfalls to 1/40 years*
  - Total annual shortfall energy for the 97.5th worst simulation year
  - Adequacy Limit = TBD, possible range 4,000 to 8,000 MWh
  - Limit set to aggregate emergency energy or acceptable amount of annual energy demand at risk

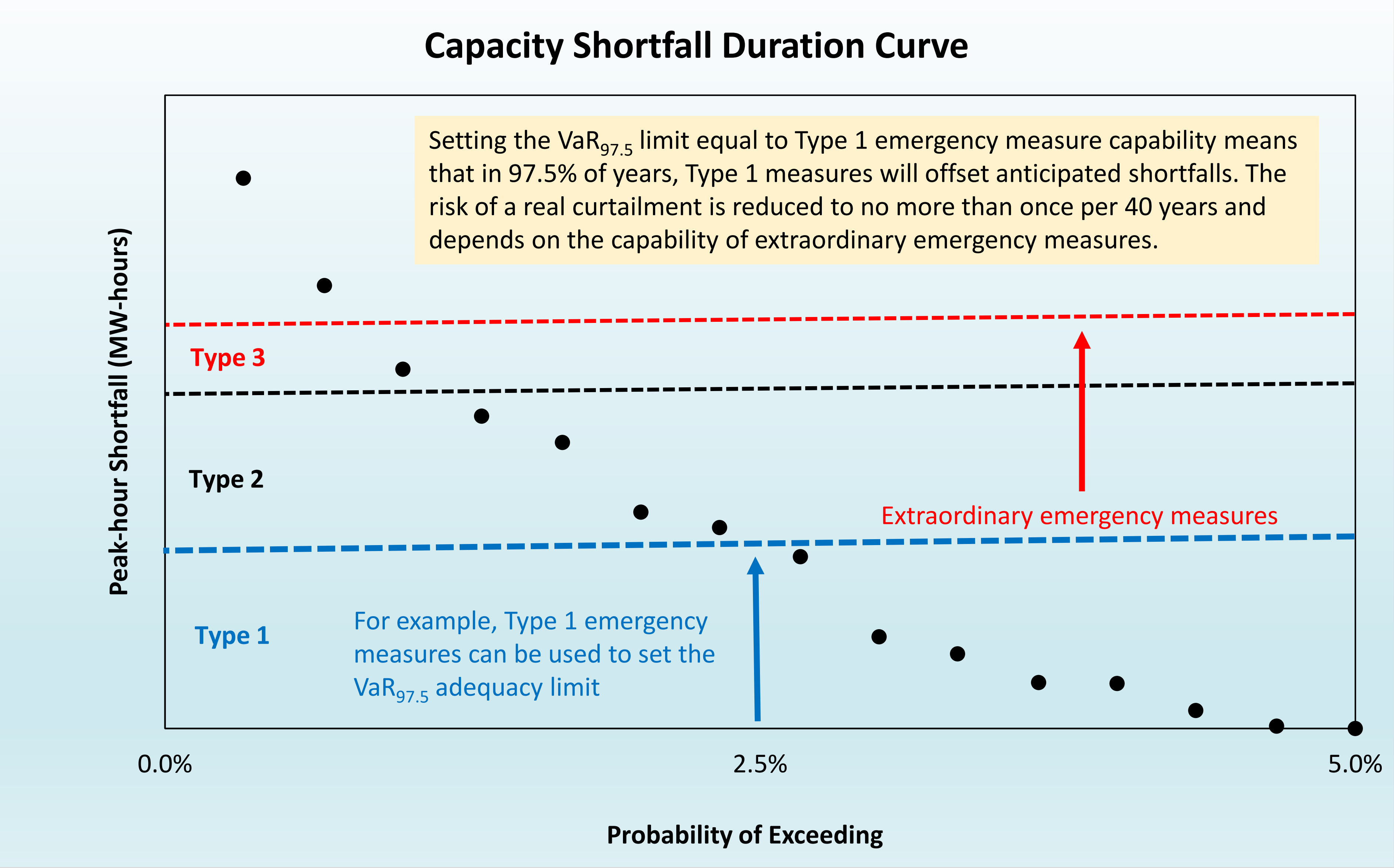
Examples of Non-modeled Emergency Measures

Quantifying Emergency Capability is Difficult

Type 1:
- 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

Type 2:
- Official's call for conservation
- Reduce less essential public load (e.g., gov't buildings, streetlights, etc.)
- Utility emergency load reduction protocols
- Curtail F&W hydro operations

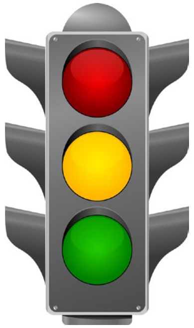
Type 3:
- Rolling brownouts
- Rolling blackouts



Interpretation of the New Standard

For power planning purposes, the power supply is deemed to be inadequate if any metric limit is violated

The level of inadequacy is assessed by the number and magnitude of violations



Severe – all metric limits are exceeded, or violations are large

Marginal – some limits are exceeded, and violations are small

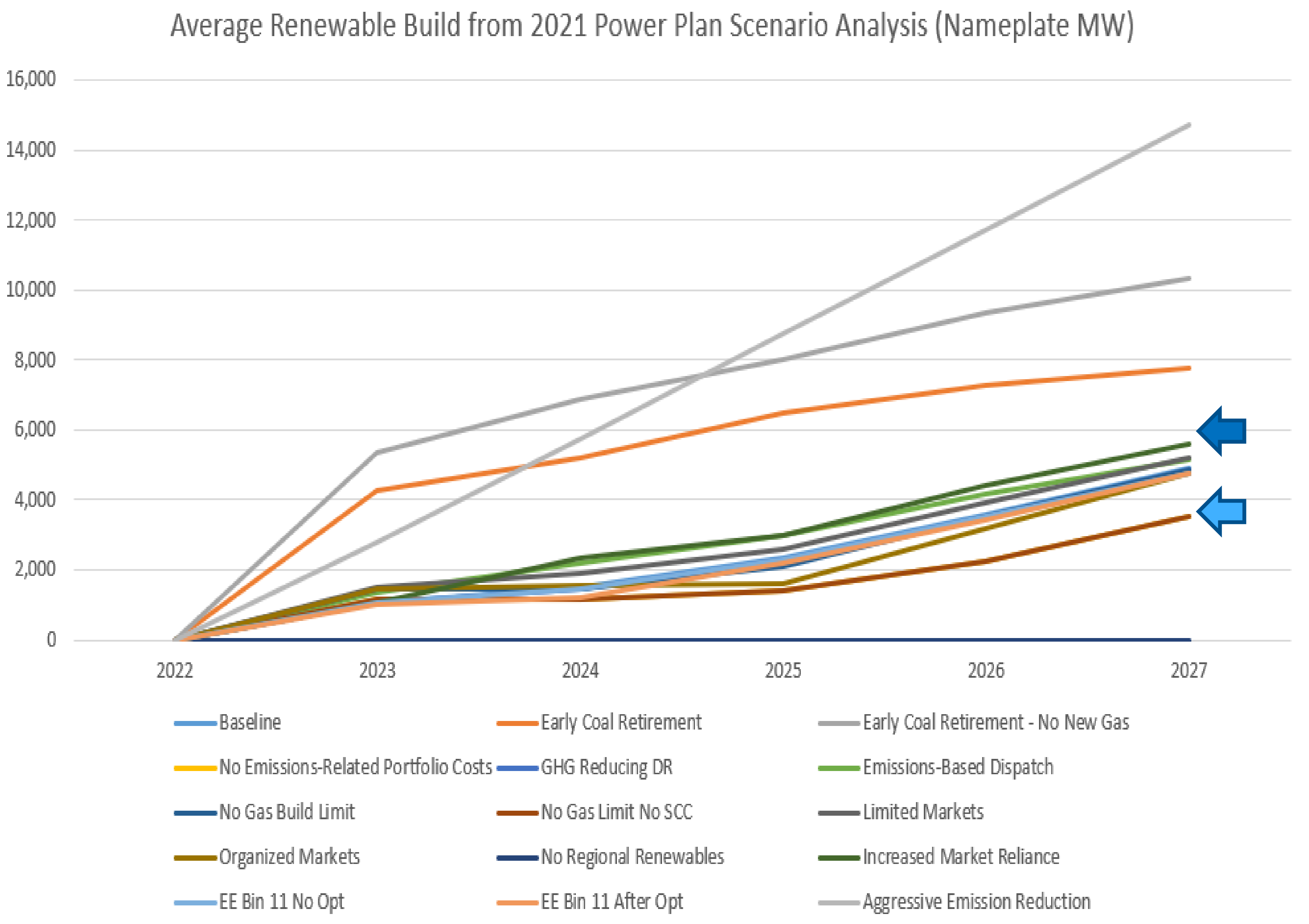
Adequate – all metrics are within limits

Results - High Level Observations

- The resource strategy seems adequate based on the LOLP metric
- The resource strategy addressed most of the summer issues
- Market fundamentals risks are mostly controlled by the net market import limit
  - Higher market reliance would likely address more adequacy issues but create higher exposure to fundamentals
  - Import limit does not completely shield region from borderline overuse of emergency resources under some market conditions
- Two primary risks are highlighted in the High WECC Demand and Early Coal Retirement scenarios
  - Analysis in the plan showed larger renewable builds (1.7 to 8.7 GW more renewables than tested in this assessment) as a key piece to maintaining adequacy should these events happen.

Interpreting Plan Strategy

- Uncertain policy future
  - Strategy that might work for **<u>most</u>** number of scenarios
- The resulting exploration is reported via results in the *reference resource strategy* (RS Ref), and the *minimum strategy* (Min RS)



Resource Strategy Interpretations

- Resource Strategy (RS Ref)
  1. 1,000 aMW of new EE
  2. 720 MW of new DR
  3. 5,410 MW of additional new Renewables
     - 590 MW of new renewables already built since plan
  4. 6,000 MW of Up Reserves*

- Resource Strategy (Min RS)
  1. 750 aMW of new EE
  2. 720 MW of new DR
  3. 2,910 MW of additional new Renewables
     - 590 MW of new renewables already built since plan
  4. 6,000 MW of Up Reserves*

- No Resource Strategy (No RS)
  - Just the 590 MW of new renewables already built since plan

Additional Notes on Process

Reserves

- Use same balancing up reserve levels as recommended in resource strategy. In other words, 3,100 MW additional recommended over current reserve assumption of 2,900 MW balancing up reserves. See p.107 in 2021 Power Plan
- This plan identified need for increase in reserves specifically are to cover increased forecast uncertainty in load and variable energy resource generation and cooperation between regional entities to most effectively utilize these reserves.

Climate Change Study-CCSM

- CCSM model results have infeasibilities
- Temporarily using CanESM to substitute for CCSM results

Note on Reserves

- Since the last presentation, modeling results indicated that **the additional 2,500 MW up reserves** over the 6,000 MW total that were recommended in the plan, **were unnecessary to enforce further existing thermal plant commitment**.
- From the results, the model's treatment of short- term forecast error and corresponding reserve response was not functioning the way staff expected. Staff chose two paths to complete this analysis and highlights forecast error as a topic for additional exploration.
  1. As was done in the plan, report shortfalls from the hour-ahead stage of the model.
  2. Use only the balancing reserve totals identified within the regional resource strategy (6,000 MW total of regional balancing up reserves).

Notes on Climate Studies

Scenario	Winter Hydro Generation	Summer Hydro Generation	Winter HDDs	Summer CDDs
CanESM		*low*	*low*	*high*
CCSM	*high*	*low*		
CNRM	*low*	*high*	*high*	*low*

High loads and low water conditions might cause adequacy events

CCSM high water conditions causing infeasibilities in model

Reminder of Studies

Plan Resource Strategy

- Resource Strategy baseline (*RS Ref*)
- No Resource Strategy (*No RS*)
- Minimum Resource Strategy (*Min RS*)

Market Conditions

- Limited Markets (*RS Ref*)
- High WECC Demand (*RS Ref, +200 aMW EE*)
- Global Instability (*RS Ref*)
- Early Coal Retirement (*RS Ref*)

WECC Stress

- No WECC Buildout (*RS Ref*)
- SW Drought (*RS Ref*)
- Pipeline Freeze (*RS Ref*)
- Wildfire* (*RS Ref*)

* Not all climate scenarios were tested

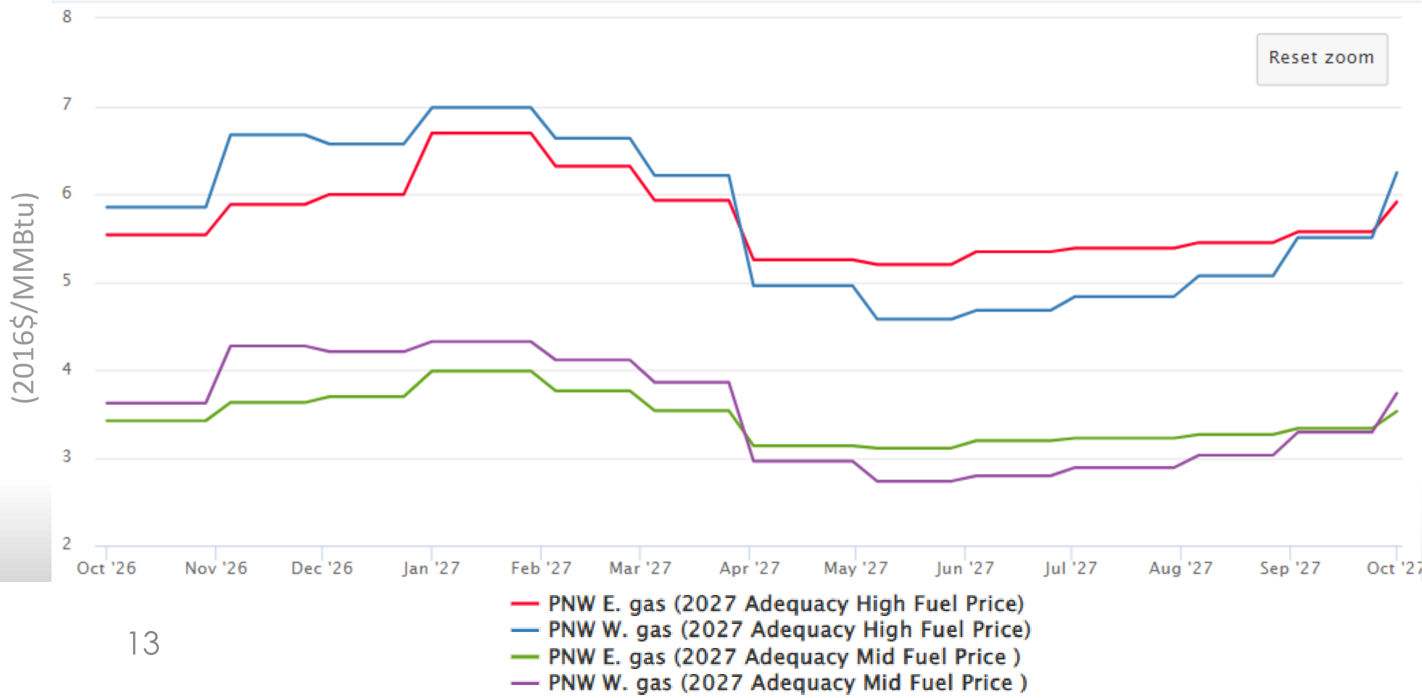
Reminders on a Couple Scenarios

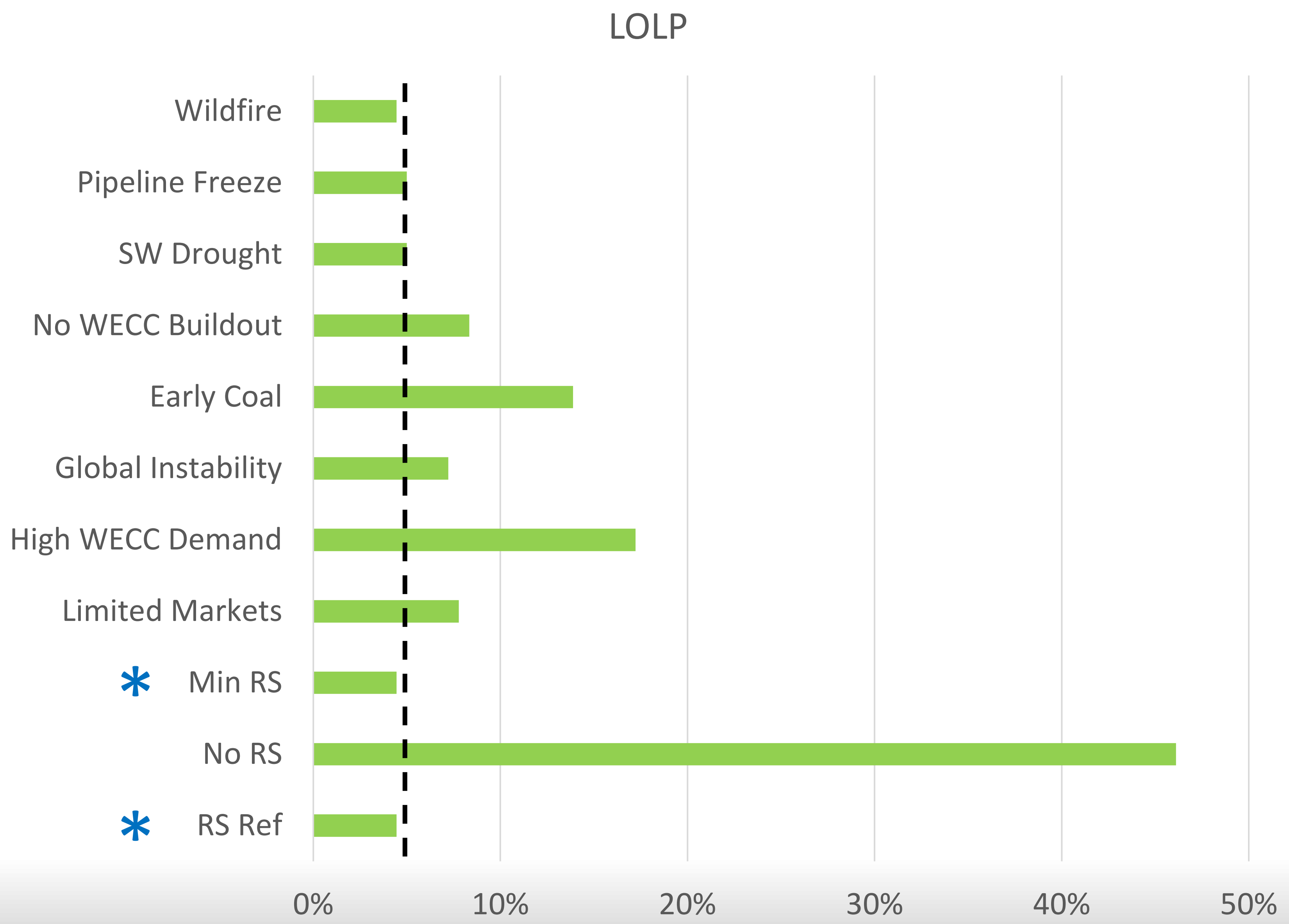
High WECC Demand

- Increased 2027 regional load on average by 9.5%
  - From the Plan (Aggressive Emission Reduction scenario)
- Increased 2027 total average WECC load by 1.5%
  - WECC values updated as of May 2022 per public information

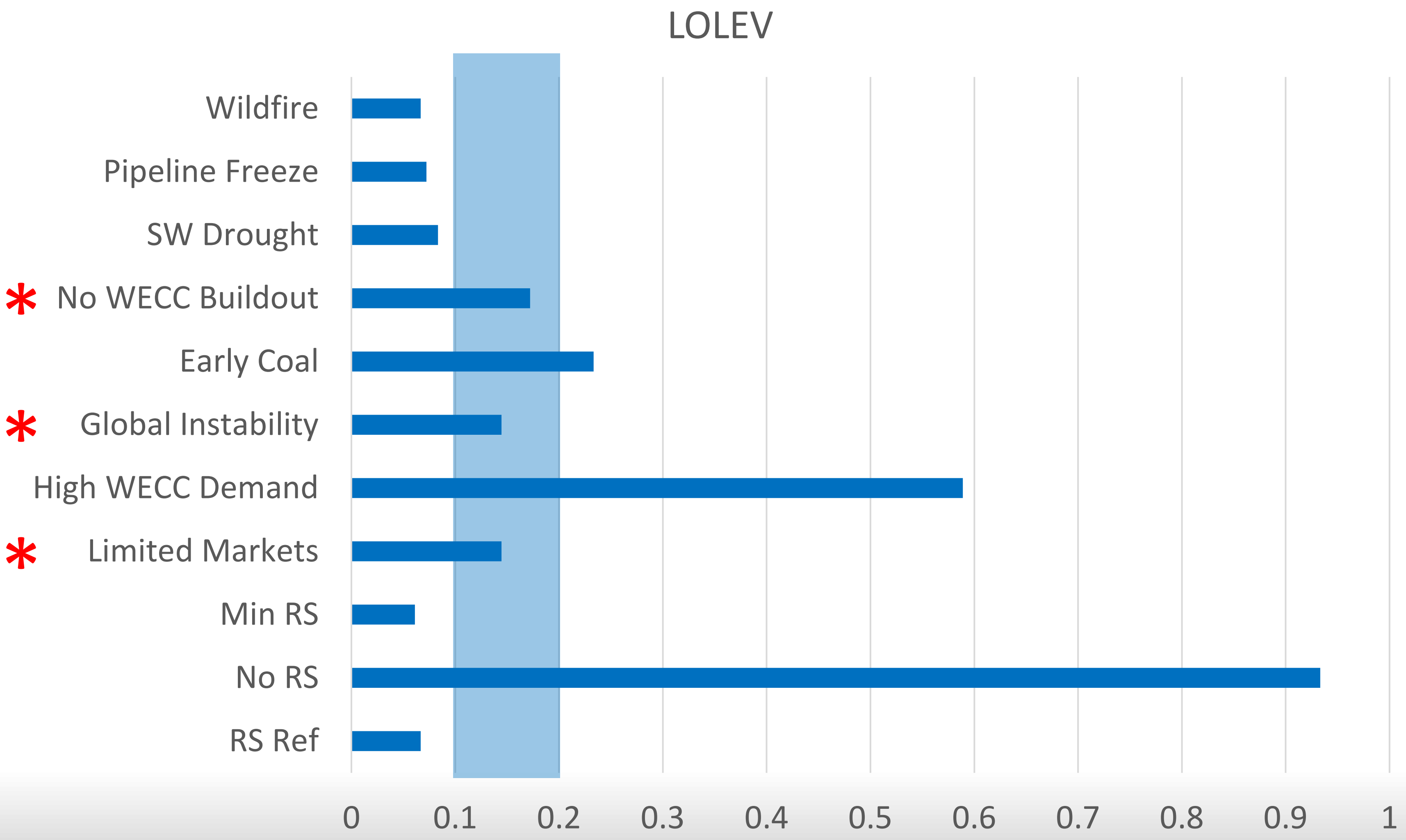
Global Instability

- Higher fuel prices by 56%-68%
- Lower annual build rate throughout WECC
  - Ramps up by 2030




LOLP
Wildfire
Pipeline Freeze
SW Drought
No WECC Buildout
Early Coal
Global Instability
High WECC Demand
Limited Markets
* Min RS
No RS
* RS Ref
0%
10%
20%
30%
40%
50%

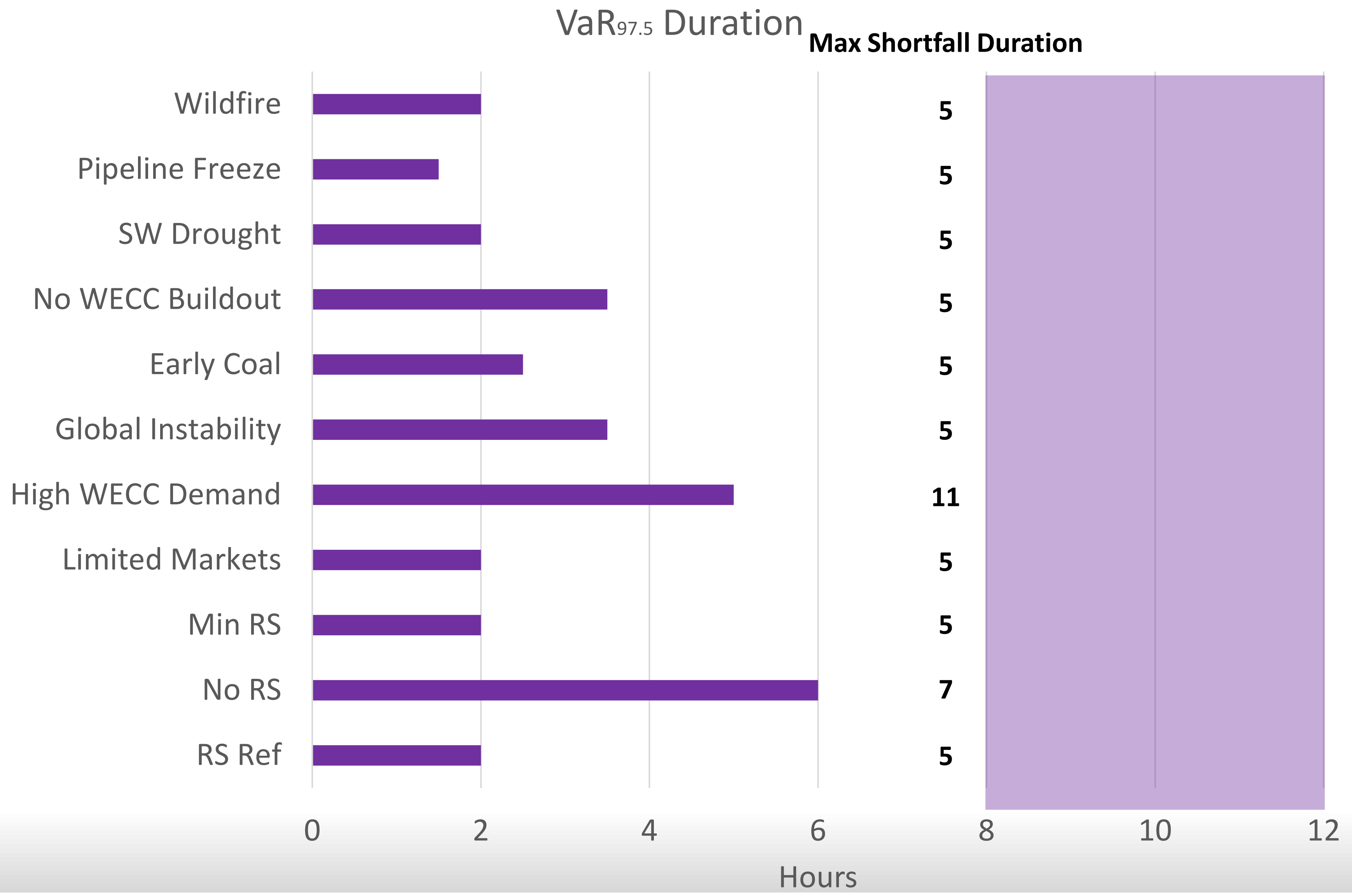
LOLEV limit range: WRAP uses 0.1 events/year and SCL and TAC both use 0.2 events/year, though defined differently: WRAP counts "event days" and not events, TAC counts all events and SCL counts only bad events.
Therefore, test a provisional limit range of 0.1 to 0.2 expected shortfall events/year.



* Borderline

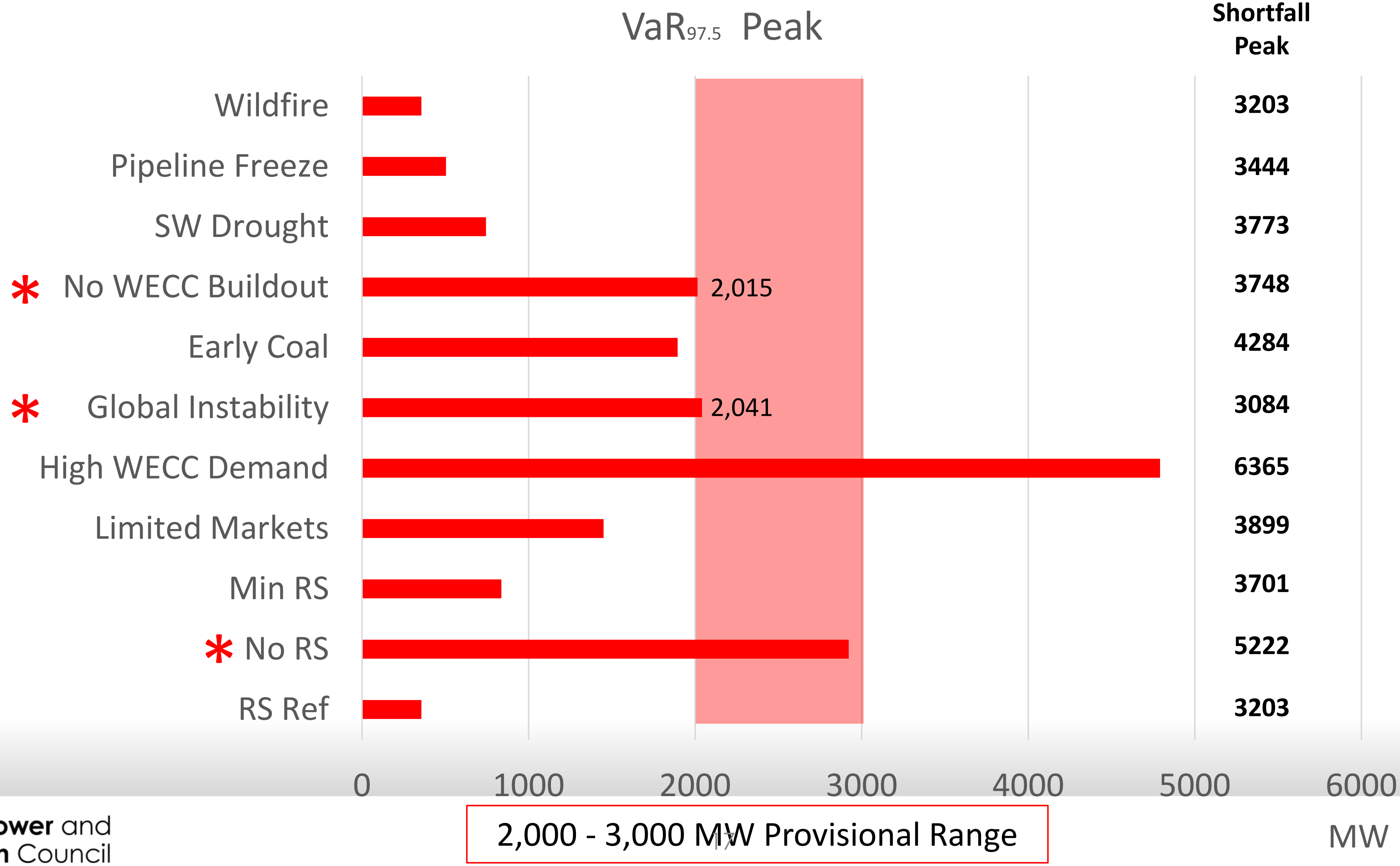
0.1 to 0.2 Events/Year Provisional Range

Duration VaR limit range: Minimum shortfall duration that could potentially cause severe harm. Initial considerations suggest testing a range of 8 or 12 hours for the provisional limit.



8 to 12 Hours Provisional Range

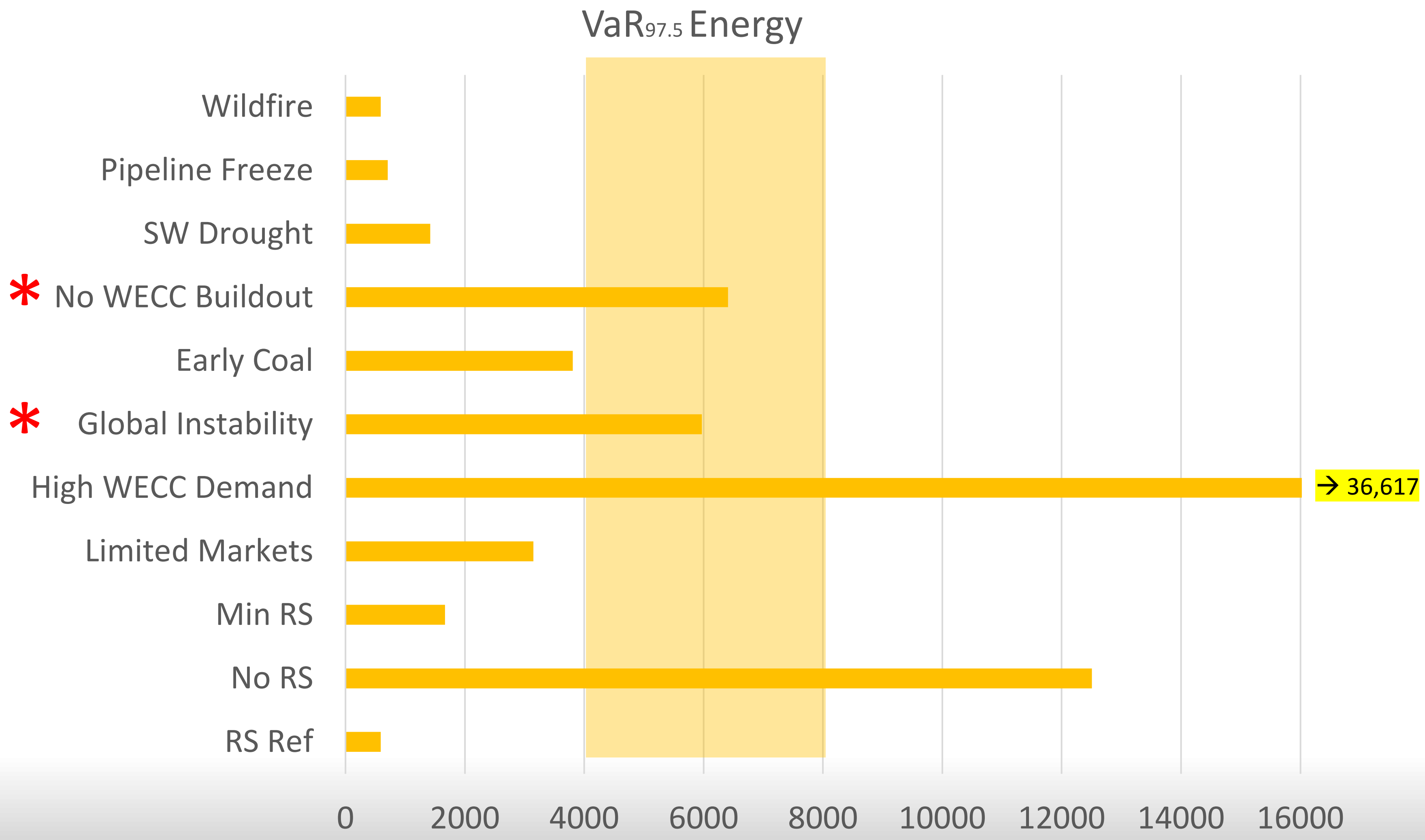
Peak VaR limit range: Based on reliable amount of emergency peaking. SCL assumes 200 MW of reliable emergency peak supply – extrapolating to the entire region yields 4,000 MW but that would not be representative. Given our conservative market reliance assumptions in the model, a 2,000-3,000 peak range is tested for the provisional limit.



Scenario	Max Shortfall Peak
Wildfire	3203
Pipeline Freeze	3444
SW Drought	3773
No WECC Buildout	3748
Early Coal	4284
Global Instability	3084
High WECC Demand	6365
Limited Markets	3899
Min RS	3701
No RS	5222
RS Ref	3203

* Borderline

Energy VaR limit range: The amount of reliable emergency energy for the year but the provisional limit is set equal to the amount of energy that can be delivered over a contiguous shortfall period. 500 to 1,000 megawatts per hour is assumed to be deliverable over the minimum 8-hour duration VaR limit (but perhaps more for shorter events). Thus, a range of 4,000 to 8,000 MW-hours is tested as the provisional limit.



Max Shortfall Energy

11,614
13,967
15,062
13,861
25,323
21,037
77,120
20,682
17,907
54,171
11,614

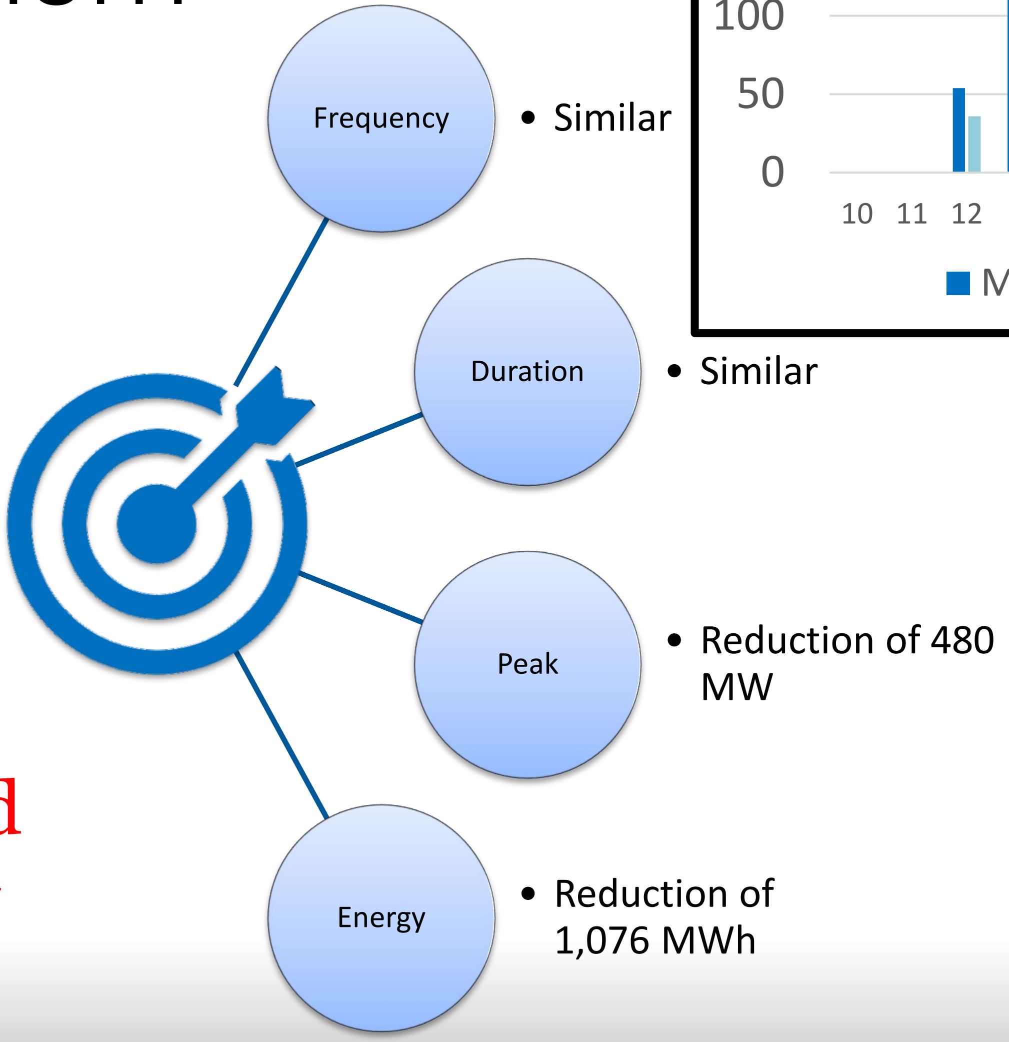
* Borderline

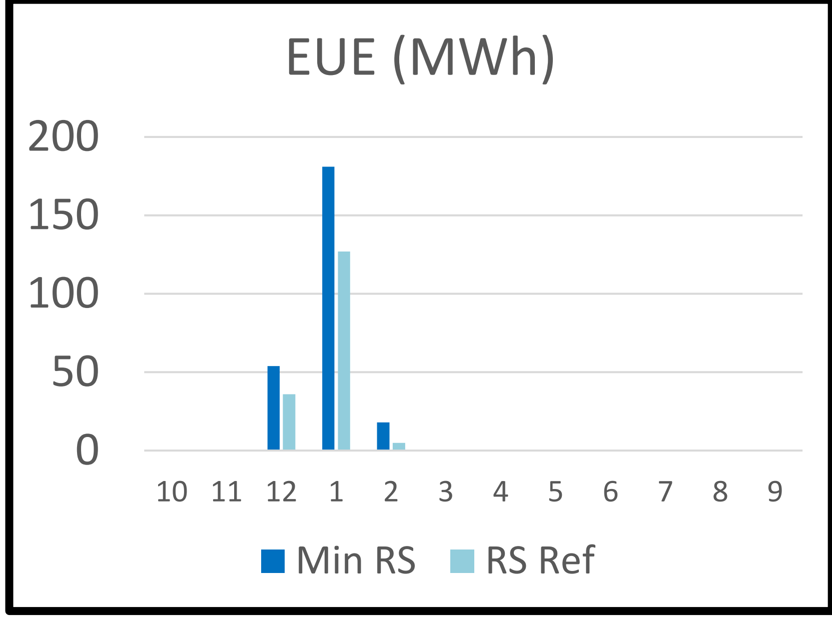
MWh

4,000 - 8,000 MWh Provisional Range

Impact of Baseline RS from the Minimum

- Recap on difference:
  - Renewables:
    - Additional 2,500 MW
  - Energy Efficiency
    - Additional 250 aMW
- Main Impact:
  - Reduction of shortfall magnitudes (decreased reliance on emergency resources)





Acceptable
Borderline
Exceed

Preliminary Summary

Study	LOLEV	Duration	Peak	Energy
RS Ref	0.067	2	357	590
No RS	0.933	6	2922	12504
Min RS	0.061	2	837	1666
Limited Markets	0.144	2	1450	3147
High WECC Demand	0.589	5	4792	36617
Global Instability	0.144	3.5	2041	5969
Early Coal	0.233	2.5	1895	3807
No WECC Buildout	0.172	3.5	2015	6410
SW Drought	0.083	2	744	1421
Pipeline Freeze	0.072	1.5	505	710
Wildfire*	0.067	2	357	590

Digging Into Adequacy Results

- The resource strategy was effective at eliminating summer shortfall events and mitigating the magnitude and frequency of winter events
- Interpreting the resource strategy at higher than the minimum of the ranges listed in the plan primarily lowered the magnitude of the worst events between 400 and 800 MW.
- Remaining shortfalls events occur mostly in winter months

Hours of Shortfall heatmap

- Frequency
- Resource strategy mitigates against summer shortfall

Reference - With Resource Strategy

Month	Hour in Month: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0	0	0	0	2	5	4	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0

Reference Without Resource Strategy

Month	Hour in Month: 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0	0	0	0	7	22	21	21	14	1	0	0	0	0	0	1	0	0	0	0	0	0	0
2	0	0	0	0	1	2	6	5	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	2	2	4	0	4	8	4	10	4	10	4	2	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	2	13	19	20	23	17	10	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	9	20	9	9	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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11	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	1	1	7	0	0	0	0	0	0	3	6	6	3	0	0	0	0	0

Maximum Magnitude Shortfall heatmap

- Max shortfall in MW
- Resource strategy mitigates against
  - Summer shortfall
  - Magnitude of winter shortfalls

Reference - With Resource Strategy

Month	Hour in Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0	0	0	0	1300	3203	2856	1915	792	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	402	443	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	173	0	0	0	0	0	0	0	0	0	1942	2160	0	0	0	0	0	0

Reference Without Resource Strategy

Month	Hour in Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0	0	0	0	3149	5222	4964	4398	3699	496	0	0	0	0	0	119	0	0	0	0	0	0	0
2	0	0	0	0	334	2560	3010	3357	2011	1844	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	676	1780	1154	0	248	1189	1526	1174	979	1089	587	29	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	625	285	384	749	370	398	355	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	303	767	1153	888	697	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	782	780	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	746	191	467	0	0	0	0	0	0	1323	4275	4496	1732	0	0	0	0	0

Maximum Magnitude Shortfall heatmap

- Max shortfall in MW
- Reference resource strategy further reduces the magnitude of winter shortfalls

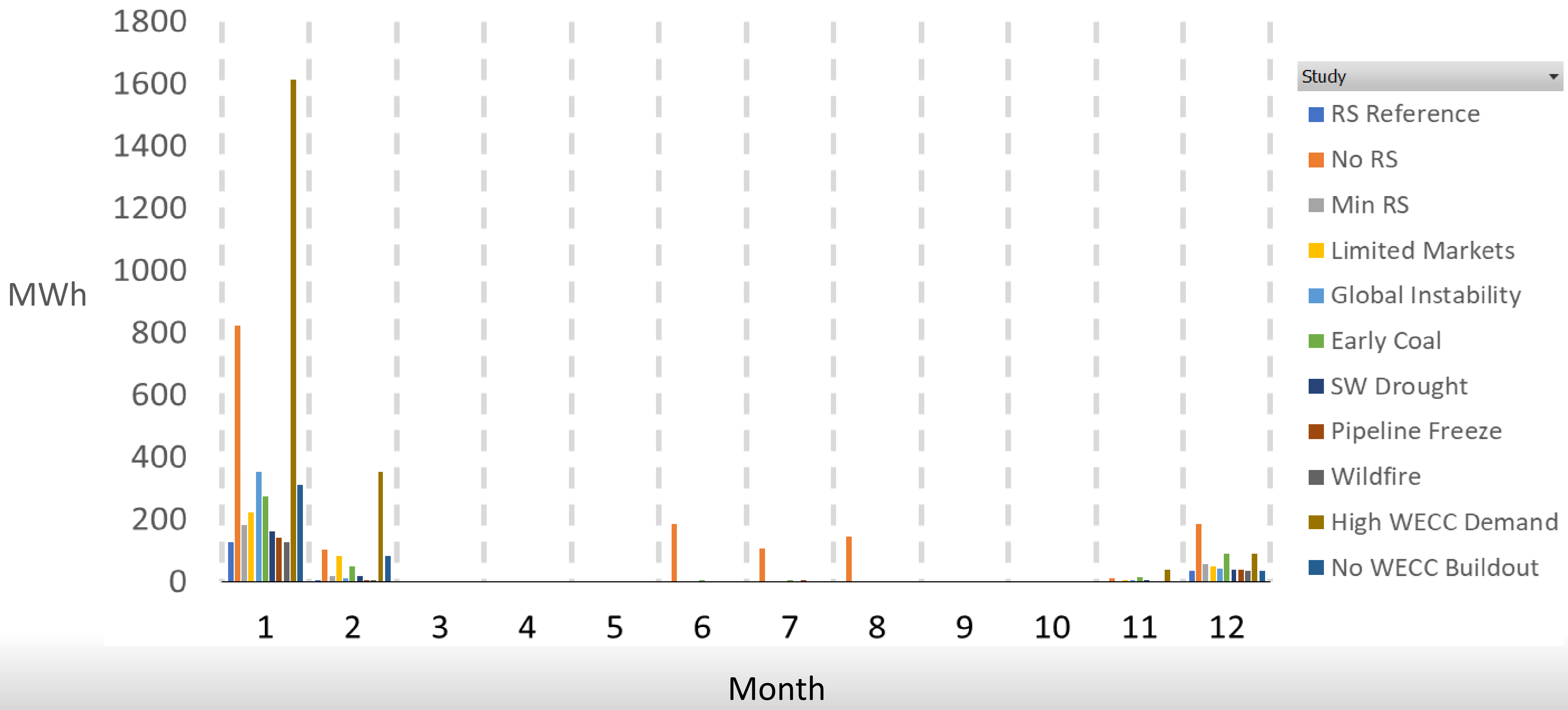
Reference - With Resource Strategy

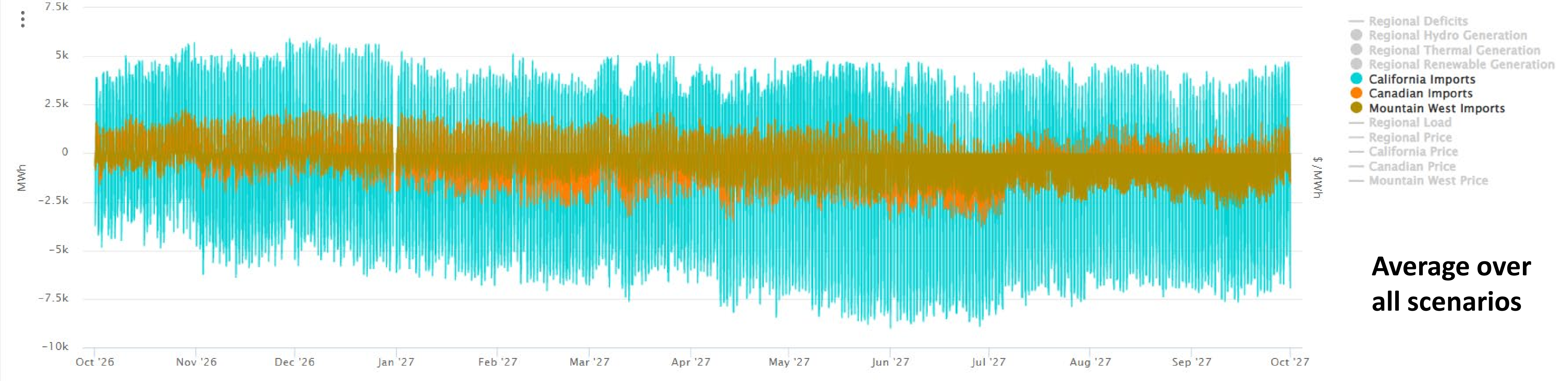
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Hour in Month																							
1	0	0	0	0	0	1300	3203	2856	1915	792	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	402	443	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	173	0	0	0	0	0	0	0	0	0	1942	2160	0	0	0	0	0	0

Reference With Minimum Resource Strategy

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Hour in Month																							
1	0	0	0	0	0	1787	3701	3297	2439	1596	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	298	896	856	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	730	0	0	0	0	0	0	0	0	0	2706	2858	0	0	0	0	0	0

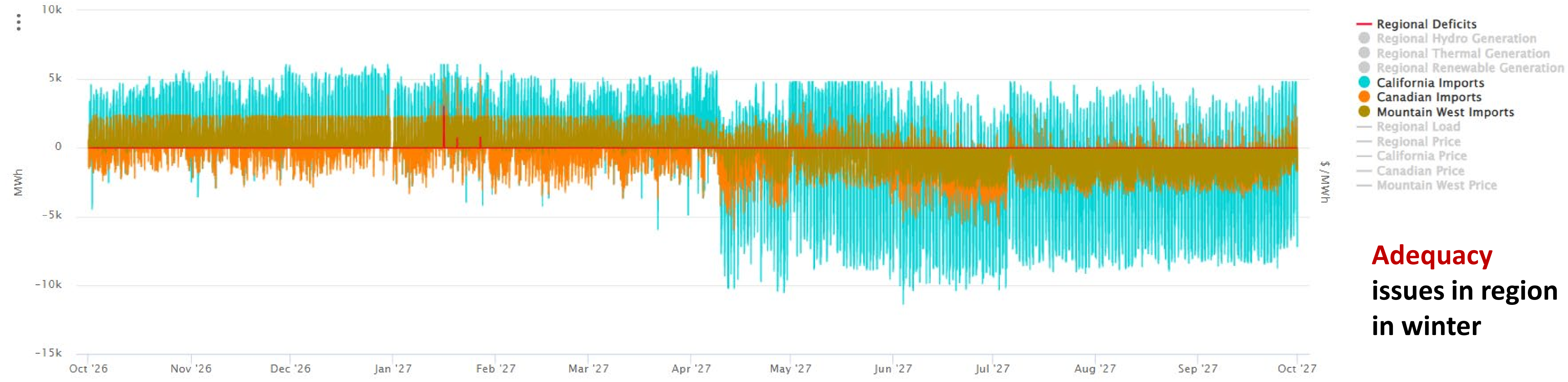
Monthly EUE shows remaining shortfalls are mostly winter problems





Average over all scenarios

Market Reliance Discussion



Adequacy issues in region in winter

Market Questions

- In the winter should we have a greater reliance on external to the region resources?
  - Most of WECC plans for summer peaks creating surplus in the winter
  - Low-priced market purchases midday are forecast to be available from certain regions
- In the market stress cases, what is the actual risk?
  - There seems to be less import availability in lower WECC buildouts or higher WECC demand futures
  - Do we want to modify the net import limits or emergency resource provisional limits?

Average California Import/Export Comparison to Resource Strategy Reference

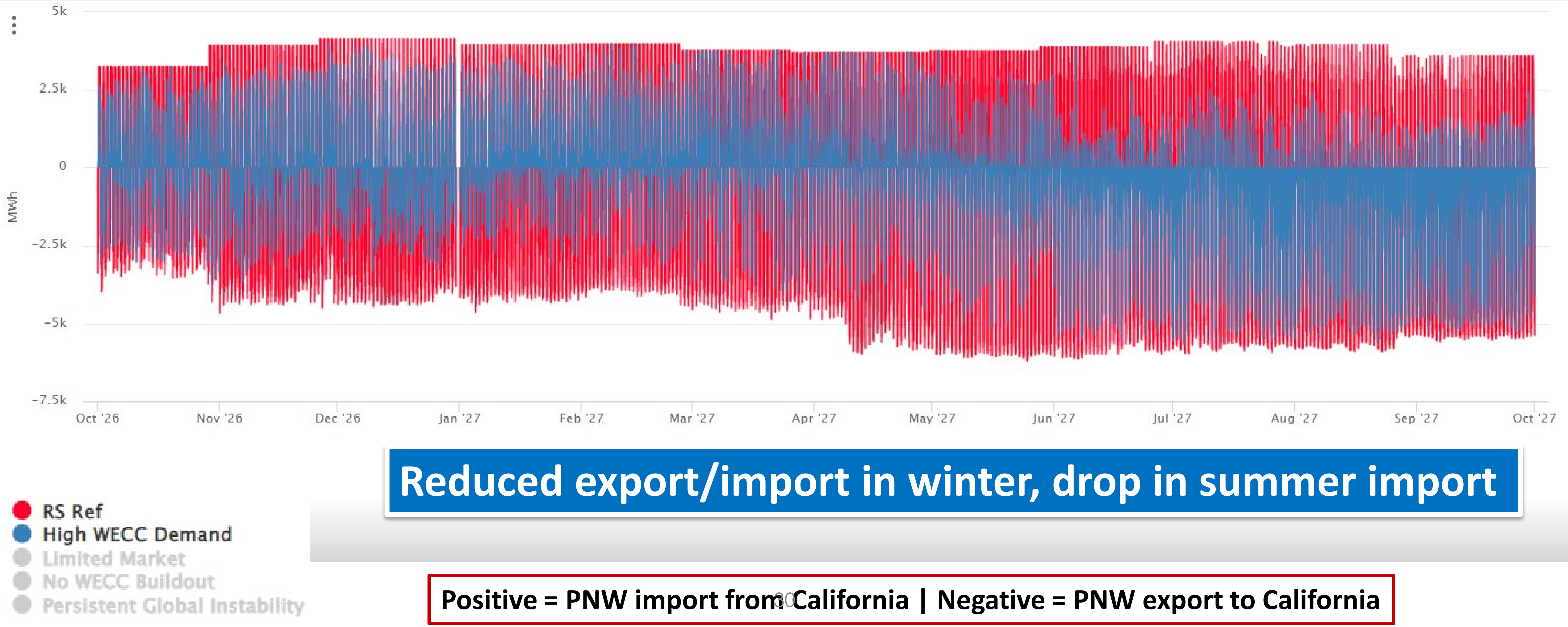
Study	Winter	Summer
Min RS	Similar	Similar
Limited Markets	Much less import / less export	Much less import / less export
High WECC Demand	Less import / much less export	Much less import / less export
Global Instability	Slightly less import / shorter exports	Less import / more export
Early Coal	Similar	Similar
No WECC Buildout	Almost export-only	Almost export-only
SW Drought	Similar	Slightly less import
Pipeline Freeze	Similar	Similar
Wildfire*	More export	Less export / similar import

Significant Differences

Example of Daily Import/Export Behavior

Positive = PNW import from California | Negative = PNW export to California

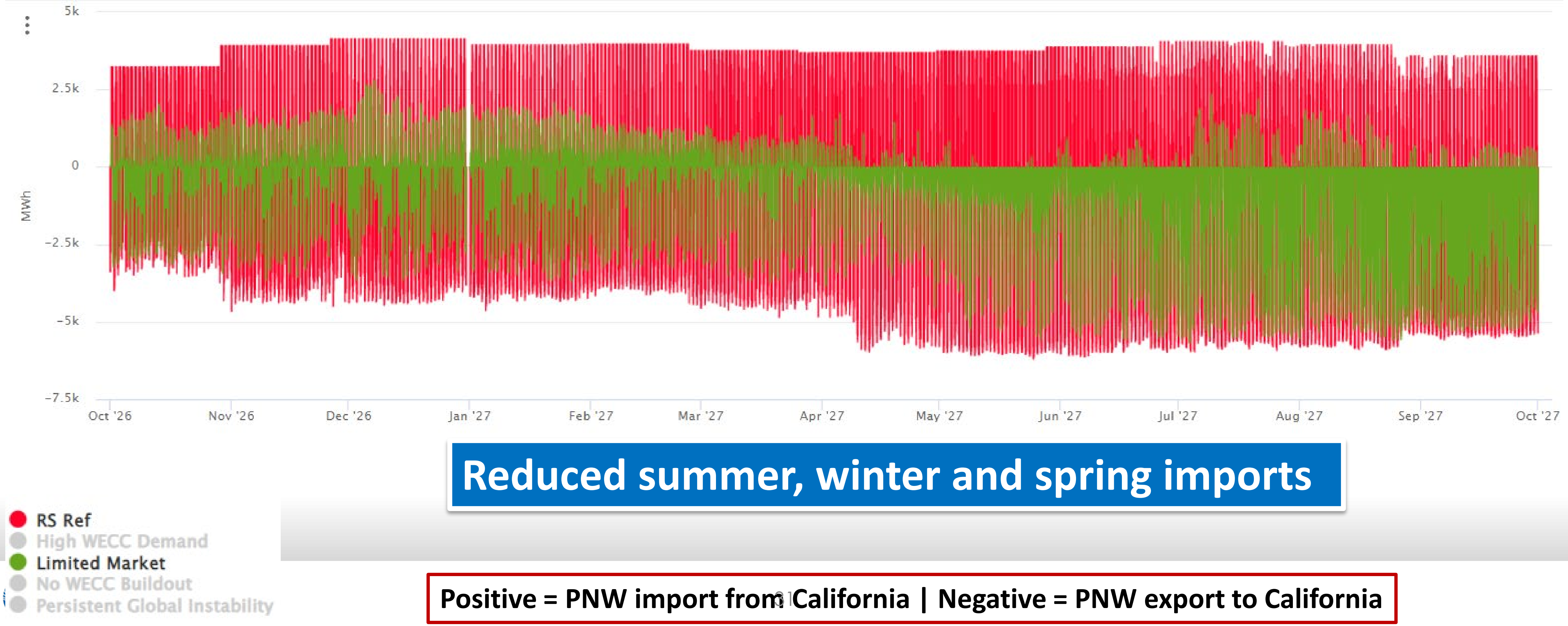
California Import/Export: High WECC Demand comparison to RS Ref



Reduced export/import in winter, drop in summer import

Positive = PNW import from California | Negative = PNW export to California

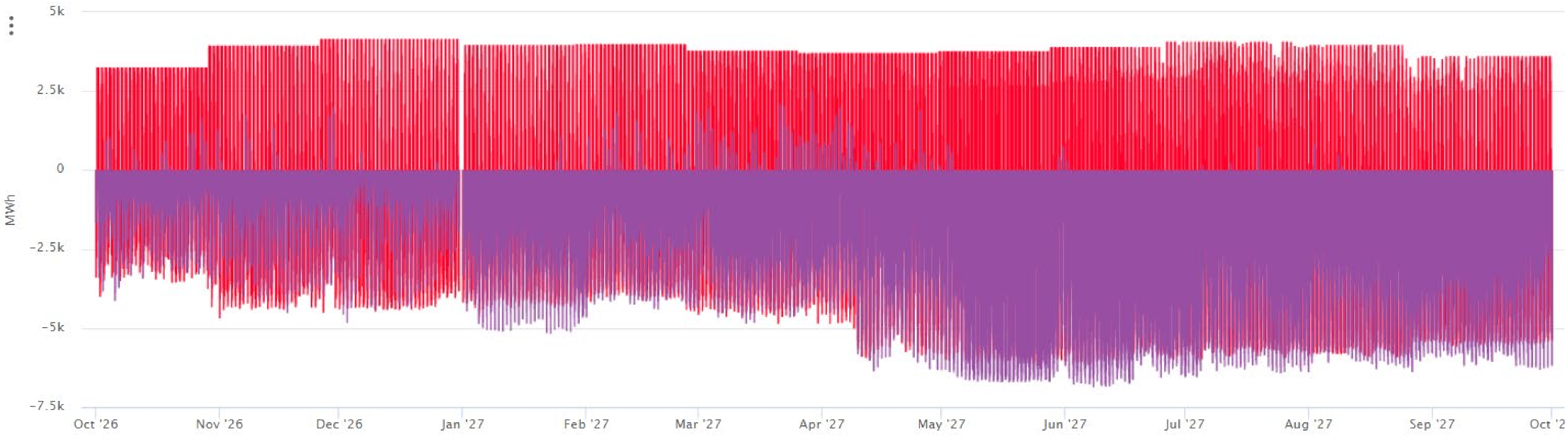
California Import/Export:
Limited Markets comparison to RS Ref



Reduced summer, winter and spring imports

Positive = PNW import from California | Negative = PNW export to California

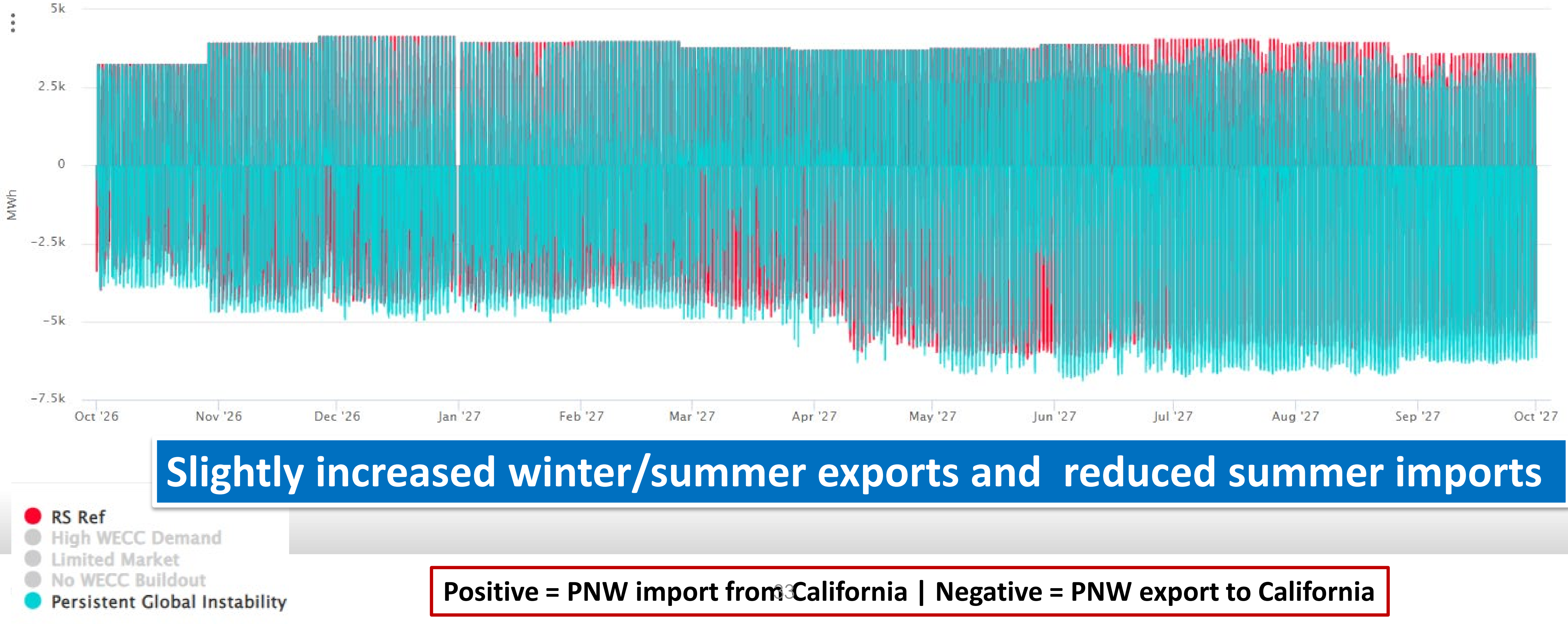
California Import/Export: No WECC Buildout comparison to RS Ref



Almost no imports from CA without a WECC Buildout

Positive = PNW import from California | Negative = PNW export to California

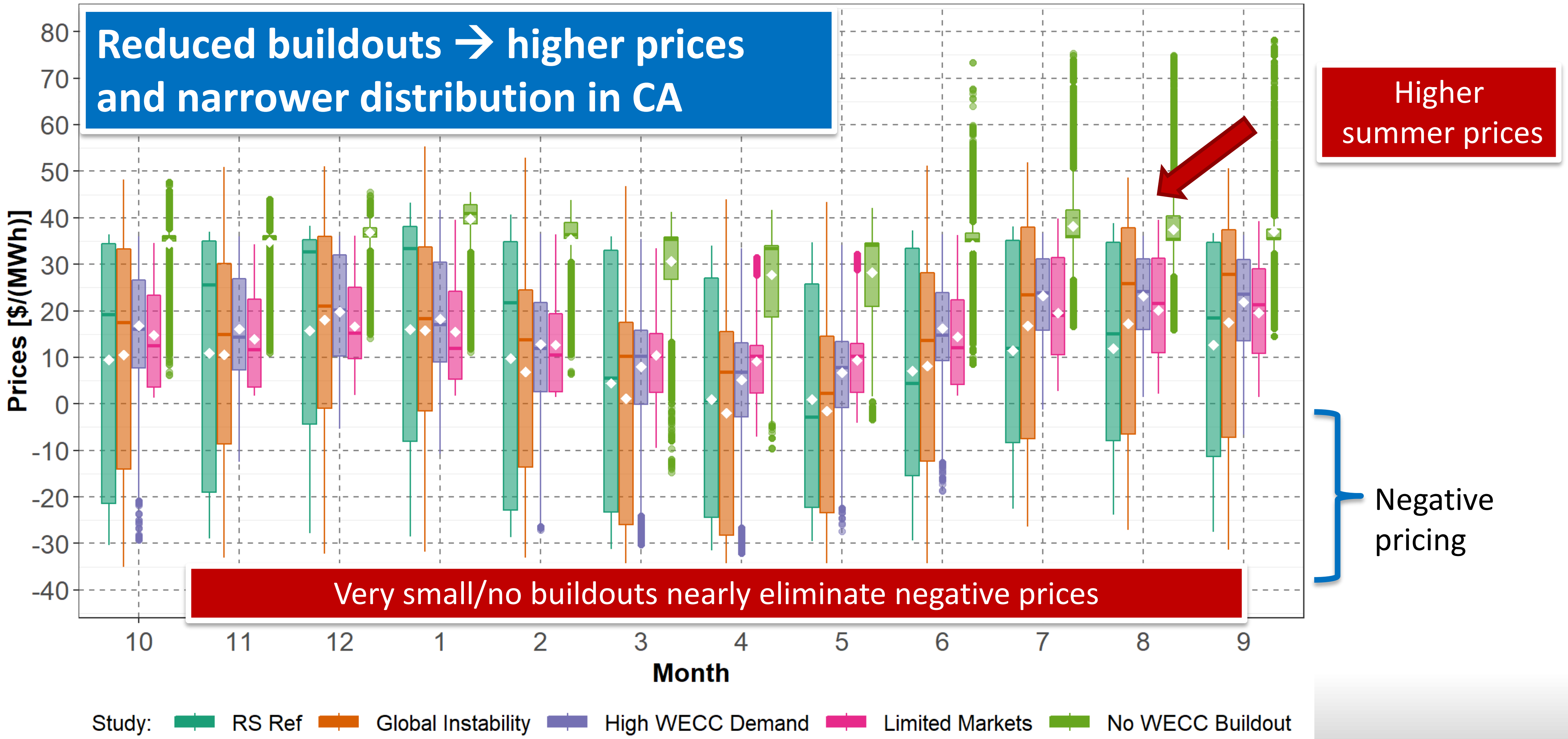
California Import/Export: Persistent Global Instability comparison to RS Ref



Slightly increased winter/summer exports and reduced summer imports

Positive = PNW import from California | Negative = PNW export to California

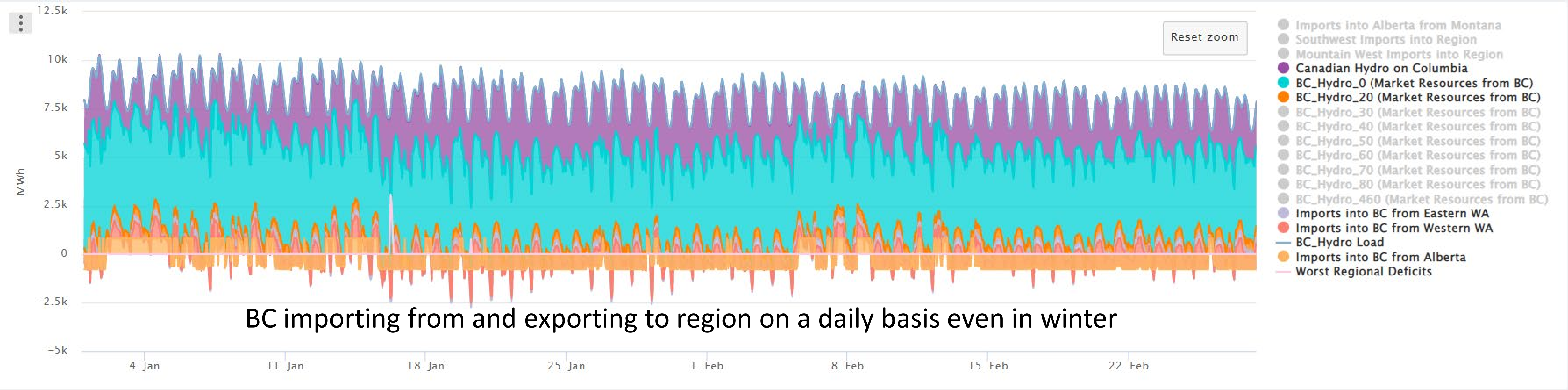
Comparison of California Prices



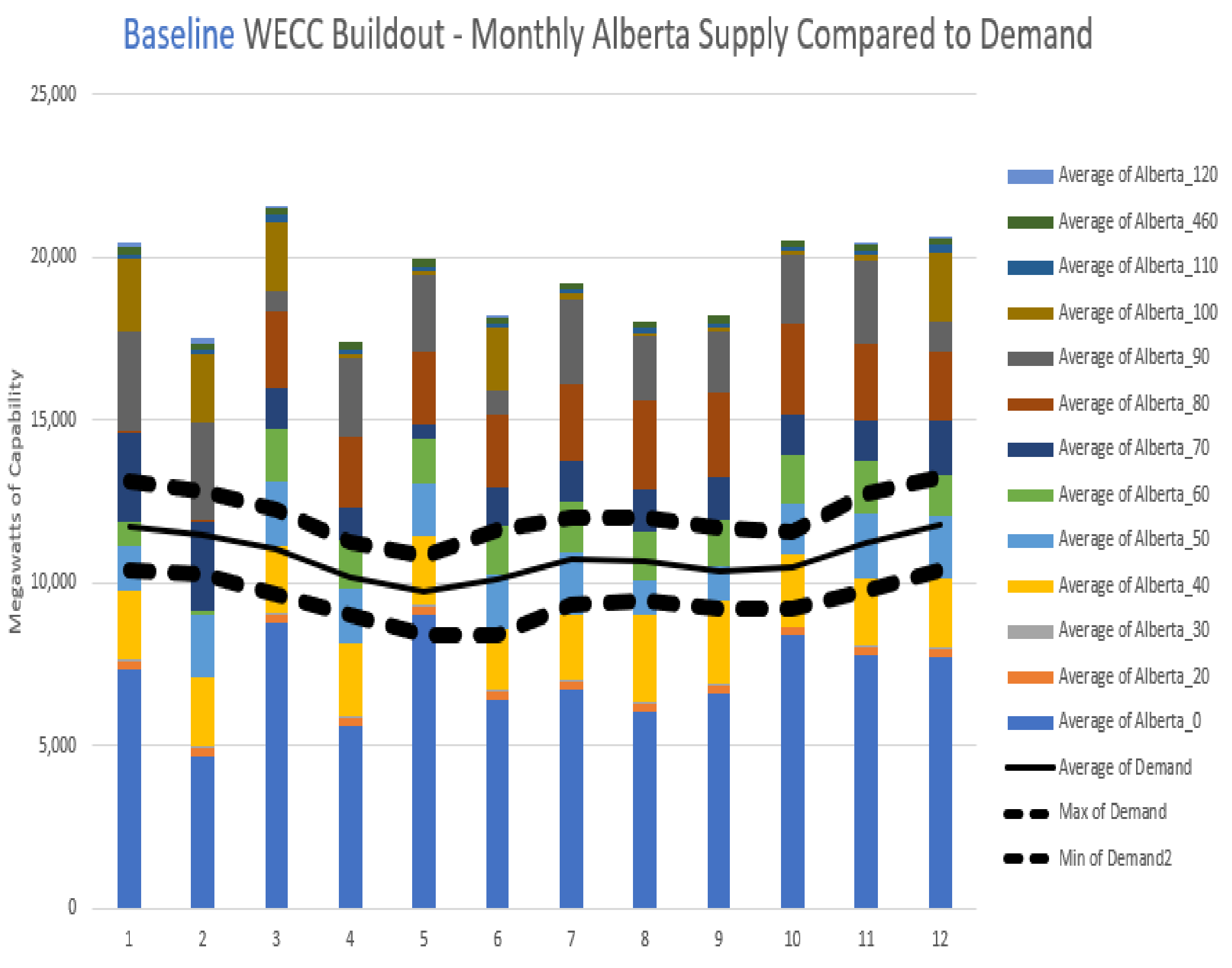
Northwest **Power** and **Conservation** Council

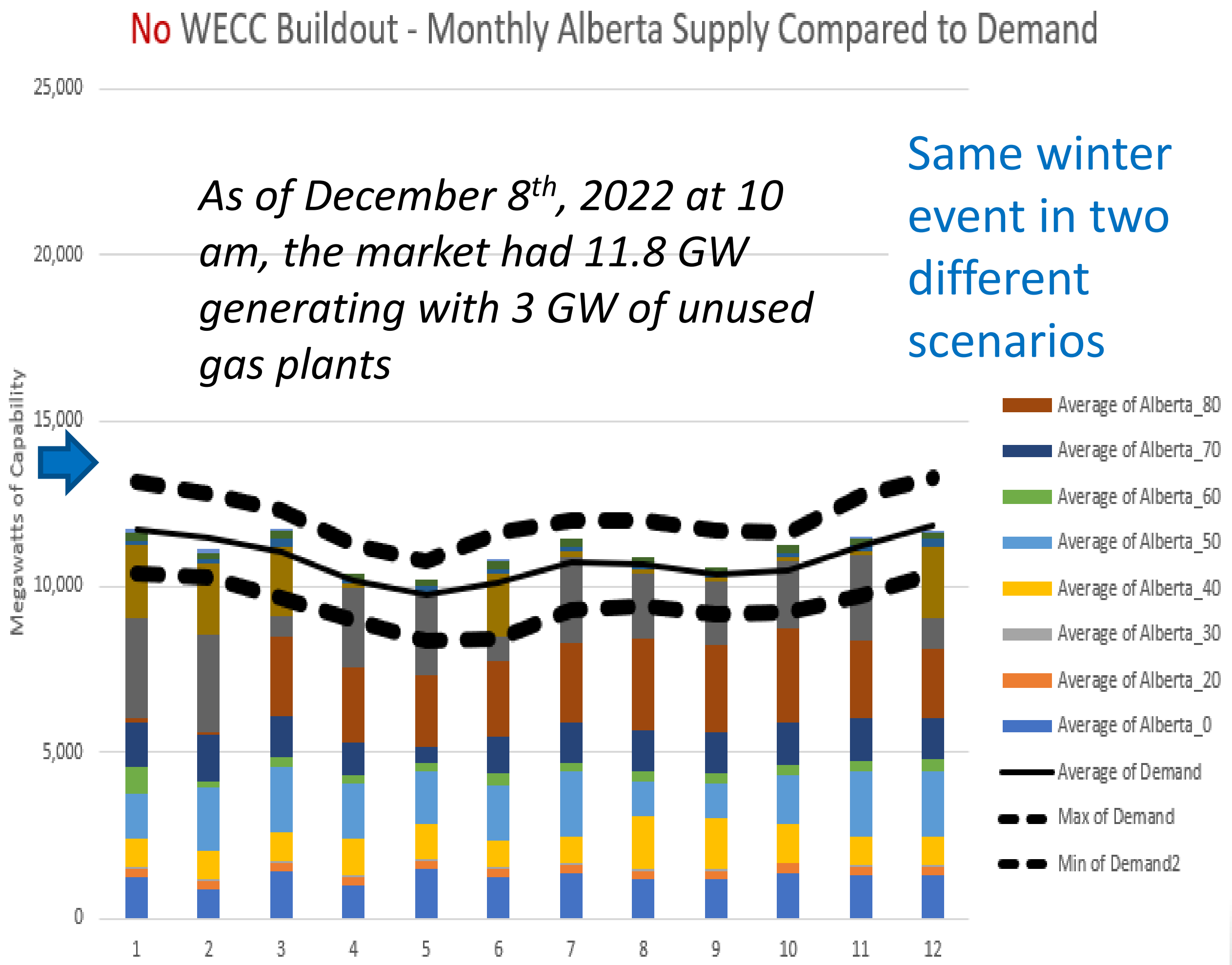
Canadian Imports Mostly Flow Through BC

- While most of our Canadian imports come from BC, they import from and export to the region, through the region (import from and export to the SW) and Alberta.



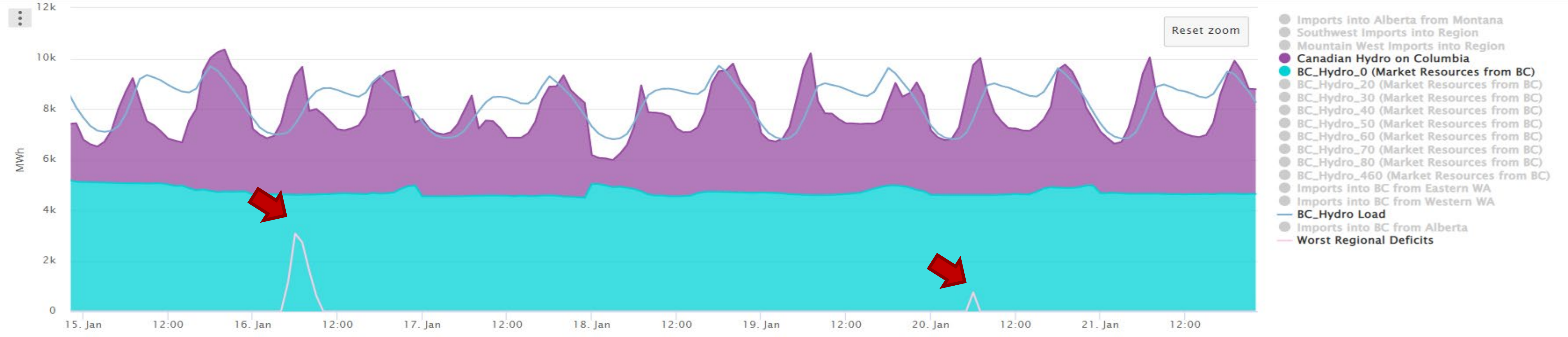
Note on Canadian imports: Alberta relies on imports from BC and region for adequacy and economics in the recent past, but this has already changed to primarily economic exchanges.

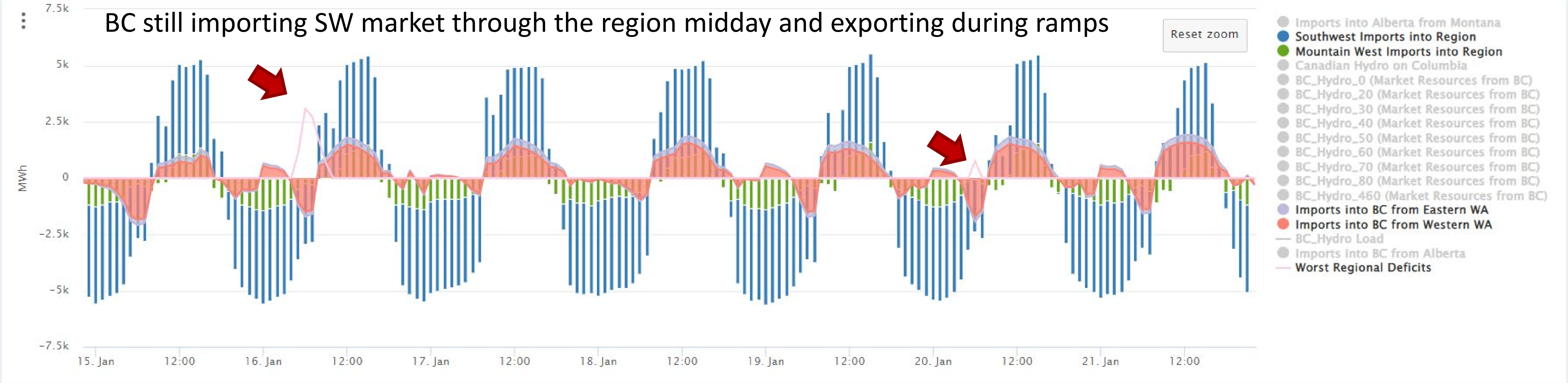




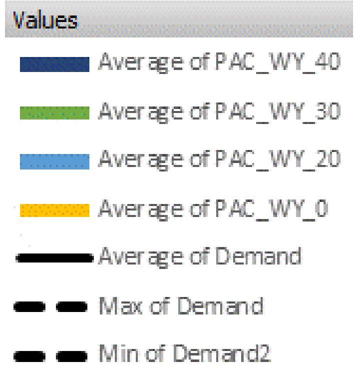
Same winter event in two different scenarios

How Much Should We Rely on Canadian Imports During or Near Adequacy Events?

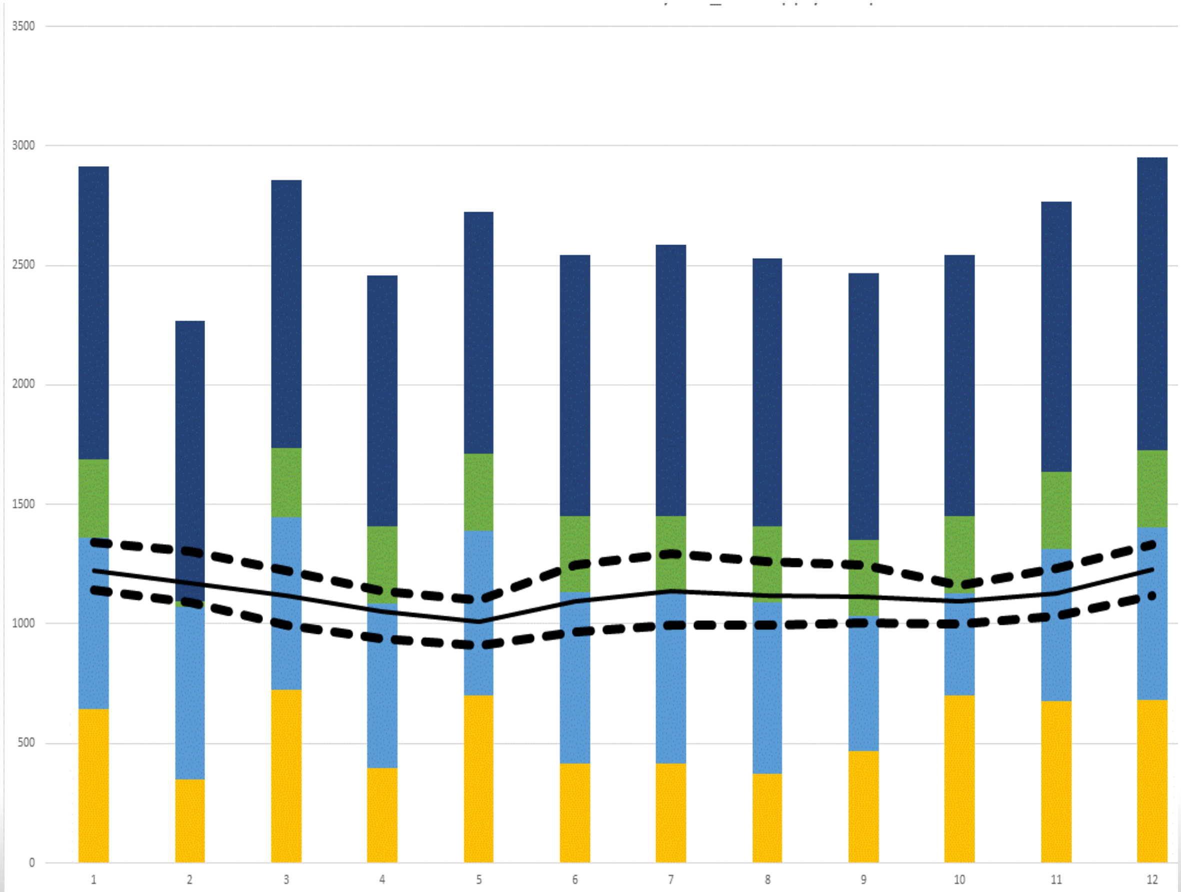




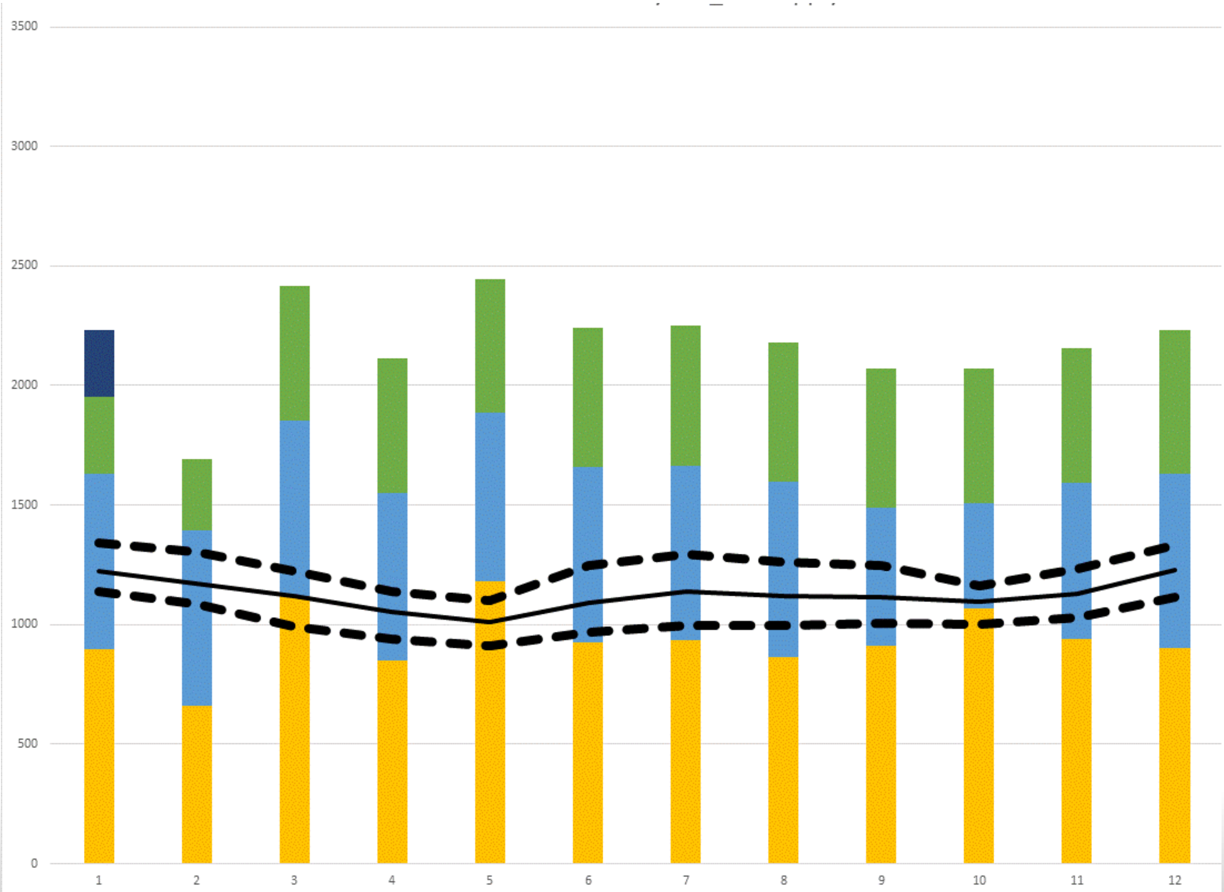
Mountain West Supply-Demand Comparison: PAC Wyoming



Baseline WECC Buildout

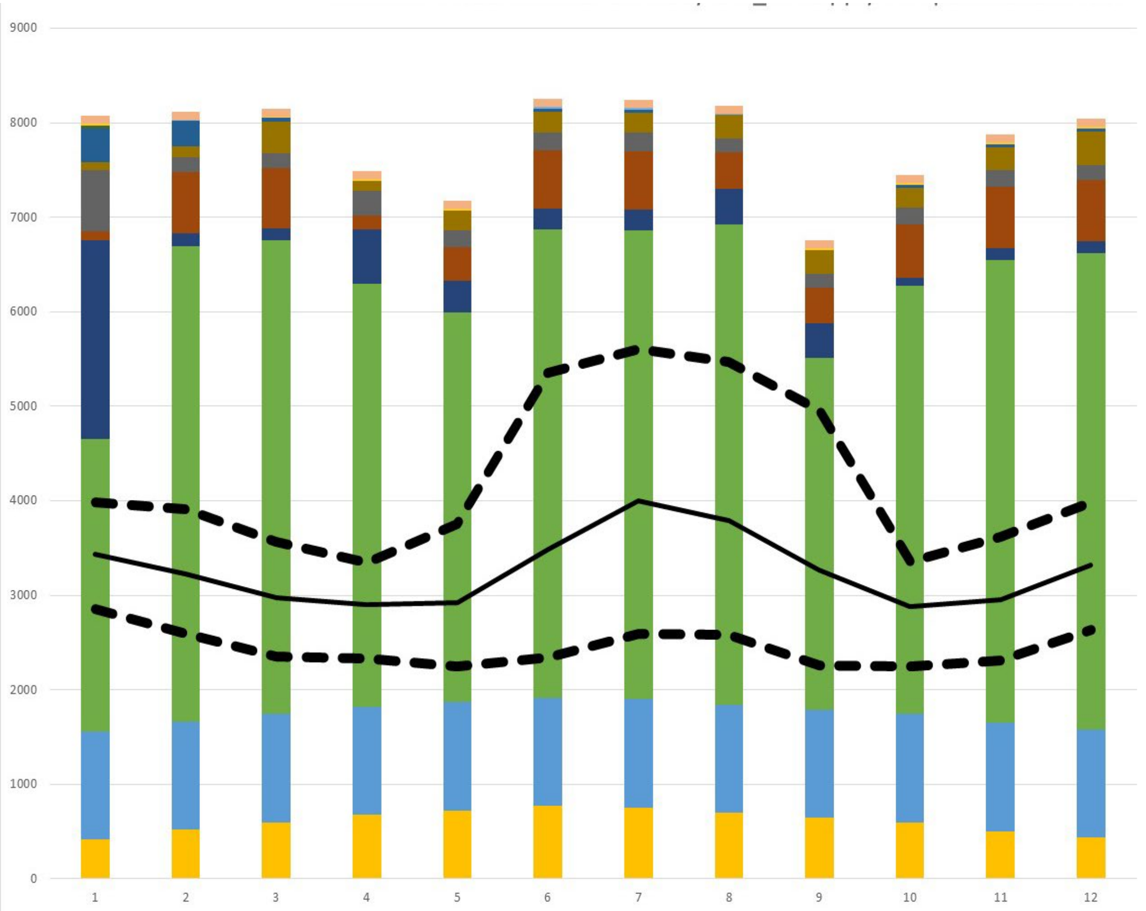


No WECC Buildout

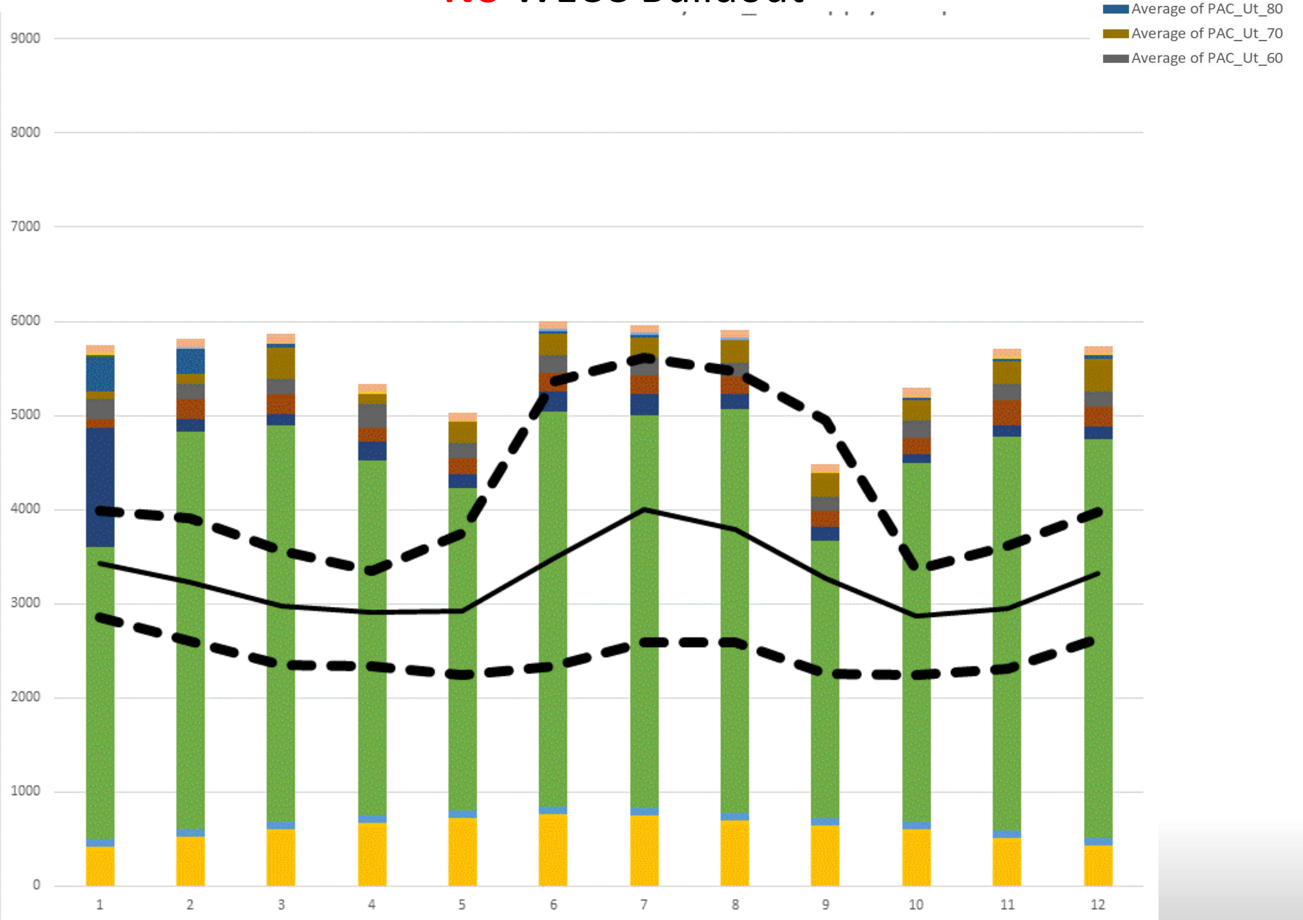


Mountain West Supply-Demand Comparison: PAC Utah

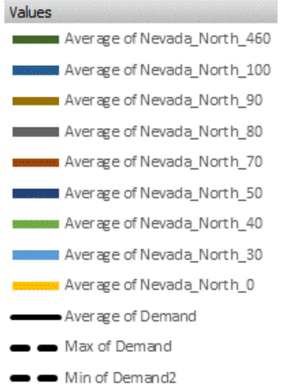
Baseline WECC Buildout



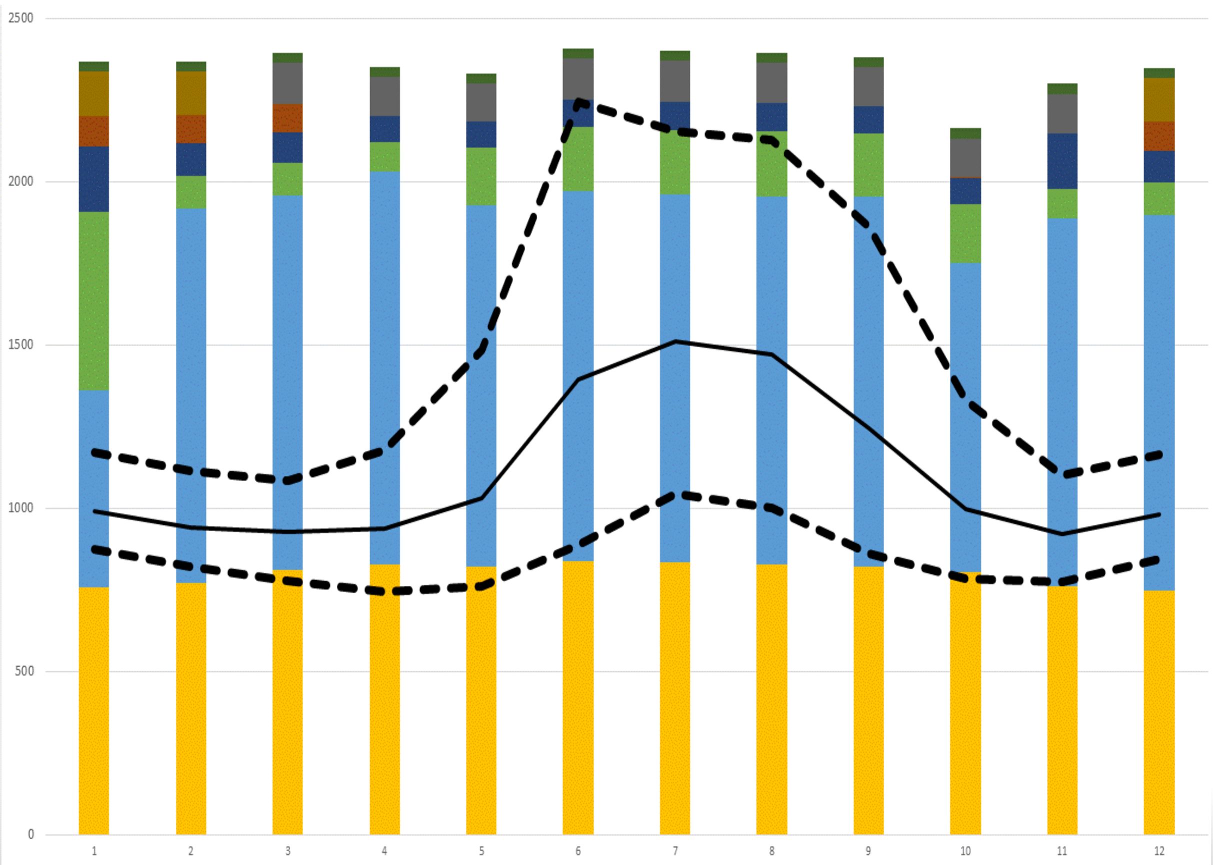
No WECC Buildout



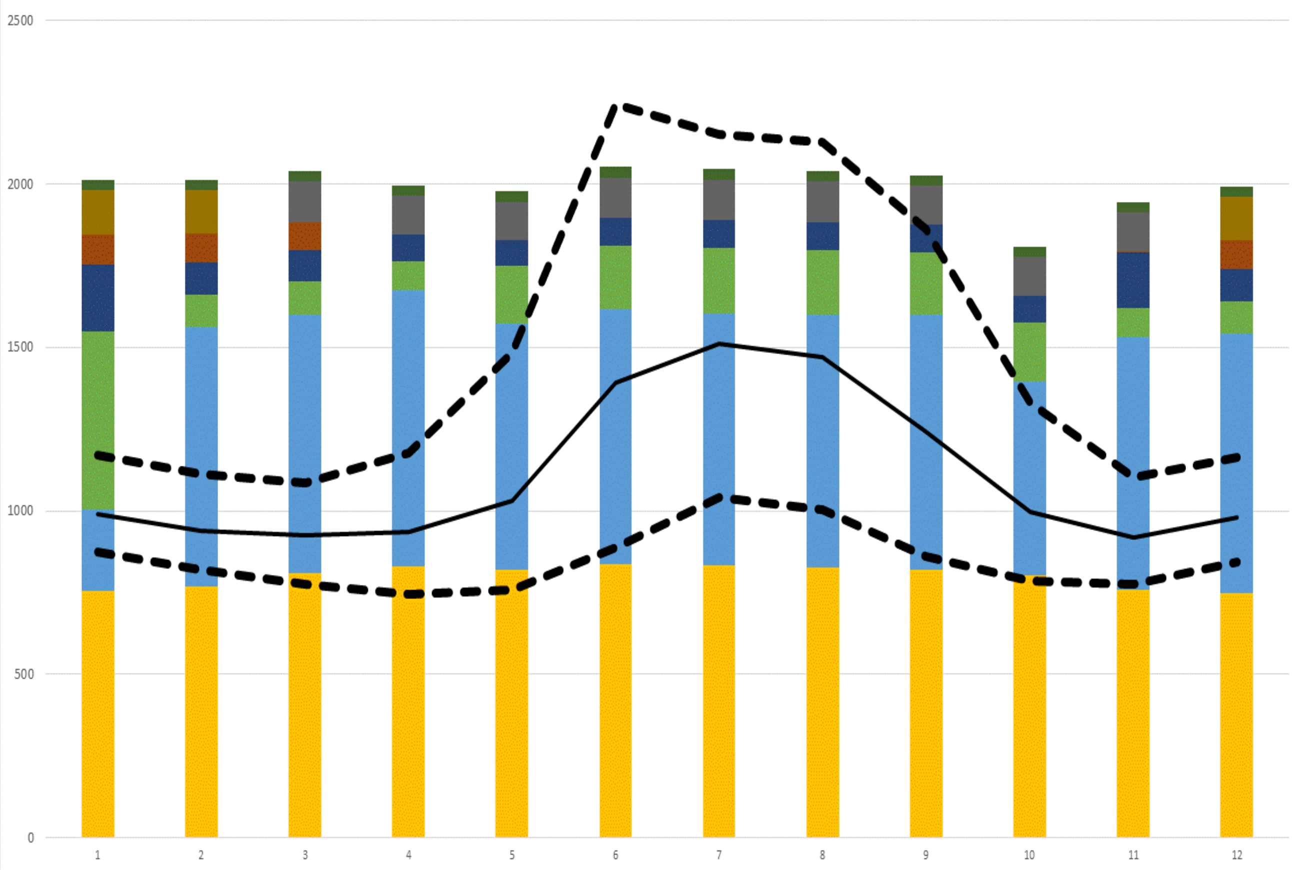
Mountain West Supply-Demand Comparison: Nevada North



Baseline WECC Buildout



No WECC Buildout



Northwest **Power** and **Conservation** Council

Proposed Adequacy Assessment Next Steps

Throughout December, staff will continue to review modeling results to inform potential conclusions for assessment

→

Based on additional review and today's feedback, staff will develop a draft executive summary with the findings

→

Staff aim to send this to members well before the January meeting to allow time for additional member input

→

Staff will bring a proposed final executive summary to the Power Committee in January, with goal of being ready for full Council consideration at the same meeting

December | **January**

Next Steps Post Adequacy Assessment : *Implementing the New Standard*

Setting Adequacy Limits

- Metrics for the proposed standard can be accepted, with binding limits for those metrics to be set after the GENESYS model review and further stakeholder feedback.
- Adequacy limits should be updated whenever appropriate.

Evaluation Period

- The standard can be amended if any metric is consistently found to be inconsequential.
- Reporting all metrics, whether part of the standard or not, provides valuable information.

Comparison to Other Standards

- Resulting planning reserve margins (PRMs) from adequacy standards with different metrics can be compared directly but only if a common methodology is used to calculate the PRM and to calculate effective resource capacity (e.g., ELCC).
- The proposed standard can be compared directly to other standards by calculating the values for adequacy metrics in those standards.

Next Steps Post Adequacy Assessment : *Model / Data Enhancements*

- Fine-tune treatment of forecast error and reserves
- Improving transmission representation
  - Understanding transmission reserves
  - Enabling hourly transmission maintenance input data
- Stochastic outages
  - Thermal (challenge of model convergence)
  - Transmission
- Model WECC-wide resources in detail (run-time permitting)
- Better tune hydro constraints for each climate change data set

Questions

- John Fazio, jfazio@nwcouncil.org
- John Ollis, jollis@nwcouncil.org
- Dor Hirsh Bar Gai, dhirshbargai@nwcouncil.org
- Dan Hua, dhua@nwcouncil.org

Additional Slides

Market Stress Comparison

- High WECC Demand and Early Coal Retirement posed greatest max shortfall
- Limited Markets further stressed in later morning ramp hours than No WECC Buildout and Persistent Global Instability

High WECC Demand

Month	Hour in Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1320	855	1427	896	1004	1361	5412	6261	5031	5666	3716	316	0	0	0	0	0	836	3159	2746	2375	1729	559	0
2	0	0	0	0	0	243	2997	6365	4721	3915	1183	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	912	0	0	0	0	0	0	0	0	0	0	179	1689	0	0	0	0
12	0	0	0	0	0	0	0	1487	748	0	0	0	0	0	0	0	213	2801	1033	0	0	0	0	0

Early Coal Retirement

Month	Hour in Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	0	0	0	0	0	2309	4285	4060	2921	2082	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1880	2208	2508	1161	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	199	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	479	673	0	0	0	0	0	0	0	0	1318	0	0	0	0	0	0	0
12	0	0	0	0	0	0	537	0	118	0	0	0	0	0	0	367	3342	3613	678	0	0	0	0	221

Max shortfalls in MW

High WECC Demand vs Early Coal Retirement

Limited Markets

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Hour in Month																							
1	0	0	0	0	0	1999	3899	3523	2573	1438	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	643	1903	1942	372	355	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	157	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	777	712	186	0	0	0	0	0	0	0	1957	2198	0	0	0	0	0	0

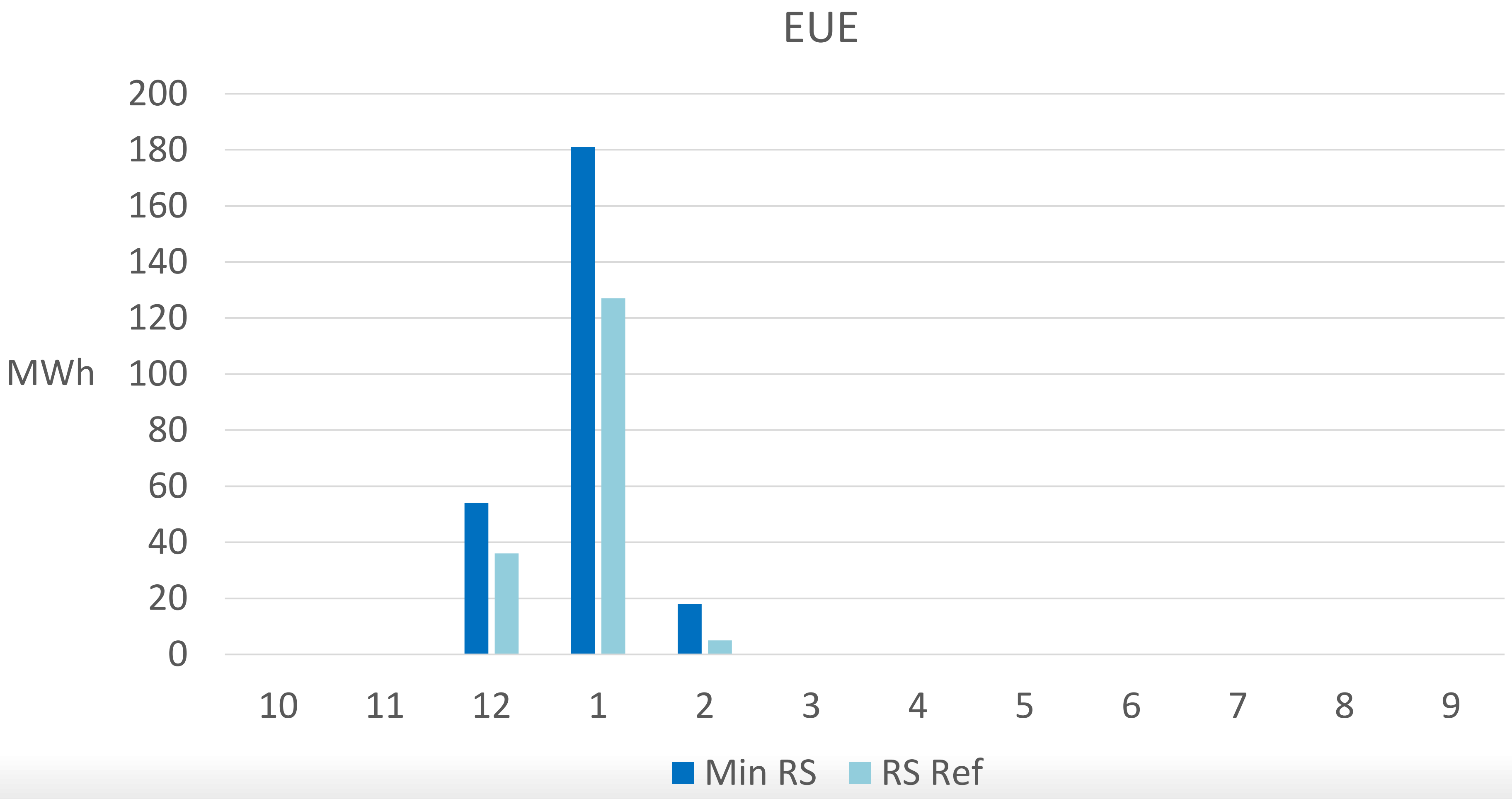
No WECC Buildout

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Hour in Month																							
1	0	0	0	0	0	1824	3748	2119	1713	1869	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	1087	1596	1880	393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	119	0	0	0	0	0	0	0	0	0	1940	2174	0	0	0	0	0	0

Persistent Global Instability

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Hour in Month																							
1	0	0	0	0	0	1254	3084	2685	2530	1981	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	913	954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	79	60	251	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	682	372	0	0	0	0	0	0	0	0	1932	2169	0	0	0	0	0	0

Comparison of RS Ref and Min RS



Limited Markets

- Removed planning reserve margins
  - Implemented by setting operating pool planning reserve margins to -99 in AURORA
  - All other inputs the same as the baseline

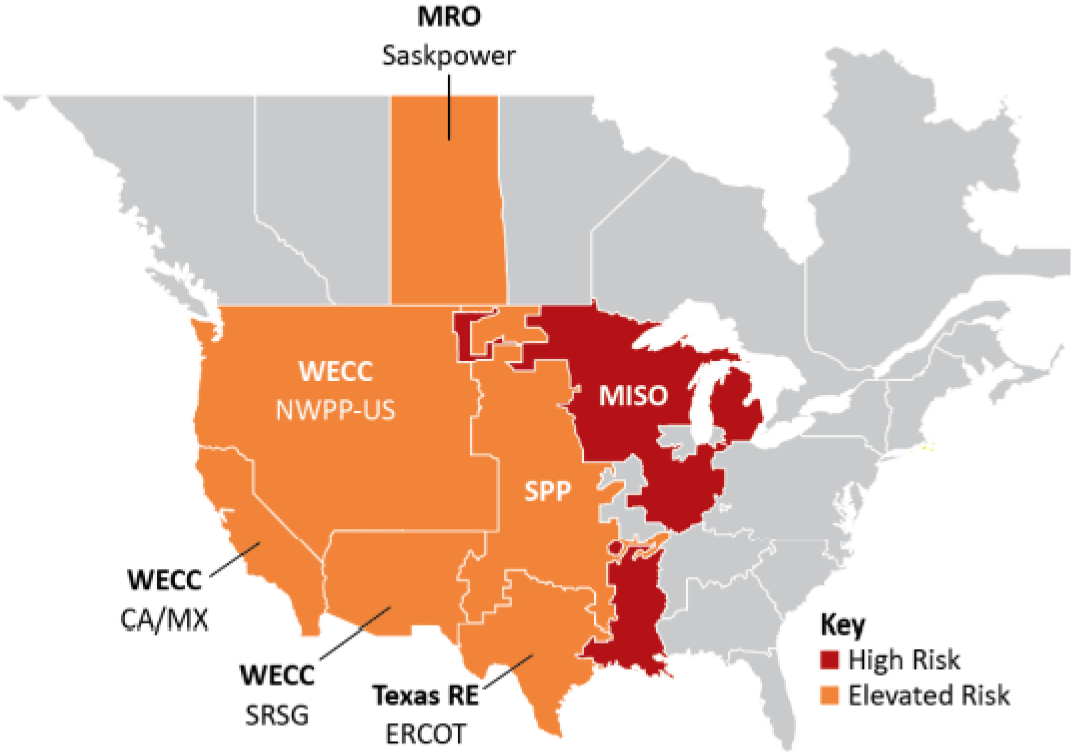


Figure 1: Summer Reliability Risk Area Summary

High WECC Demand

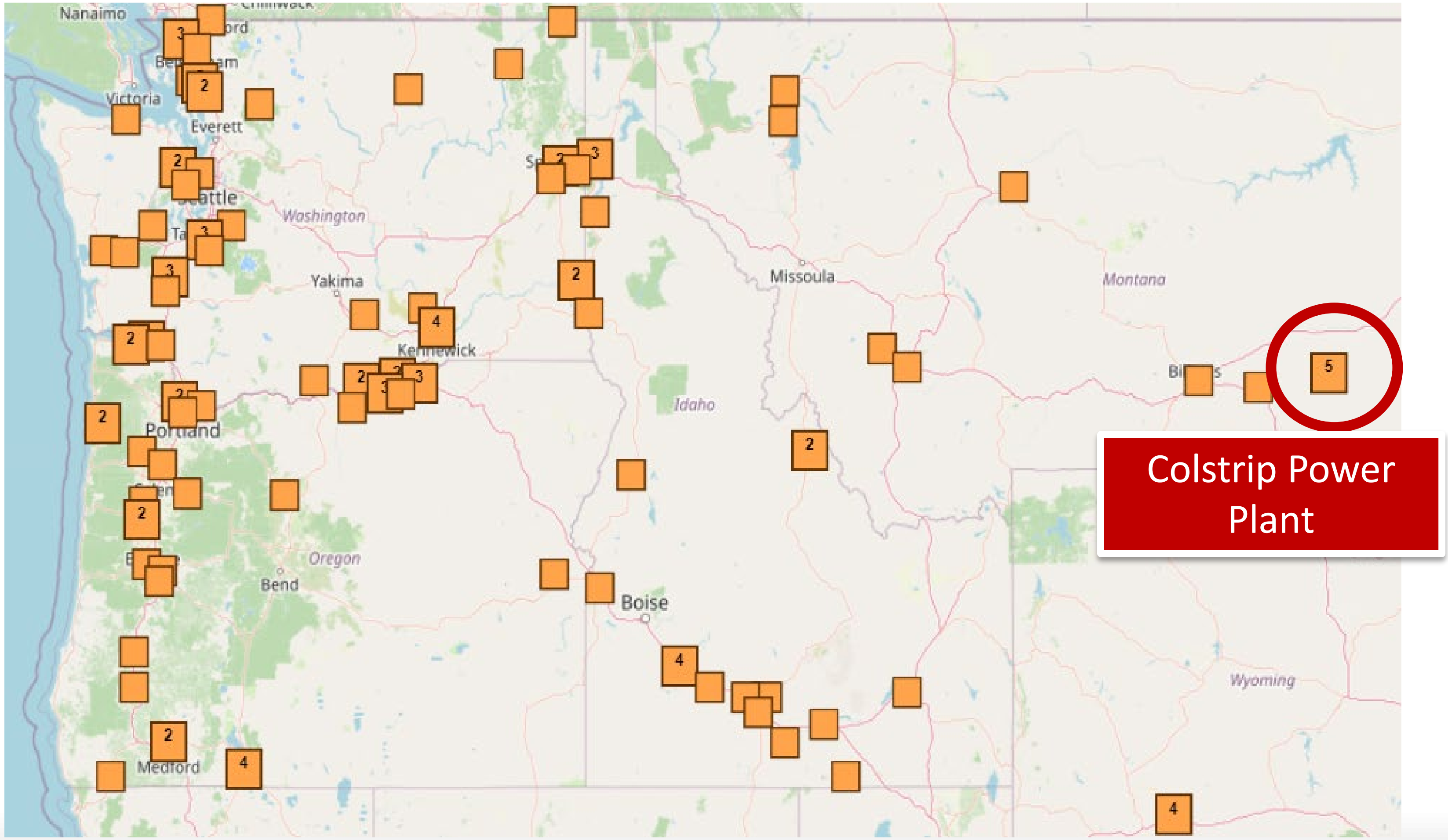
- High electrification Pacific NW, California, BC and Alberta
  - High demand only in those areas, baseline forecast elsewhere
- All other inputs the same as the baseline, except updating policy targets (in MWhs)

Persistent Global Instability

- Higher fuel costs and delayed renewable deployment.
  - Implemented by changing maximum annual new additions on short duration storage, solar and wind generation until 2030.
  - Other resource ramps unchanged due to online date or previous restrictions
  - All other inputs the same as the baseline

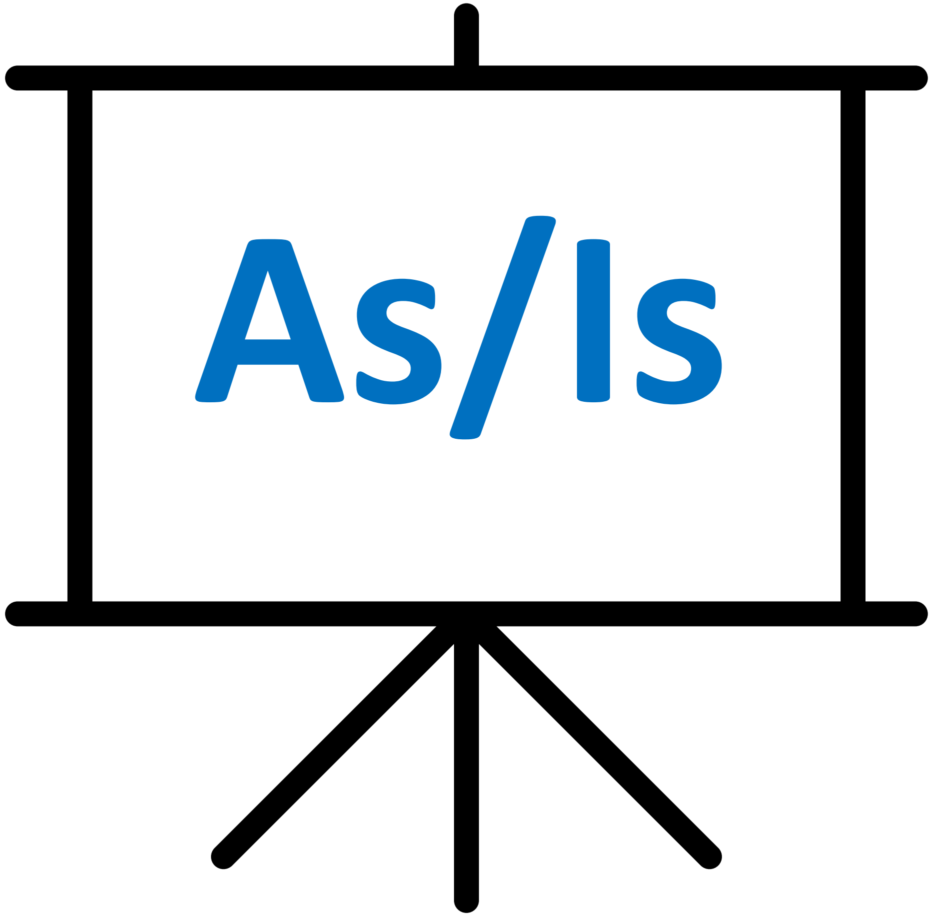
Early Coal Retirement

- Removal of Colstrip 3 and 4 from the adequacy analysis



No WECC Buildout

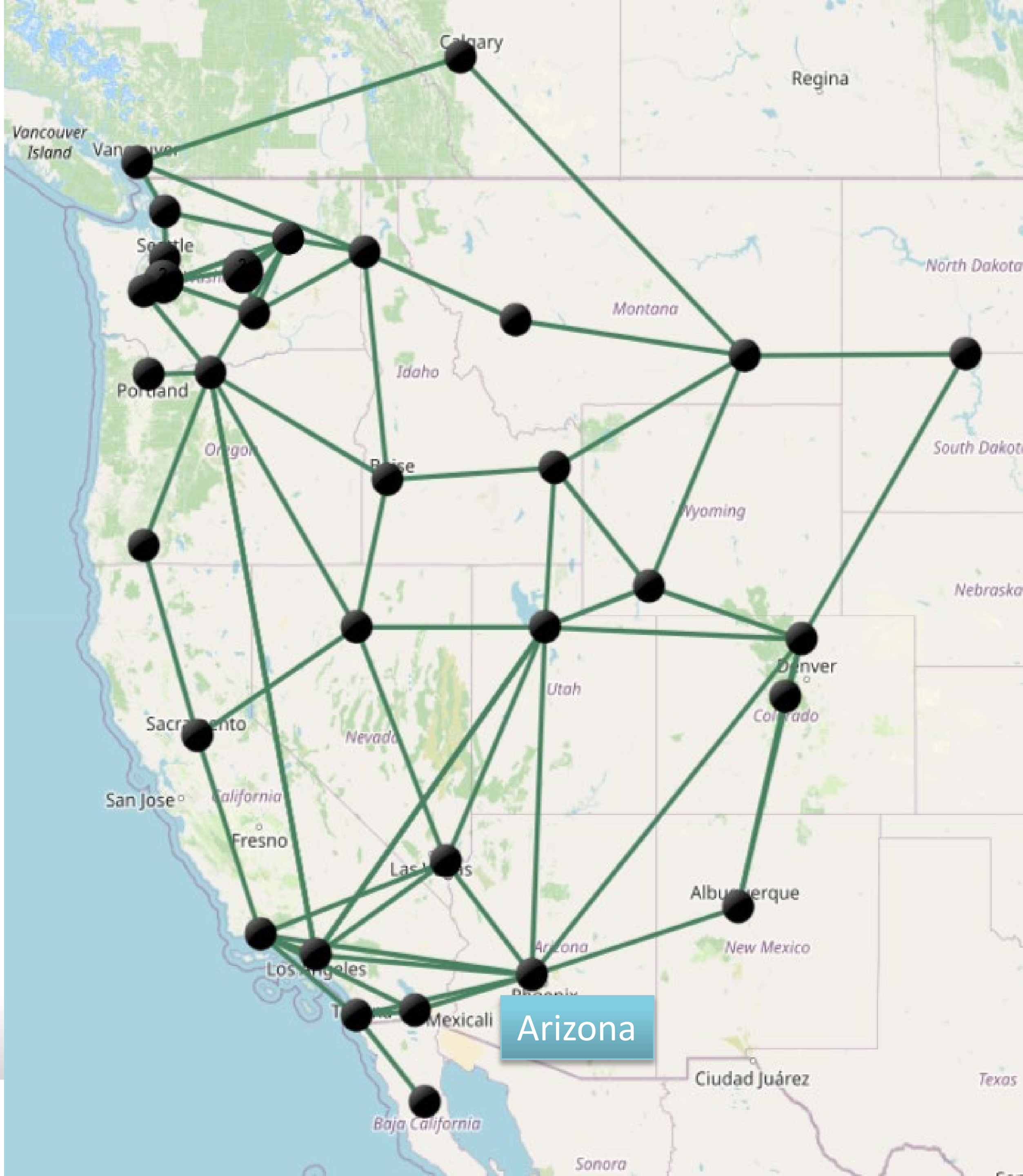
- Only existing resources across the WECC, except the NW
- Reference resource strategy included for the PNW



Pipeline Freeze-off

i. Loss of 5,000 MW natural gas from Arizona

ii. November – February

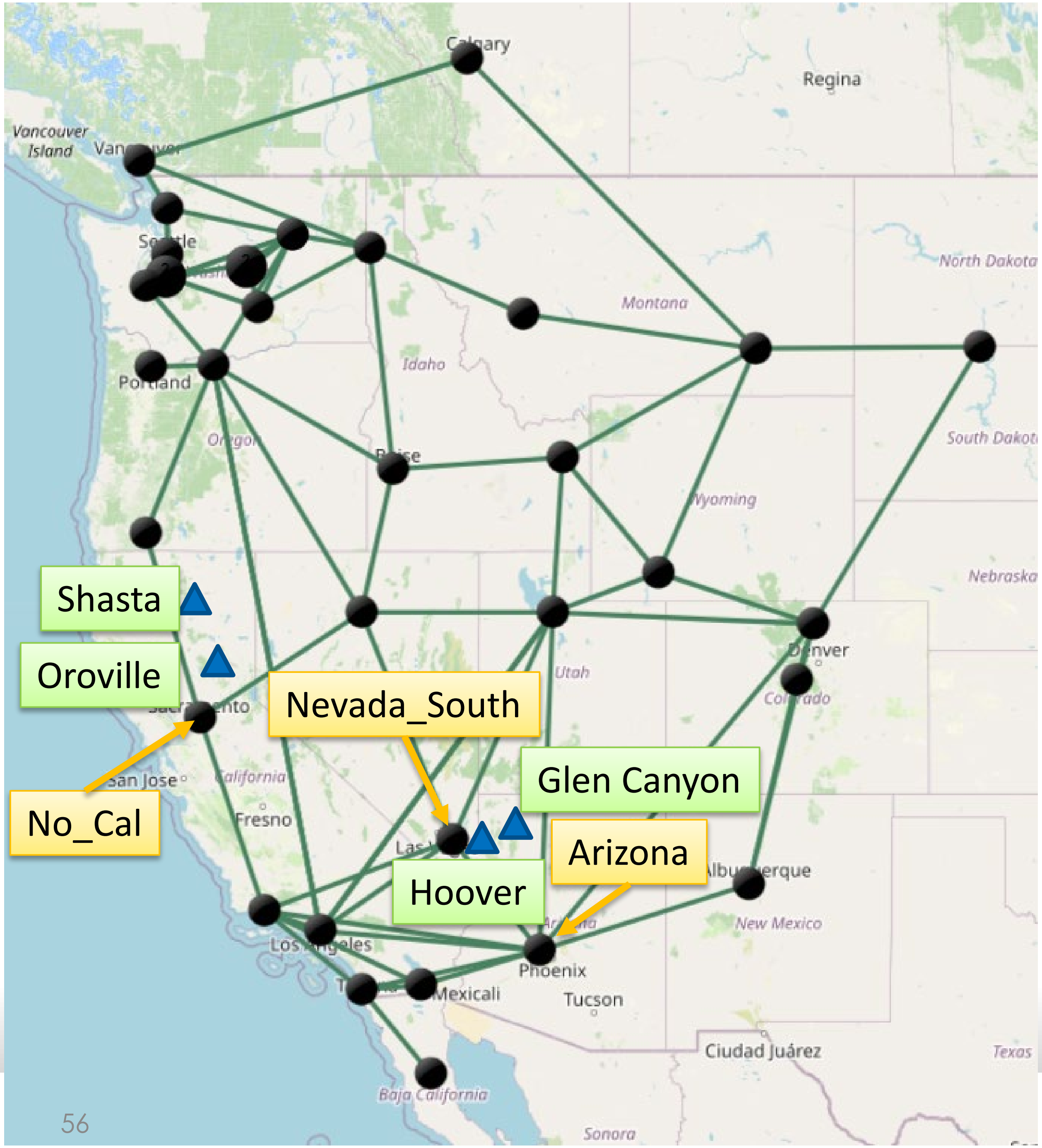


Northwest Power and Conservation Council

SW Drought

i. Glen Canyon – 1,312 MW
   i. Removal of **923** MW (Arizona)
ii. Hoover – 2,078 MW
   i. Removal of **730** MW (Arizona)
   ii. Removal of **316** MW (Nevada South)
iii. Lake Oroville – 645 MW
   i. Removal of **542** MW (No_Cal)
iv. Lake Shasta – 714 MW
   i. Removal of **315** MW (No_Cal)

Removal of 2,826 MW SW hydro



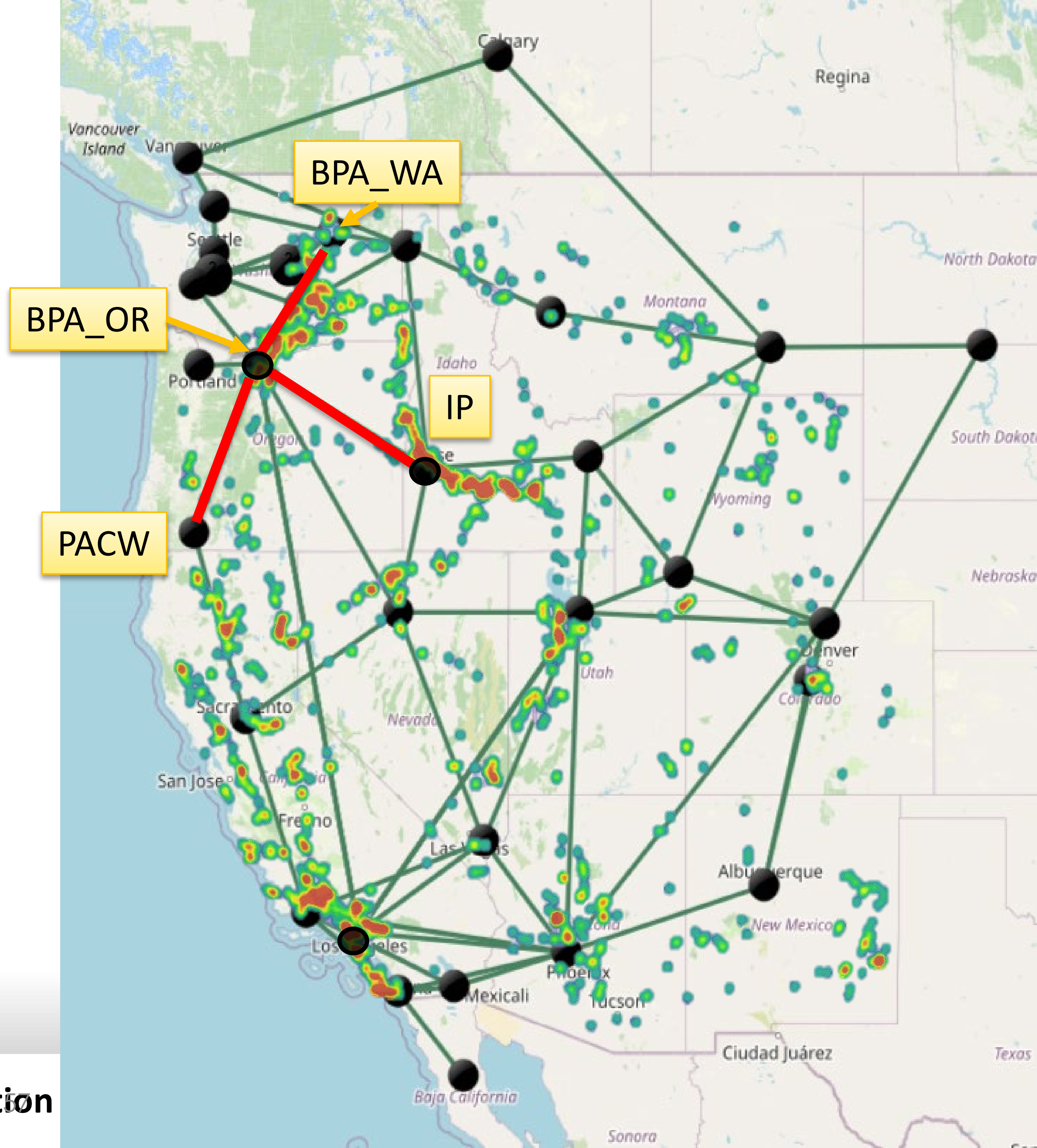
Wildfire

i. BPA_OR <-> PACW: **5,800 MW**
   i. 11_71

ii. BPA_OR <-> IP: **2,000 MW**
   i. 11_161

iii. BPA_OR <-> BPA_WA: **7,500 MW**
   i. 11_21

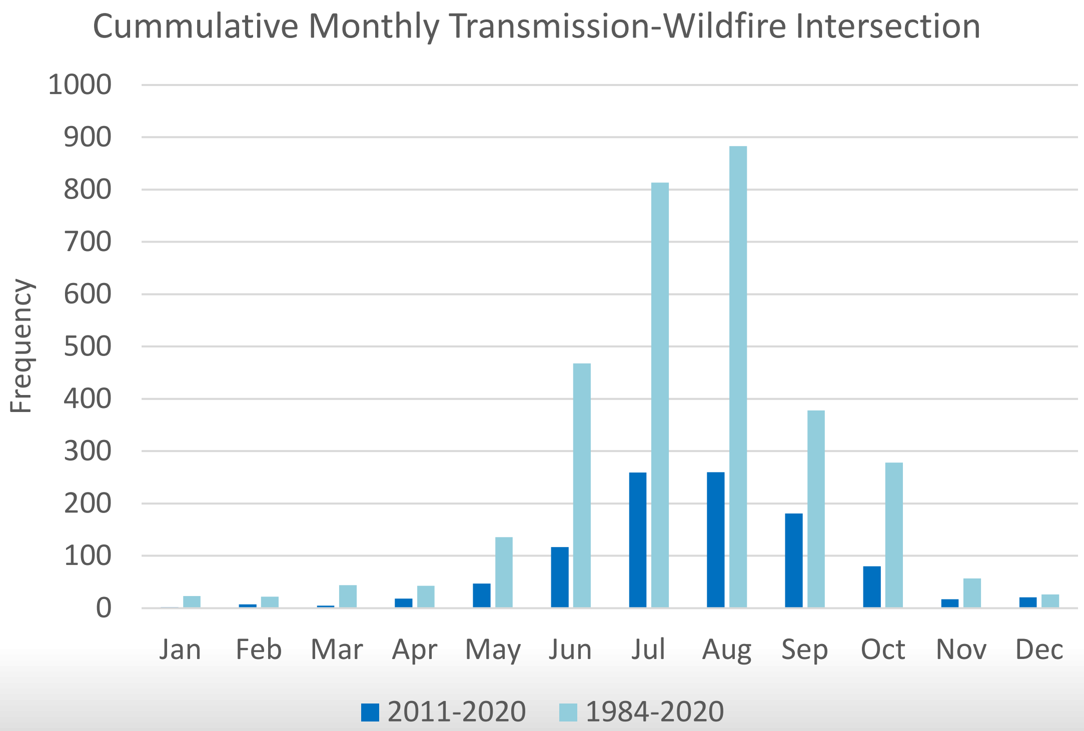
iv. Wildfire dates:
   i. July 16-23
   ii. Derating:
      i. 50-90% of lines

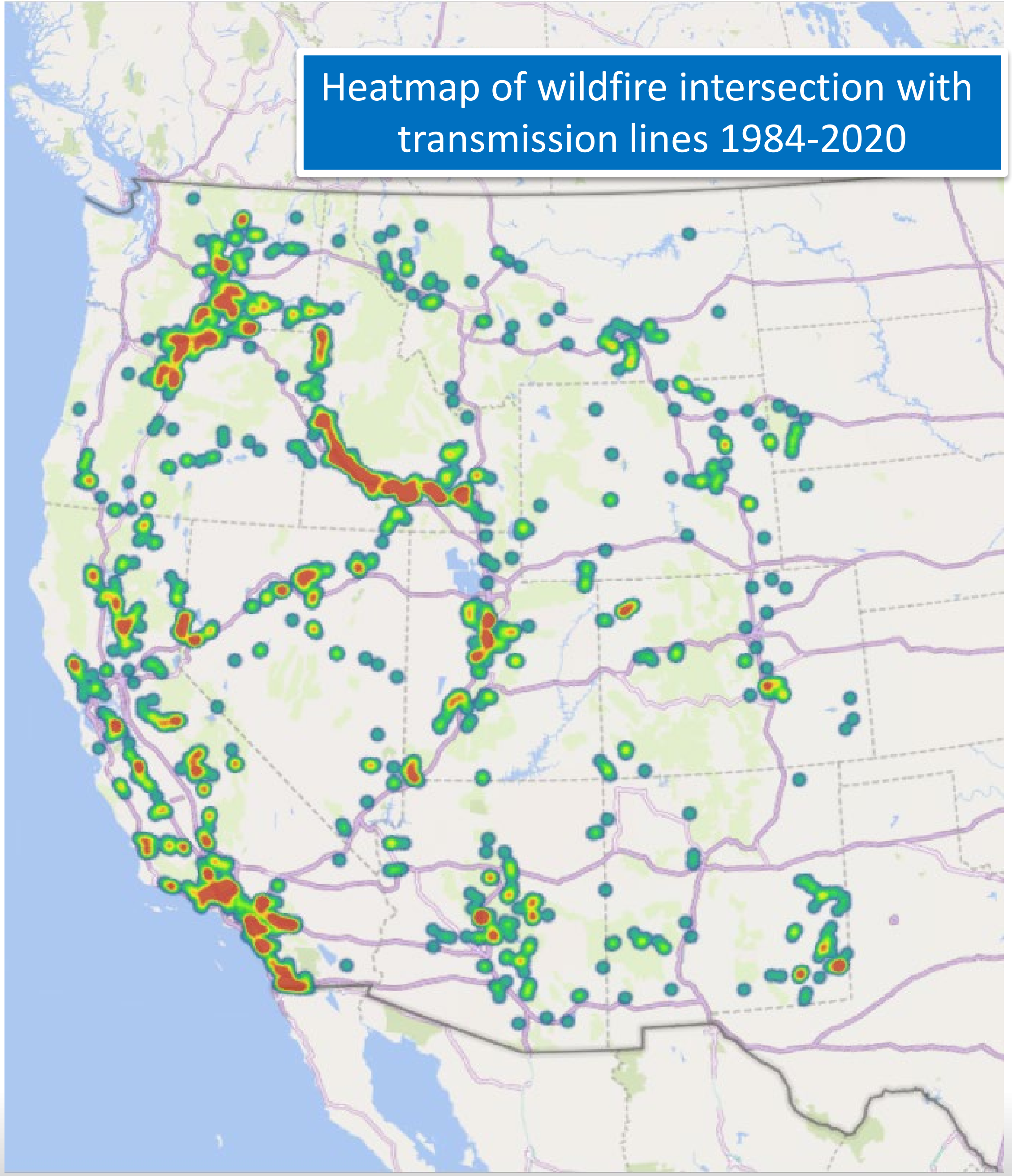


See next slide for additional information

Wildfire Risk for Transmission

i. Historic Wildfire-transmission intersections
   i. 1984-2020





Northwest **Power** and **Conservation** Council

July and August highest prevalence for wildfires incidents

Caveat on PNW Wildfire scenario

- Model improvement needed for fine-tuned representation
- Enhanced of assumptions (outage duration)
- Development of wildfire profiles for stochastic analysis