MEMORANDUM

TO: Council Members

FROM: Dor Hirsh Bar Gai, Power System Analyst

SUBJECT: 2029 Adequacy Assessment Final Results

BACKGROUND:

Presenters: Dor Hirsh Bar Gai, John Ollis

Summary: Staff will present the final resource adequacy assessment results for the 2029 operating year using the Council’s multi-metric adequacy approach.

The 2029 assessment indicates that keeping on track with the implementation of the 2021 Power Plan resource strategy – including acquiring the high end of the cost-effective energy efficiency target, acquiring at least 6,600 MW of renewables, and holding 6,000 MW of balancing up reserves – alongside system changes in the region of announced non-retirements of thermal plants and expanded transmission capability, will result in an adequate power supply in 2029, despite forecasted load growth from transportation electrification and data centers.

However, areas of risk remain. Pursuing the same resource strategy, but only acquiring the low end of cost-effective energy efficiency target, would not provide for an adequate system. Furthermore, if data center load growth will be in the higher range of the forecast, the region will have insufficient resources to maintain adequacy – signaling the importance of analyzing such futures in the next Power Plan.
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 multi-metric adequacy approach to categorize the risk of frequency, duration, and magnitude of events that is currently under evaluation by the Council since 2022 and approved in 2023, evolving past the resource adequacy standard of Loss of Load Probability (LOLP) metric used since 2011.

Workplan: A.2.4 Conduct the regional Adequacy Assessment and prepare report detailing the analysis and findings.

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 hydro, 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.

In January 2023 the Council approved a transition towards a multi-metric adequacy approach with the completion of the 2027 Adequacy Assessment to 1) prevent overly frequent use of emergency measures, (2) limit the risk of long duration shortfall events, (3) limit the risk of big capacity shortfalls, and (4) limit the risk of big energy shortfalls. Frequency, duration, and magnitude metrics are used in combination of expected and tail-end event statistics, known as value at risk (VaR).
2029 Adequacy Assessment: Final Results

July 9, 2024 Council Meeting

Dor Hirsh Bar Gai
John Ollis

Agenda

- Background
- Assessment Setup
- Results
- Executive Summary
What Are Adequacy Assessments?

Testing Plan strategy on bulk power system...

Purpose of presentation:
Asking for a head nod to Council agreement on key takeaways for executive summary

over potential risk scenarios to signal...

system adequacy

Transmission level

Distribution level
Adequacy Approach

- Adequacy studies simulate the NW power system to meet NW load
- In each simulation, representing one year, a simulated model shortfall event occurs over a time period when load cannot be served by resources in the model
- However, 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

What are Emergency Measures?

- **Within utility control (“Type I”)**
  - 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

- **Extraordinary measures (“Type II”)**
  - 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
The Metrics and Thresholds

<table>
<thead>
<tr>
<th>Protection against frequent deficits</th>
<th>Protection against tail-end (extreme) deficits</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOLEV</td>
<td>Duration VaR 97.5</td>
</tr>
<tr>
<td>0.1 in summer</td>
<td>8-hour</td>
</tr>
<tr>
<td>0.1 in winter</td>
<td>1,200 MW</td>
</tr>
<tr>
<td>+ report annual</td>
<td>+ report NVaR</td>
</tr>
<tr>
<td>Peak VaR 97.5</td>
<td>9,600 MW</td>
</tr>
<tr>
<td>Energy VaR 97.5</td>
<td>+ report NVaR</td>
</tr>
</tbody>
</table>

Rephrasing the adequacy perspective:
Let's make sure emergency measures aren't used too often (satisfying LOLEV) and 39-out-of-40 years let's make emergency measures are not used too long or are too big (satisfying duration, peak and energy VaR)

Region & WECC Market Fundamentals

- Out of Region Market Buildout Update

- Adequacy results are informed by market fundamentals (capability and price) per outside the region market resources with buildout from AURORA

- Council uses a market (import) reliance limit in the winter (2,500 MW) and summer (1,250 MW) to limit market exposure risk
Assessment Setup

Scenarios

- Reference
- Higher data center load (in region)
- Alternative Trajectories within Resource Strategies (achieving low range of EE target)
  - In-region gas supply limitations
  - Earlier availability of transmission (reconductoring in region)
  - Delayed availability of transmission and emerging tech in WECC
  - Emission pricing

2029 Assessment Studies

Pushed to 9th Plan
Incremental Load Differences in 2029

<table>
<thead>
<tr>
<th></th>
<th>EE Savings aMW</th>
<th>EV Loads aMW</th>
<th>Data Center Loads aMW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2029 Reference scenario</strong></td>
<td>1,300</td>
<td>1,048</td>
<td>2,386</td>
</tr>
<tr>
<td><strong>2029 Low End EE scenario</strong></td>
<td>1,000</td>
<td>1,048</td>
<td>2,386</td>
</tr>
<tr>
<td><strong>2029 High Data Center scenario</strong></td>
<td>1,300</td>
<td>1,048</td>
<td>3,976</td>
</tr>
</tbody>
</table>

Average Loads by Climate Scenario

- **Higher Data Center**
- **Low End EE**
- **Reference**

Graph showing average loads for different climate scenarios with bars representing different years and load levels.
2021 Power Plan Resource Strategy reminder

**Existing System: Increase Reserves**
To reduce regional needs and support integration of renewables, the region needs to double the assumed reserves. This can most cost-effectively be done through more conservative operation of the existing system (both thermal and hydro units).

**Renewables: At least 3,500 MW by 2027**
Renewables are recommended due to their low costs, interruptibility, and carbon reduction benefits. Long-term build out will impact the transmission system and should be done mindful of the cumulative impacts of the new resources.

**Energy Efficiency: 750-1,000 aMW by 2027**
Significantly less acquisition than prior plan due to being less cost-competitive, a slower build resource, not inherently dispatchable, and sensitive to market prices. Efficiency that supports system flexibility is most valuable.

**Demand Response: Low-Cost Capacity**
Highest value products are those that can be regularly deployed at a low-cost and with minimal to no impact on customer. The Council identified demand voltage regulation and time of use rates as two products, estimating 720 MW of potential.
The 2029 Resource Strategy – the Reference

• Our goal for this assessment was to assume the same trajectory of the strategy used in the reference case for the 2027 Adequacy Assessment

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>2029 Adequacy Assessment</th>
<th>2027 Adequacy Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewables</td>
<td>6,600 MW</td>
<td>5,900 MW</td>
</tr>
<tr>
<td>EE</td>
<td>1,300 aMW</td>
<td>1,000 aMW</td>
</tr>
<tr>
<td>DR</td>
<td>720 MW</td>
<td>720 MW</td>
</tr>
<tr>
<td>Reserves</td>
<td>6,000 MW</td>
<td>6,000 MW</td>
</tr>
</tbody>
</table>

2021 Plan Buildout Trajectories

Not shown here: Early coal retirement, with limits on gas, and the deep decarbonization scenario resulted in the highest builds (~36 GW in 2041)
Other System Changes

Thermal generation
Announced changes to several thermal plants converting to gas units and not retiring (~1,480 MW)
- Valmy 1 & 2 (138.6 & 134 MW)
- Bridger 1 & 2 (~1,200 MW)

Transmission expansion
12,700 MW of added transmission capacity throughout the WECC;
1,000 MW in region (B2H)

Modified hydro operations
Changes to spill operations in Lower Snake and Lower Columbia projects (Resilient Columbia Basin Agreement (RCBA, Appendix B))

New Transmission

<table>
<thead>
<tr>
<th>Planned Transmission</th>
<th>New Capacity (MW)</th>
<th>Path</th>
<th>Online Date</th>
<th>GENESIS Buses</th>
<th>Existing Today (MW)</th>
<th>New 2029 capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ten West Link</td>
<td>3,200</td>
<td>SCE to APS</td>
<td>2024</td>
<td>So_Cal to Arizona</td>
<td>1,400</td>
<td>4,600</td>
</tr>
<tr>
<td>SunZia</td>
<td>3,000</td>
<td>PNM to APS</td>
<td>2026</td>
<td>New Mexico to Arizona</td>
<td>1,700</td>
<td>4,700</td>
</tr>
<tr>
<td>Transwest Express</td>
<td>3,000</td>
<td>WAPA Wyoming to PACE UT</td>
<td>2027</td>
<td>wapa RM to PAC_UT</td>
<td>650</td>
<td>3,650</td>
</tr>
<tr>
<td></td>
<td>1,500</td>
<td>PACE UT to Nev South</td>
<td>2027</td>
<td>PAC_Ut to Nevada South</td>
<td>250</td>
<td>1,750</td>
</tr>
<tr>
<td>SWIP North</td>
<td>1,000</td>
<td>IP to North Nevada</td>
<td>2027</td>
<td>IP to north Nevada</td>
<td>350</td>
<td>1,350</td>
</tr>
<tr>
<td>B2H</td>
<td>1,000</td>
<td>IP to BPA_OR</td>
<td>2026</td>
<td>IP to BPA_OR</td>
<td>2,000</td>
<td>3,000</td>
</tr>
</tbody>
</table>
Out-of-Region Market Update Observations

Forecasted out-of-region market availability has been updated, including updates to out of region market loads, resources and policy implementation.

A few notes:

1. Despite the market resource availability assessment not being final, it is sufficient for an adequacy assessment.

2. More storage than energy resources added in early years.

3. Some coal to gas plant conversions seems to be deferring the need for additional on-call fuel resources (like new gas plants) to maintain planning reserve margins.

Assessment Results
## Final Results

<table>
<thead>
<tr>
<th>Metric</th>
<th>Threshold</th>
<th>Reference</th>
<th>High Data Center</th>
<th>Low End EE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter LOLEV</td>
<td>0.1</td>
<td>0.022</td>
<td>1.294</td>
<td>0.350</td>
</tr>
<tr>
<td>Summer LOLEV</td>
<td>0.1</td>
<td>0.017</td>
<td>0.3</td>
<td>0.033</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration VaR 97.5</td>
<td>8 hours</td>
<td>0</td>
<td>20.6</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Magnitude</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak VaR 97.5</td>
<td>1,200 MW</td>
<td>0</td>
<td>3,076</td>
<td>1,567</td>
</tr>
<tr>
<td>Energy VaR 97.5</td>
<td>9,600 MWh</td>
<td>0</td>
<td>196,324</td>
<td>4,196</td>
</tr>
<tr>
<td><strong>Reported metrics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual LOLEV</td>
<td>0.1</td>
<td>0.05</td>
<td>1.644</td>
<td>0.444</td>
</tr>
<tr>
<td>Peak NVaR 97.5</td>
<td>~3%*</td>
<td>0</td>
<td>9%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Energy NVaR 97.5</td>
<td>~0.0052%*</td>
<td>0</td>
<td>0.09%</td>
<td>0.002%</td>
</tr>
</tbody>
</table>

* Approximate

### Peak (deficit) Curve

![Peak (deficit) Curve](image)

- VaR 97.5
- 1,200 MW Threshold
- 3,076 MW
- 1,567 MW
- 0 MW

**Legend:**
- Low End EE
- Higher DC
- Reference
Energy (deficit) Curve

VaR 97.5

196,324 MWh

4,196 MWh

9,600 MW Threshold

0 MWh

Percentile

Lower EE

Higher DC

Reference

196,324 MWh

4,196 MWh

0 MWh

VaR 97.5

9,600 MW Threshold

0 MWh

Percentile

Low End EE

Higher DC

Reference

Northwest Power and Conservation Council
Duration (deficit) Curve

VaR 97.5

21 hours

8 Hour Threshold

1.5 hours

0 hours

---

Duration (deficit) Curve

VaR 97.5

21 hours

8 Hour Threshold

1.5 hours

0 hours
Majority of deficits are Short even in Low End EE and Higher Data Center scenarios

~67% of Shortfalls in Low End EE and Higher Data Center have a peak below 1,200 MW
Timing of Shortfalls

- Reference:
  - Evening ramp / early night (18:00-23:00) (mostly winter)

- Low End EE target
  - Morning and evening ramp / early night biggest deficits (Feb in G and Dec/Jan in A)
  - Large deficits throughout the day as well (across winter, scenario A)
  - Mid day and late evening ramp (spring, scenario C)

- High DC
  - Deficits throughout the day (Feb in G and Dec-Feb in A)
  - Evening ramp in summer
  - Large deficits throughout the day as well (across winter, scenario A)
  - Spring at 23:00 and summer during day and evening ramp (scenario C)

Timing and Magnitude of Shortfalls - Reference

| Month / Hour | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|--------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Jan          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Feb          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Mar          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Apr          |   |   |   |   |   |   |   |   |   |   |    | 46 |    |    |    |    |    |    |    |    |    |   |   |   |    |
| May          |   |   |   |   |   |   |   |   |   |   |    |    | 359 |    |    |    |    |    |    |    |    |   |   |   |    |
| Jun          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Jul          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Aug          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Sep          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Oct          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Nov          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |
| Dec          |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |   |   |   |    |

Month / Hour: 0 to 23

Values: 0 to 924
### Timing and Magnitude of Shortfalls – Low End EE

| Month / Hour | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|--------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Jan          | 219| 620| 1394| 2524| 3855| 5346| 4414| 3431| 1220| 336| 450| 768| 521| 1491| 2785| 2767| 2972| 542| 413 |
| Feb          | 728| 658| 618| 612| 652| 730| 1147| 3694| 1606| 835| 1223| 1026| 262| 461| 936| 1200| 1643| 2162| 2681| 3455| 2798| 1259| 1714| 3511|
| Mar          | Apr| 894| 609 | 1426| 825 | 230 | 576 | 635 | 975 | 533 | 504 |
| May          | 1159| 224| 347| 98 | 2020| 817 |
| Jun          | 2020| 1426| 1714| 3511|
| Jul          | 522 | 2020| 1426| 3511|
| Aug          | 3431| 1404| 2547| 3521| 4829| 5563| 6440| 6489| 5663| 4829| 3521| 2847| 1404 |

### Timing and Magnitude of Shortfalls – Higher DC

| Month / Hour | 0  | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|--------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Jan          | 925| 900| 876| 871| 894| 1146| 3986| 6117| 5886| 3963| 3684| 1726| 1558| 1431| 1433| 1326| 2121| 1910| 2759| 3043| 1501| 1022| 981| 1621|
| Feb          | 1144| 653| 613| 607| 647| 1004| 3062| 5684| 5138| 4762| 3648| 1059| 1059| 947| 888 | 1303| 803 | 1856| 1790| 2433| 1346| 1217 |
| Mar          | Apr| 38439| 69 | 199 | 45 | 1217 |
| May          | 978 | 193 | 550 | 551 | 533 | 208 | 141 |
| Jun          | 34 | 368 | 1026 | 1217 |
| Sep          | Oct| Nov| Dec| 3999| 1537| 685 | 697 | 724 | 1541| 8213| 6080| 8866| 8407| 7561| 6121| 3306| 2700| 4068| 4414| 6689| 6440| 5663| 4829| 3521| 2847| 1404 |
Nod to Executive Summary

Key Messages

• Assuming the reference case is the trajectory:
  – Continued implementation of the strategy, including ensuring sufficient reserves and acquiring another two years of energy efficiency and renewables, not retiring thermal plants, and expanded transmission capacity offset the adequacy challenge of increased loads of anticipated data centers and EV electrification

• The low end of EE target offers more risk to maintain regional adequacy
  – The low end of EE, alongside the resource strategy, does not fully mitigate challenges of increased loads in 2029 despite alleviating circumstances of not retiring thermal plants and expanded transmission
    – Shortfalls occur throughout the days in winter (thought greatest magnitudes in morning/evening ramp hours
    – Additional challenges in spring and summer

• If the higher data center load case is more likely:
  – The ~1,600 MW of increased load associated with additional data center load growth above the reference case causes adequacy challenges resulting in an inadequate system
  – The plan is to study the impact and resource strategy associated with increased load uncertainty in the upcoming Power Plan.
Questions?

Dor Hirsh Bar Gai
dhirshbargai@nwcouncil.org

John Ollis
jollis@nwcouncil.org