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November 8, 2022

MEMORANDUM

TO: Council Members

FROM: John Ollis, Manager of Planning and Analysis

SUBJECT: GENESYS Review Process and Preliminary Adequacy Results

BACKGROUND:

Presenter: John Ollis and Dor Hirsh Bar Gai

Summary: Staff has been working towards the 2027 Resource Adequacy Assessment, which will provide the first check on the Council's 2021 Power Plan resource strategy. Part of this work has included a focused effort revisiting assumptions to better understand the operating limitations of the Northwest hydro system to improve modeling in GENESYS.

At the Power Committee, staff will provide another update on all of these efforts, building on to the discussions from previous committee meetings. Specifically, staff will update the Power Committee on the progress of updating hydro operations in GENESYS, focusing on the vetting of the revised limitations and capabilities reviewed with stakeholders and regional experts. Staff will also provide the first look at preliminary results for the adequacy assessment.

Staff is continuing to work on these efforts with a goal of providing a draft final 2027 Resource Adequacy Assessment for committee review and discussion in December and full Council consideration in January 2023.

Relevance: The Council conducts an annual resource adequacy assessment to provide an early look at resource adequacy. The 2027 Resource Adequacy Assessment is the first one that will provide a check on whether the Council's 2021 Power Plan resource strategy continues to ensure an adequate system.

The Council uses the GENESYS model as one of the major tools in analyzing resource adequacy. GENESYS also provides hydroelectric system output to both the AURORA model and the Council's Regional Portfolio Model and was used to validate that the power plan's resource strategy will produce adequate supplies. Because of the critical role that GENESYS plays in developing the Council's power plan, the model was evaluated and enhanced in the lead up to the 2021 Power Plan to improve forecasting reliability as well as to improve its data management capabilities and to make it less cumbersome to use. Staff have been working on model enhancements to address stakeholder concerns and continue to improve Council modeling capabilities.

Background: The Council's 2021 Power Plan was developed during a time of significant change and uncertainty in the power system. The resource strategy and plan recommendations aimed to provide a path forward for an adequate, economic, efficiency, and reliable power supply, while balancing the uncertainty in the road ahead. The Council also recognized that new information could prompt reconsideration of the strategy, and the Council committed to monitoring and evaluating the regional power system and policies as part of plan implementation. This adequacy assessment is one piece of that continued evaluation.

The 2021 Power Plan included a resource strategy with several elements, including:

- Acquire between 750 and 1000 average megawatts of energy efficiency
- Acquire a minimum of 3500 megawatts of renewables
- Examine demand response products that can provide value during ramping periods and offset emissions (specifically time of use rates and demand voltage regulation)
- Expand the use of reserves to improve the utilization of the existing system

Inherent to this strategy are several underlying assumptions. This includes the incorporation of climate change data to inform future resource availability and loads. It also assumes existing transmission capability utilized efficiently is sufficient to implement the resource strategy, noting two main observations. First, that the current transmission system is underutilized and has additional capacity in most hours of the day, despite being limited from a long-term firm contractual basis. Second, as significant resources are added over time more efficient utilization of transmission resources likely will require broad regional coordination on

transmission usage, additional transmission capability or a modified resource strategy.

With respect to GENESYS, the Council redeveloped the model leading up to the 2021 plan. Many of the assumptions were locked in early in the planning time period with not enough time to revisit them during the plan. As staff learned more about the actual system operations it became clear that some of those planning assumptions would need to be refined to better represent the hydro system operations on a project-by-project basis.

During the late stages 2021 Power Plan, there was limited capability and time to make drastic assumption changes in the model. However, it was deemed valuable during the plan to hold a technical workshop to walk through hydro system on a project-by-project basis with regional stakeholders. After the plan, an effort was made set aside time to revisit feedback from stakeholders and assumptions in the model on a more holistic basis to better understand limitations and capabilities of the regional hydro system.

More Info: [GENESYS Technical Conference](#)

[RAAC Technical and Steering Committees](#)

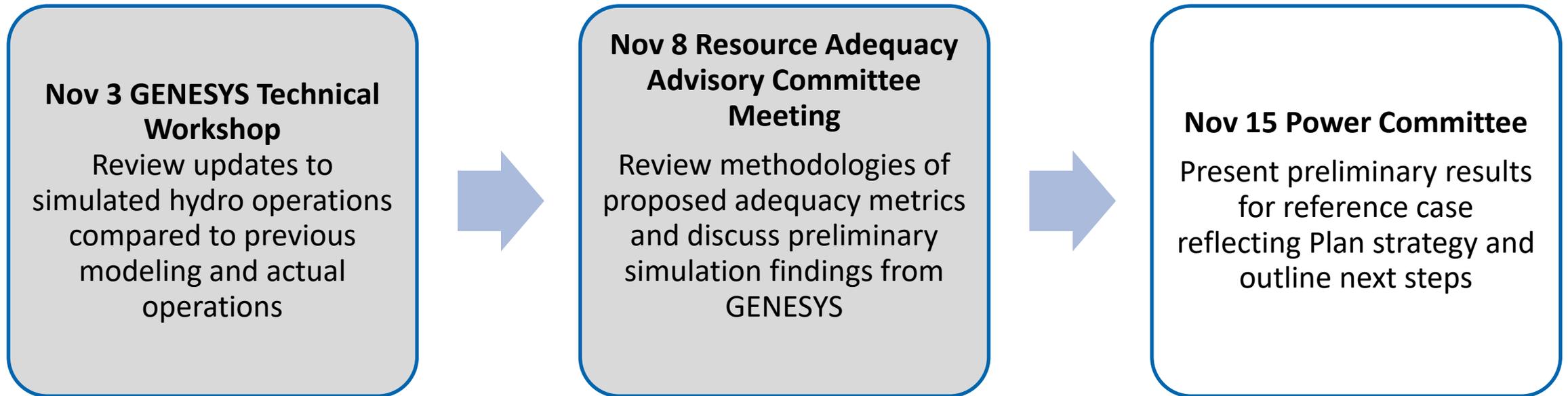
GENESYS Review Process and Preliminary Adequacy Results

Power Committee

11/15/2022

John Ollis, Dor Hirsh Bar Gai

Adequacy Assessment Timeline and Deliverables



Overview

- GENESYS Hydro Review Update
 - Stakeholder feedback from the 11/3/2022 technical workshop
 - Next Steps
- Resource Adequacy Update
 - Stakeholder feedback from the 11/8/2022 Resource Adequacy Advisory Committee meeting
 - Adequacy study setup and preliminary results
 - Next steps

Review: Discussion on How We Modified Our Approach

- **We now only use the source data rather than information from HydSim results.**
 - This meant that staff reviewed and catalogued over 15,000 constraints in HydSim and just over 3,000 active constraints are now translated to GENESYS.
 - Over 100 instances of project specific operations data that were not represented in HydSim now incorporated into GENESYS
 - **These source data and assumptions were discussed with regional planners and operators.**



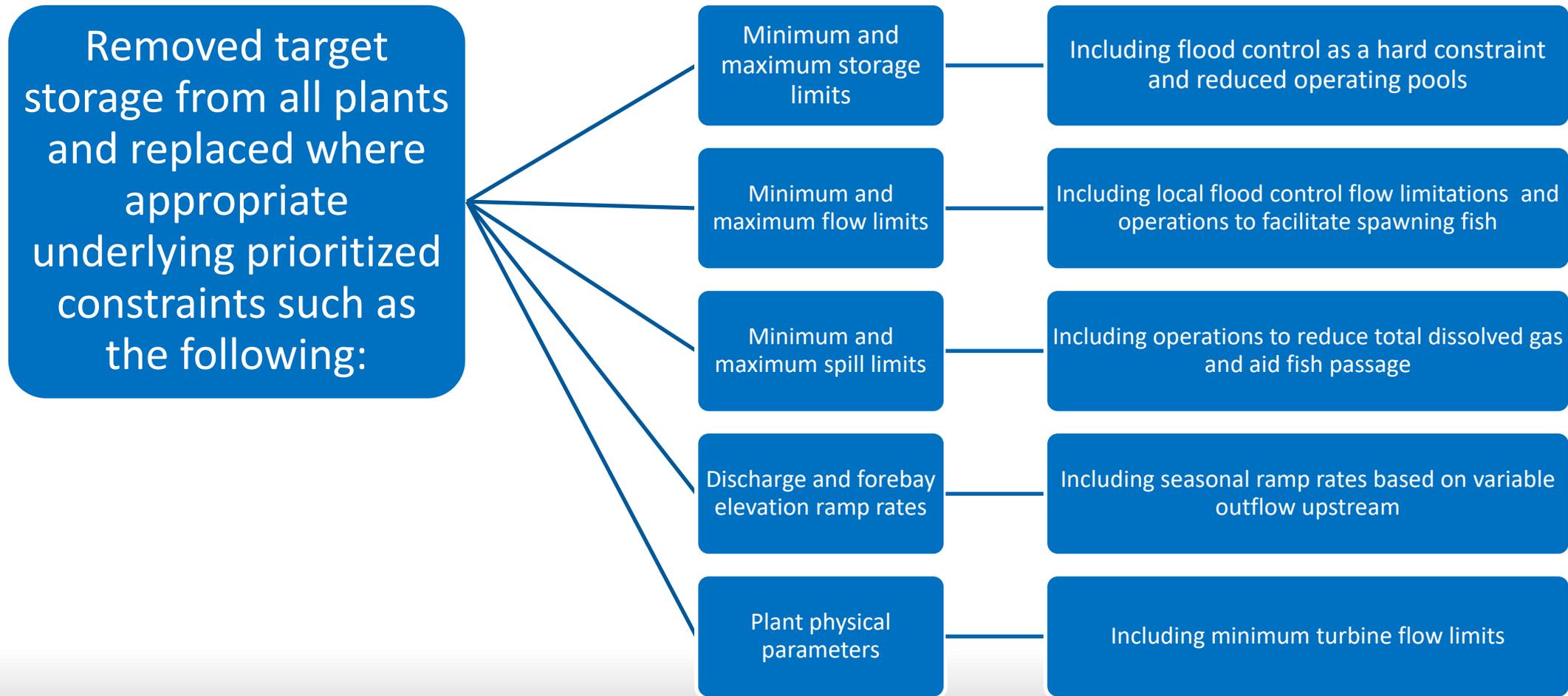
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Review: Discussion About to Whom We Have Spoken



Entity	Meetings
BPA Planners/Operators	8/22 and 9/2
USACE Operators	9/2
Idaho Power Planners/Operators	8/26
Seattle City Light Planners/Operators	9/9
Tacoma Power Planners/Operators	9/12
Portland General Electric Planners/Operators	9/20
Avista Planners/Operators	9/28
Grant/Chelan/Douglas County PUDs Operators	10/4
BC Hydro Planners/Operators	10/13
Puget Sound Planners/Operators	11/9

Review: Discussed How We Implemented What We Learned



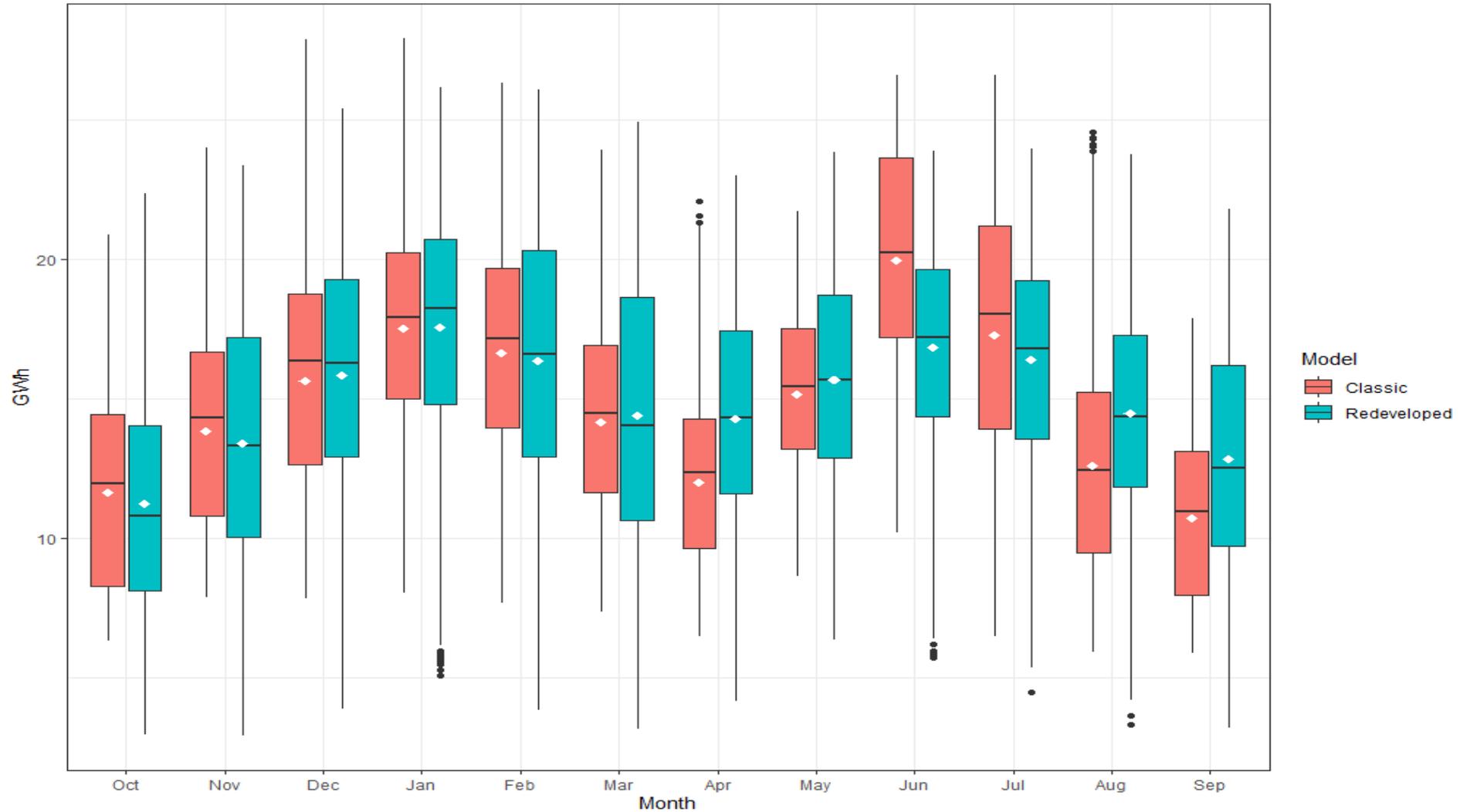
Discussion on Hydro Flexibility

- Staff compared simulated operations from the classic and the redeveloped model using a number of different ways of observing hydro flexibility.
- Staff also highlighted some of the different assumptions/capabilities that might lead to different hydro operations in the two models.

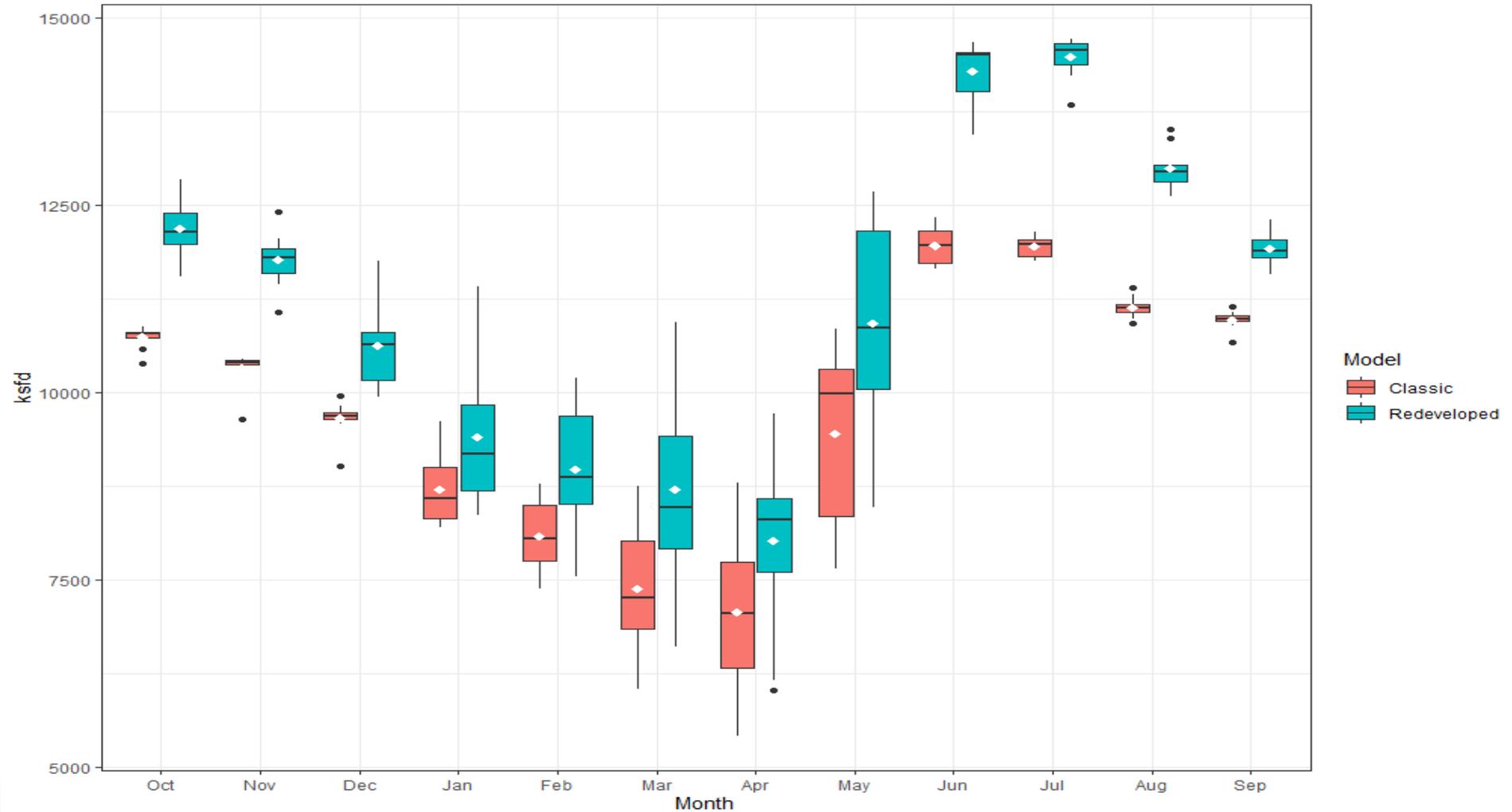
Key Observations

- **Hydro Generation:**
 - Notable differences during spring and summer hydro generation, in response to enhanced seasonal constraints and market dynamics
- **Storage utilization:**
 - Increased storage capability, in response to additional modeled storage, seasonal constraints, and market dynamics
 - Summer months
- **Swing:**
 - Redeveloped GENESYS demonstrates more consistent generation flexibility
- **Spill**
 - Redeveloped GENESYS suggests increased spill during most of the year, likely in response to enhanced constraints and market dynamics
- **Reserves**
 - Hydro and thermal reserves operating in alignment with hydro generation
 - Hydro reserves well above up-reserves (incremental) from Classic model

Hydro Generation

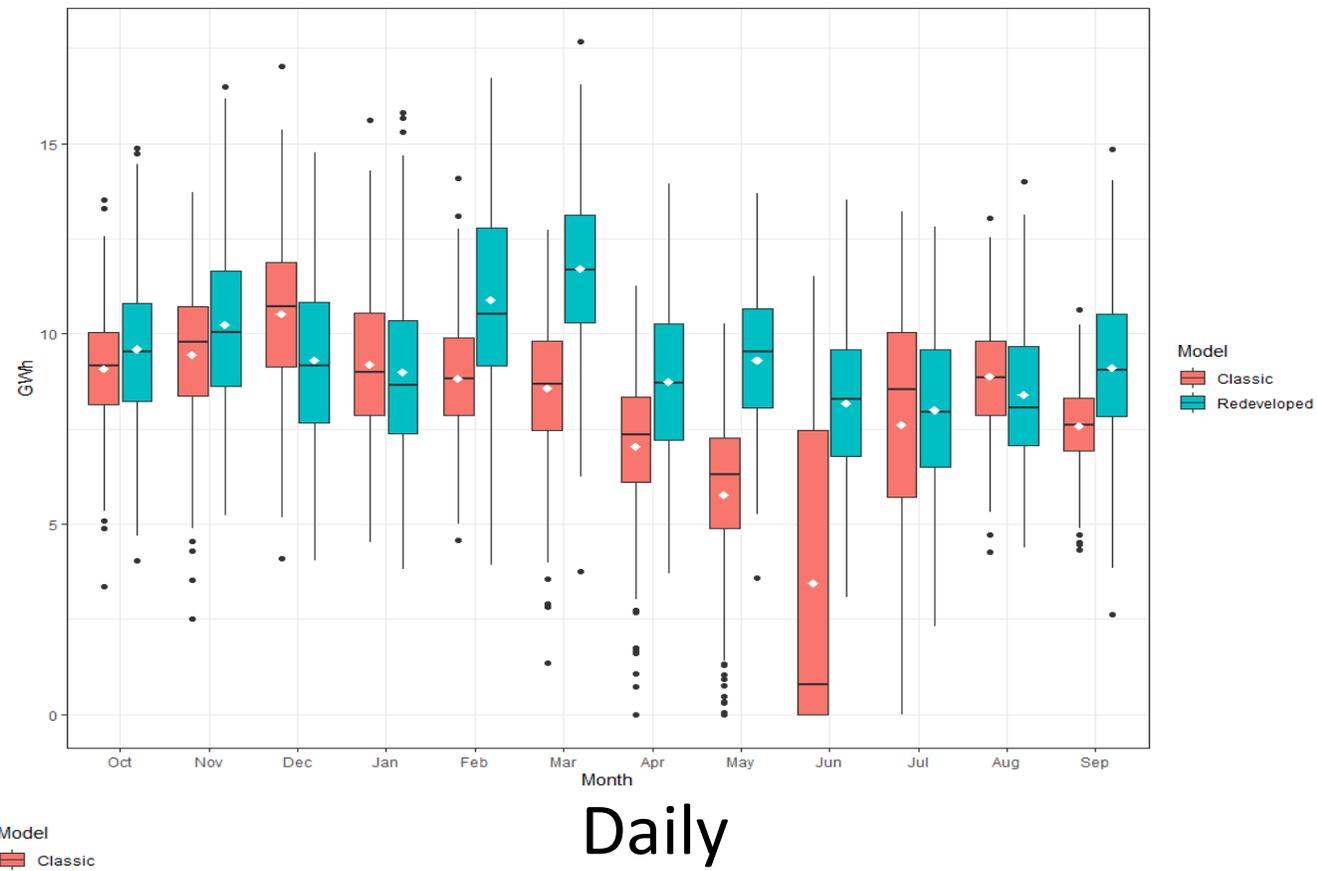
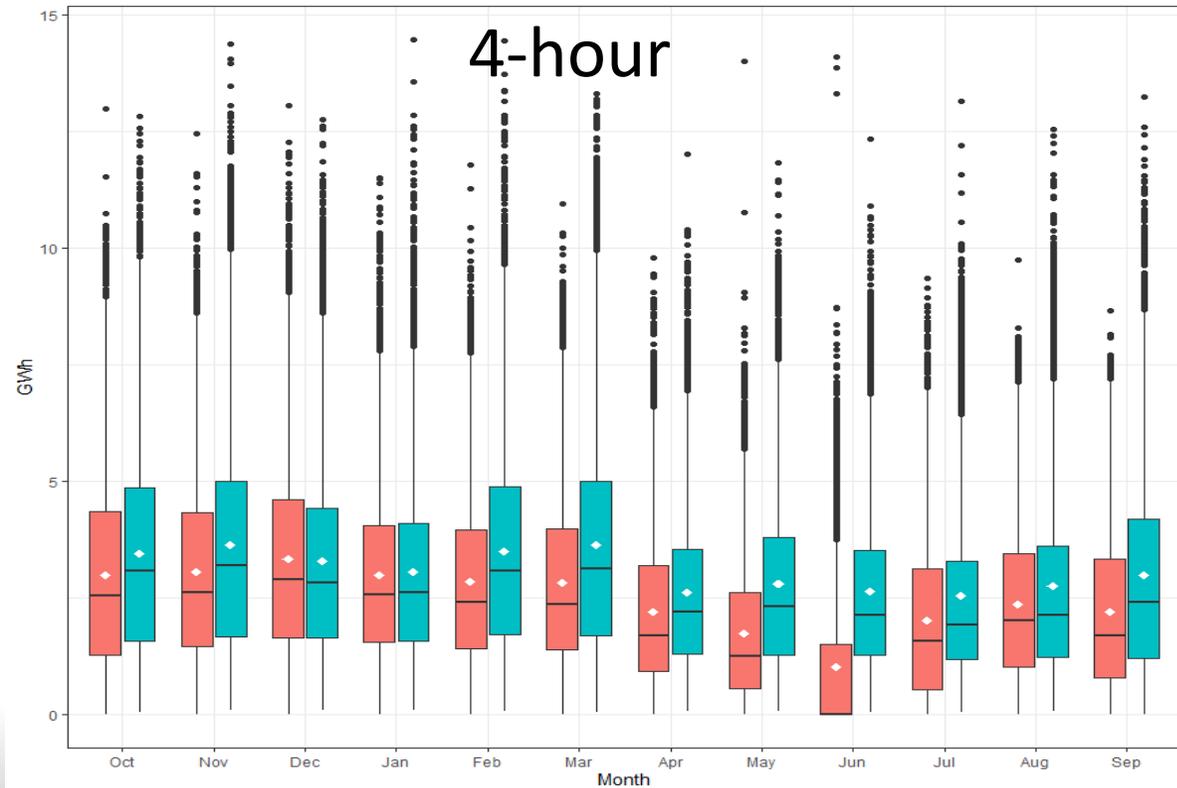


End-of-Month Content Comparison

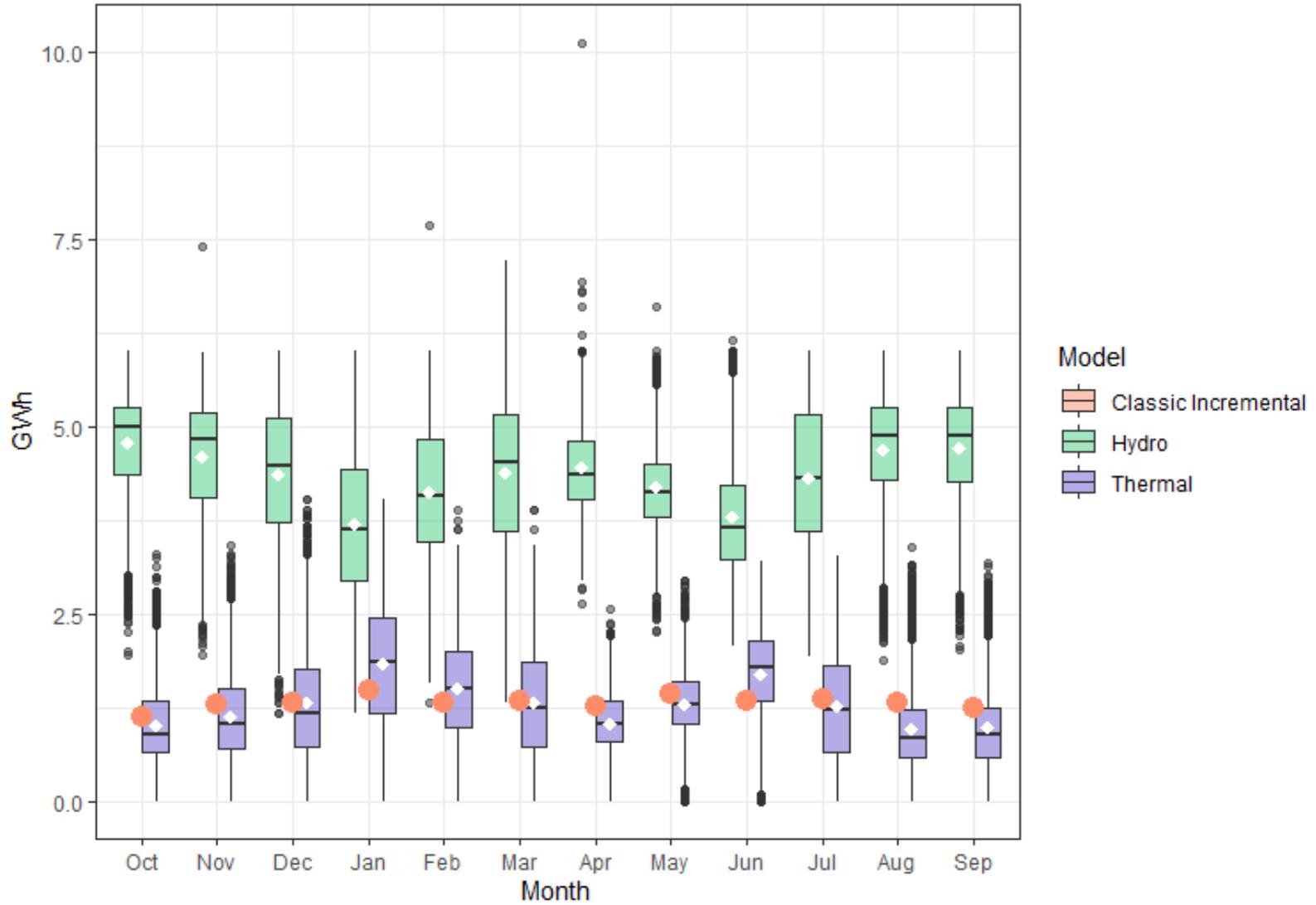


Redeveloped model has ~2500 ksfd more than Classic Assumptions

Swing

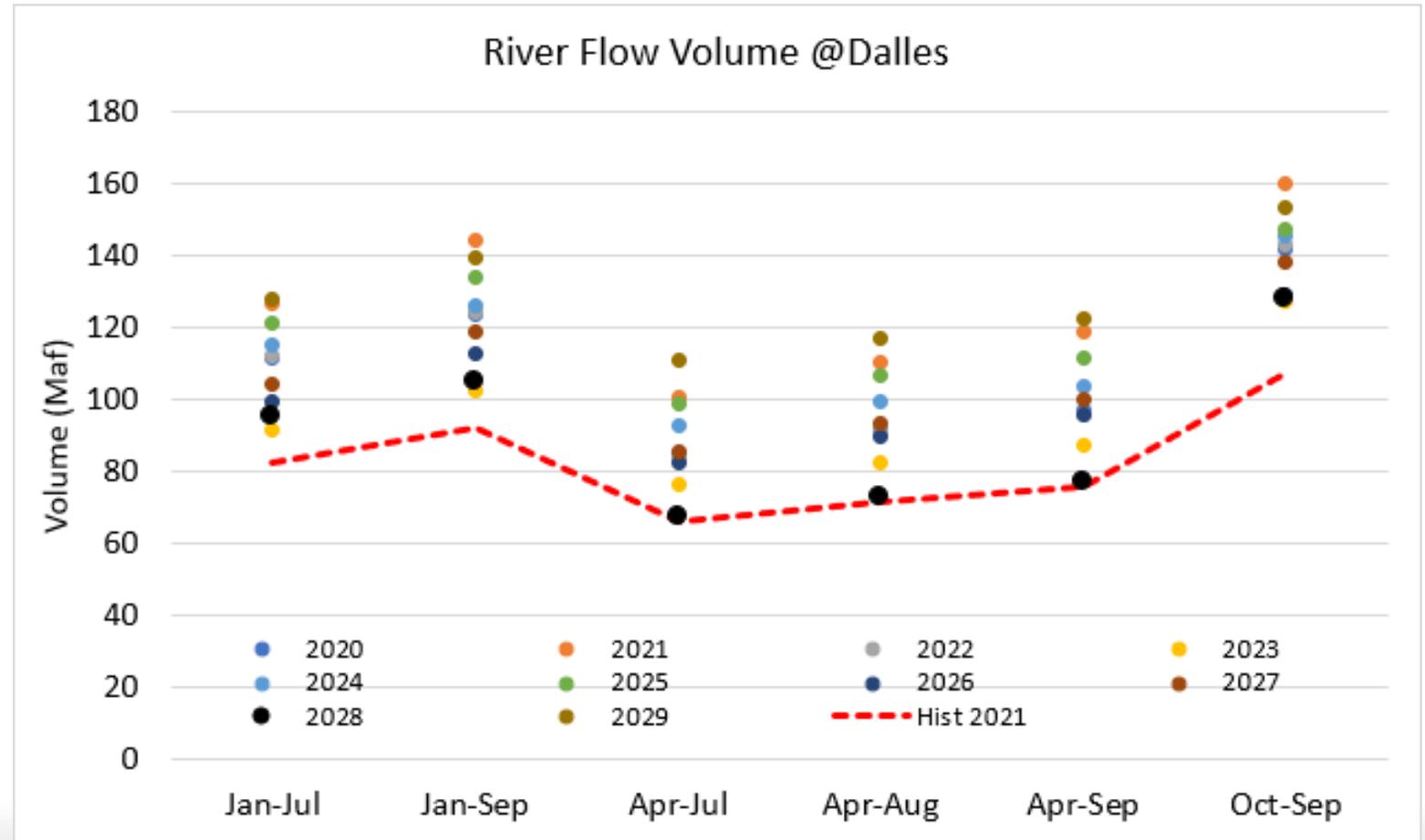


Reserve Allocation



Staff Compared Simulated Operations to Actuals

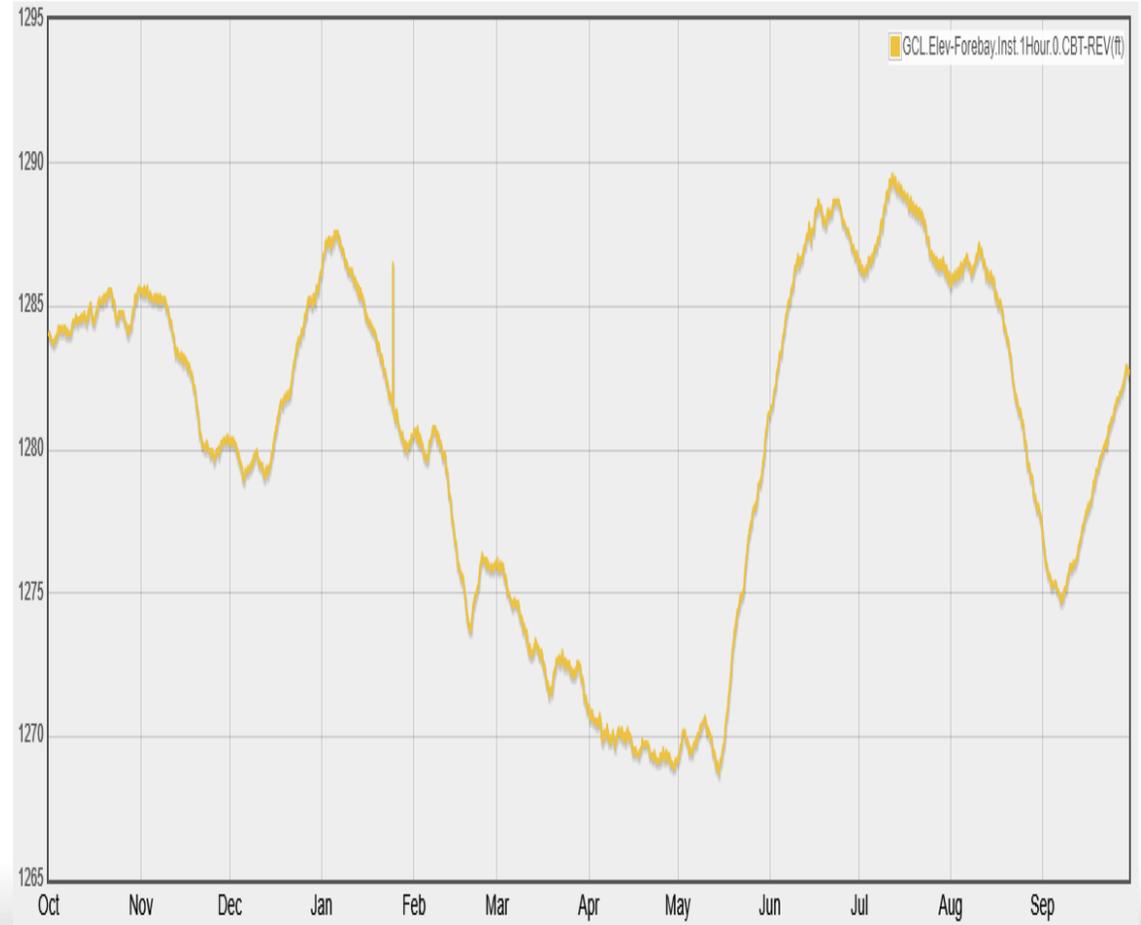
- Consider 2021 actuals and a similar water year in the climate change record.
- 2028 water year matches well in spring and summer flows at the Dalles



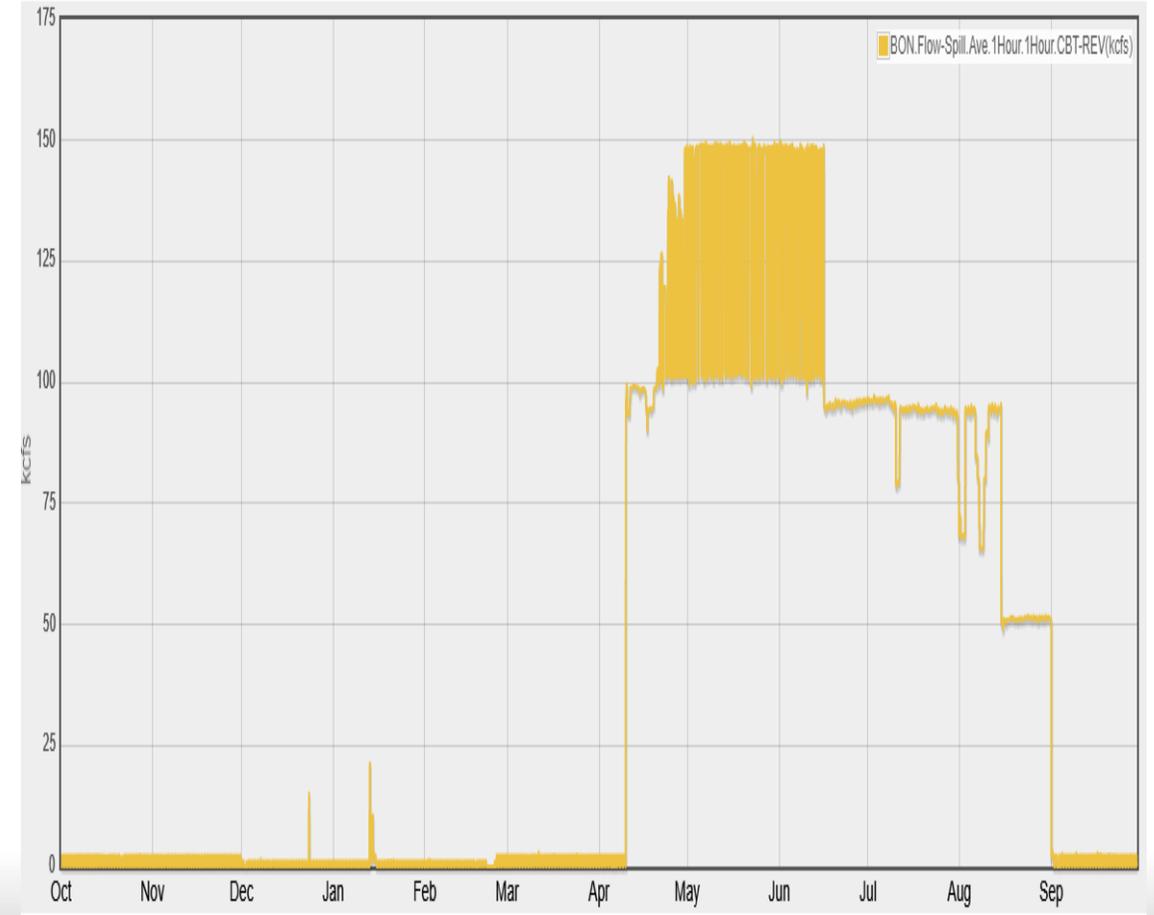
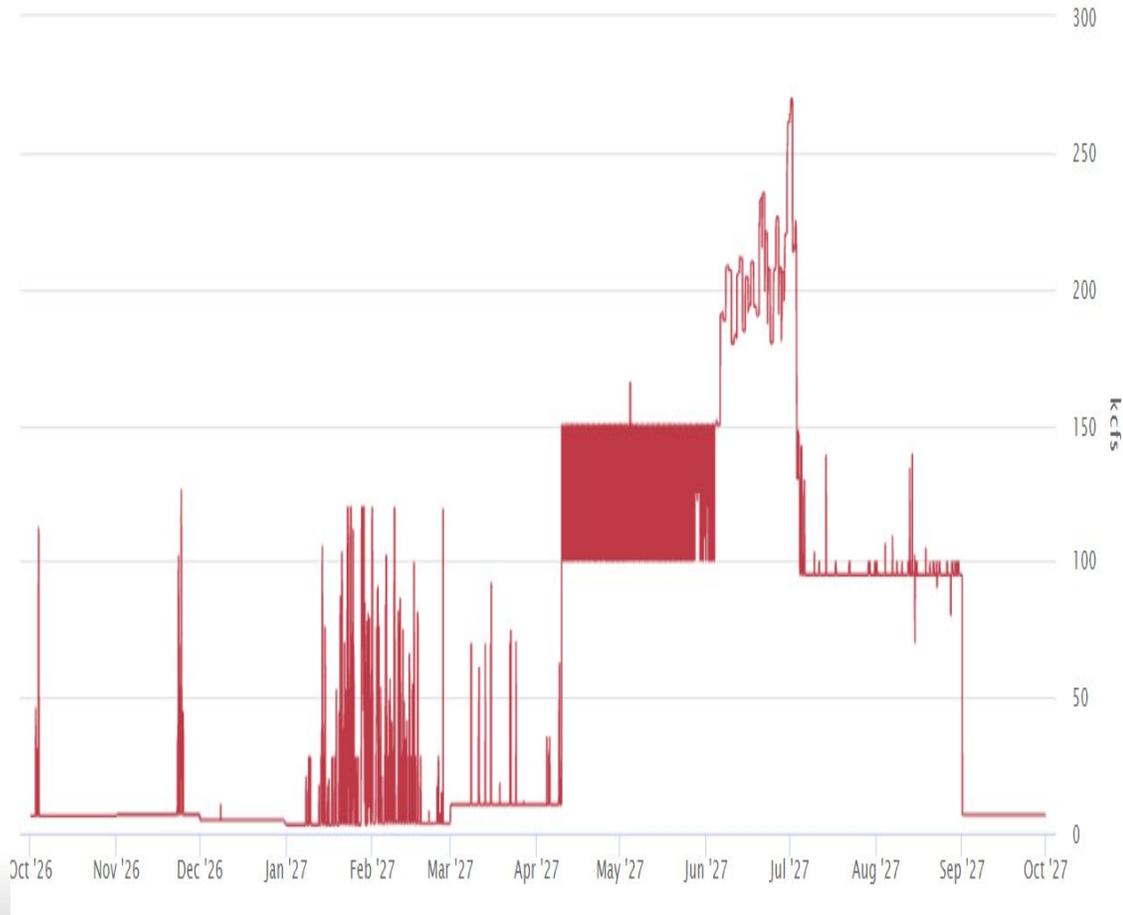
Simulated Versus 2021 Actuals

- 2021 water year references actual operations from *October 2020 through September 2021*
 - <https://www.nwd-wc.usace.army.mil/dd/common/projects/www/gcl.html> (Coulee)
- The simulated water year uses the *CNRM* climate change data set year *October 2027 through September 2028* stream flows
 - Recall that the CC stream flows are representative throughout the decade
 - All data shown unless called out is from the True-up stage which is like the simulated actuals
- Since these are not the exact same water year we would not expect the operations to be exactly the same, however we would expect drawdown and refill of the large reservoirs, flows and limited pool operation on the mainstem to be similar.
- Staff is still honing some penalties and priorities on the river system:
 - Minimum outflows/spills versus minimum operative pool

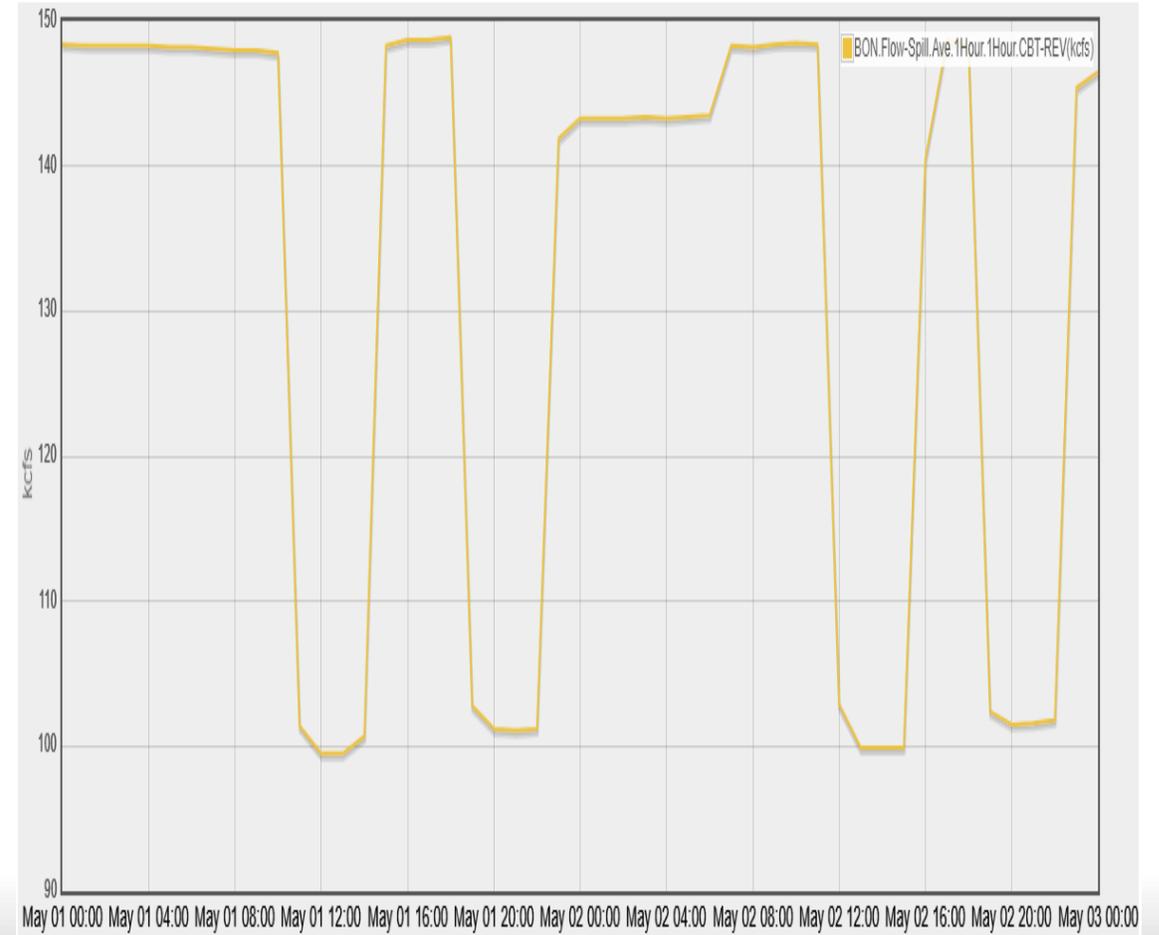
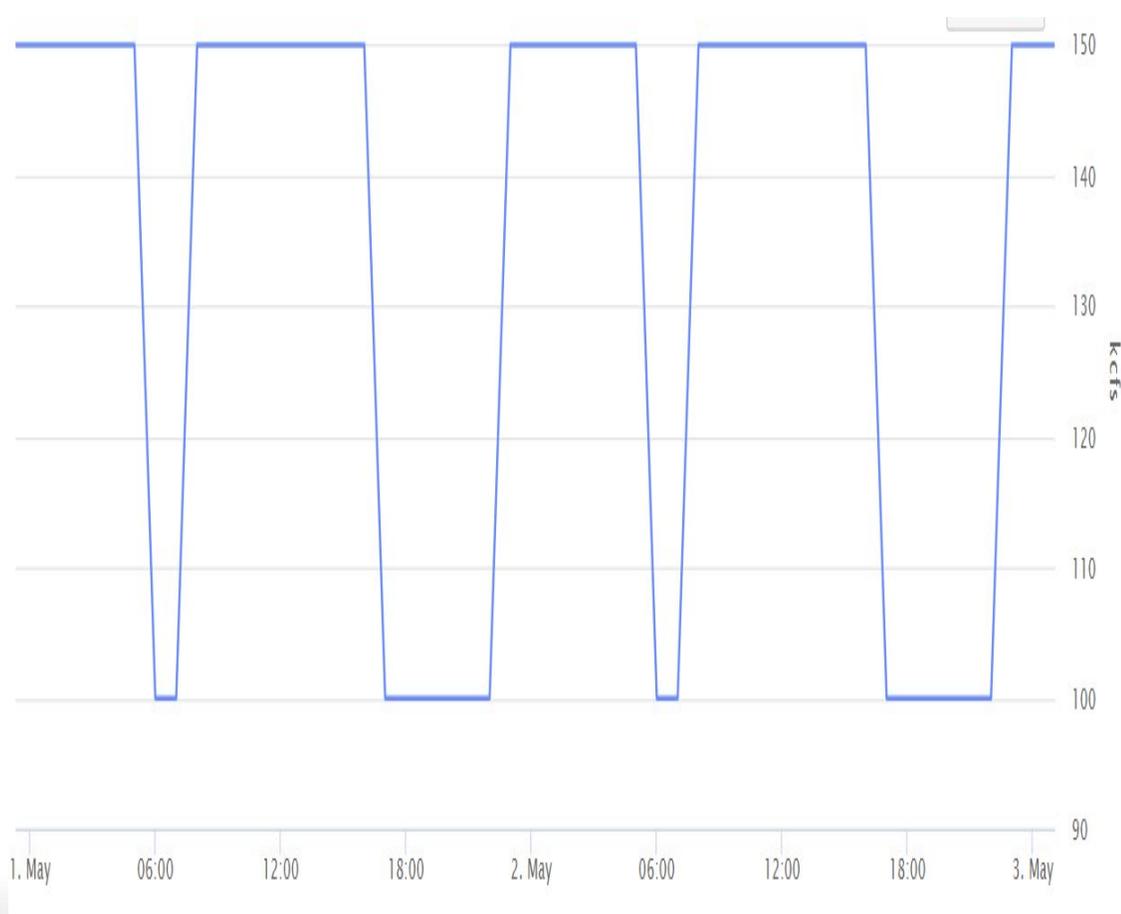
Coulee Forebay Elevations



Bonneville Total Spill



Bonneville Total Spill



Observations

- Some of the operations need to have small tweaks in the priority level to make simulated operations more consistent with actual operations.
- At a high level the constraints seem to be guiding the reservoir usage similarly as observed in the 2021 ops.
- Minimal but mostly positive feedback so far
 - Folks are impressed with the ambition and effort
 - Significant interest in the constraints catalog

Staff is **mostly complete** with updates to the hydro operations constraints for the upcoming adequacy assessment. Most remaining outstanding issues will be catalogued, and assumptions refinement can continue after the assessment.



Timeline of Next Steps

Resource Adequacy Advisory Committee Meeting

- Discussed proposed new adequacy standard
- Discussed the 2027 Adequacy Assessment setup and preliminary results.

Revised New Adequacy Standard

- Adequacy Standard *metrics* and (provisional) *limits** (set independently)
 - *LOLEV* – based on tolerance for use of emergency measures
 - *Curtailment LOLH* – based on economic risk (i.e., CONE and VOLL)
 - *Peak VaR_{97.5}* – limits the risk to peak load (MW) *curtailment* to 1/40 years
 - *Energy VaR_{97.5}* – limits the risk to energy (MWh) *curtailment* to 1/40 years
- Adequacy is assessed based on annual limits, but monthly metric values are reported to indicate the timing (seasonality) of shortfalls
- Final limits for the adequacy metrics will be set after the GENESYS model validation is complete and will be updated, as necessary

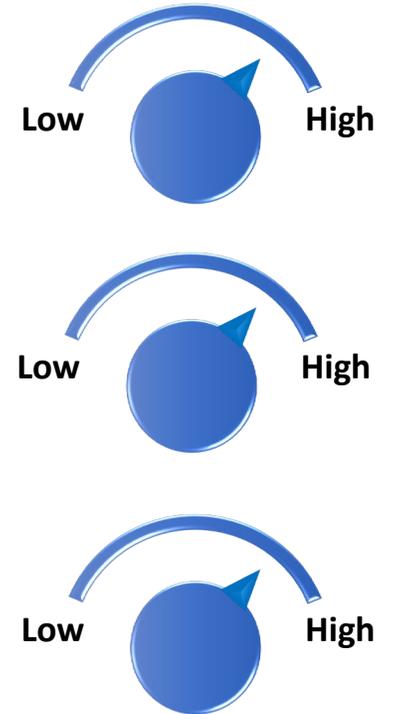
*Not all metrics are equally precise. For example, experience in the UK and the Netherlands indicates that their (economic risk) LOLH limits may not be sufficiently restrictive based on real-life practices.

RAAC Feedback on the New Standard

- Overall positive feedback on the multi-metric approach and agreement that it provides a better measure of risk than the LOLP
- General agreement on the objectives
 - Prevent overly frequent use of emergency measures
 - Prevent spending too much for curtailment mitigation but concern about methodology
 - Limit occurrence of big capacity and energy shortfalls
- Agreement that adequacy should be reported on a monthly or seasonal basis
- Questions regarding how the new standard can be compared to standards set by other agencies
- Agreement that the set of *metrics* defining the new standard can be accepted before their *limits* are finalized.

Key Decision: How Do We Interpret the 2021 Power Plan Resource Strategy in GENESYS?

1. **Range** of 750 aMW to 1000 aMW of Energy Efficiency
 - Start with 750 aMW spread evenly throughout the region and work from there
2. **At least** 3,500 MW of renewable generation
 - Start with 3,500 MW of new renewable generation
 - Made up of existing resources built since plan AND potential new resources
3. **Over** 3,000 MW of additional reserves may be required to sufficiently incentivize enough generation to be online in order to have enough fuel to meet morning and evening ramps.
 - Start at 3,100 MW of additional balancing up reserves and work from there
4. 720 MW of TOU and DVR Demand Response
 - 720 MW of DR is spread evenly throughout the region



Where We Are in the Iterative Process?

- Started with initial interpretation of resource strategy
- After observations and iterations,
 - Added 2500 MW up reserves *Given observed underutilized thermals*
 - Added 3000 MW renewables *Given observed energy shortfall*
 - **Added 250 aMW of EE** *Given observed energy shortfall*
- Since this is meant to be an **adequacy test** of the plan's resource strategy **not a power plan**, we likely will not iterate much further.
- **The end point of iterative process will be the reference interpretation for testing the plan strategy.**

Pacific NW Planned Resources¹

Nameplate MW	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Wind	65	765	1,265	2,235	2,685	2,785	2,985	3,185	3,285	3,385
Wind w. battery	40	40	40	40	40	40	40	200	200	200
Solar	-	-	380	1,025	1,405	1,555	1,790	2,045	2,075	2,130
Solar w. battery	-	262	262	1,462	1,462	1,587	1,587	2,541	2,541	2,541
Generic renewables		355	355	596	1,104	1,116	1,116	1,116	1,116	1,191
Battery		55	55	105	155	155	410	845	845	845
Natural gas	-	357	357	357	525	525	525	525	580	580
Storage/capacity	<u>125</u>	<u>162</u>	<u>292</u>	<u>572</u>	<u>637</u>	<u>741</u>	<u>1,031</u>	<u>1,136</u>	<u>1,216</u>	<u>1,508</u>
TOTAL	585	1,940	3,191	6,794	7,869	8,348	9,073	10,747	11,087	11,534
Total renewables	460	1,422	2,543	5,866	6,708	7,083	7,518	9,087	9,292	9,447

PNUCC 2022 Northwest Regional Forecast, Table 9: Potential Supply Resources Timeline

<https://www.pnucc.org/wp-content/uploads/2022-PNUCC-Northwest-Regional-Forecast-final.pdf>

Assumptions on Market Limits



Market Availability	Redeveloped GENESYS
Winter SW spot market	2,500 MW supply/price dependent*
Winter SW purchase ahead	None
Winter IPP availability	2,400 MW supply/price dependent*
Total winter hourly max import	2,500 MW
Summer SW spot market	1,250 MW supply/price dependent*
Summer SW purchase ahead	None
Total summer hourly max import	1,250 MW
Summer IPP availability	2,400 MW supply/price dependent*
Market Prices	Dynamic market prices

Market is also limited by fundamentals tested via multiple scenarios.

We are not currently planning on testing different market import limits.

Should we test different market import limits?

2027 Adequacy Assessment Scenarios

Scenario Name	Market Resources	Transmission	Gas Prices	Loads
With Existing Resources Only - Reference				
WECC Baseline				
Limited Markets	Limited Markets			
Persistent Global Instability	Persistent Global Instability		High	
High WECC Demand	High WECC Demand			High
No WECC Buildout	Baseline minus new WECC builds			
WECC stress (pipeline freeze off)	Baseline minus 5000 MW SW winter gas			
WECC stress (drought)	Baseline minus SW Hydro			
WECC stress (transmission fire risk)	Baseline	Derated for fire hazard		
Early Coal Retirement in Region	Baseline			
With Planned Resources - Reference				
WECC Baseline				
Limited Markets	Limited Markets			
Persistent Global Instability	Persistent Global Instability		High	
High WECC Demand	High WECC Demand			High
No WECC Buildout	Baseline minus new resource builds			
WECC stress (pipeline freeze off)	Baseline minus 5000 MW SW winter gas			
WECC stress (drought)	Baseline minus SW Hydro			
WECC stress (transmission fire risk)	Baseline	Derated for fire hazard		
Early Coal Retirement in Region	Baseline			

Do we need these scenarios?

2027 Adequacy Assessment Results

Scenario Name	LOLP	LOLEV	Curtail LOLH	P VaR _{97.5}	E VaR _{97.5}	EUE	NEUE	P CVaR ₉₅	E CVaR ₉₅
With Existing Resources Only - Reference									
With Planned Resources – Reference*									
Limited Markets*									
Persistent Global Instability*									
High WECC Demand**									
No WECC Buildout*									
WECC stress (pipeline freeze off)*									
WECC stress (drought)*									
WECC stress (transmission fire risk)*									
Early Coal Retirement in Region*									

* Using reference interpretation

** WECC High Demand expected to have more EE and renewables, may differ from reference interpretation

RAAC Feedback on the 2027 Assessment

- No objection to method for setting amount of “up” reserves
- 8,500 MW of reserves seems high
- How would additional reserves be allocated or enforced?
- More fine tuning needed to set and optimize use of reserves
- Concern about how market structure can affect imports
- No objection to using “mid-range” level of renewables (an additional 3,000 MW over the minimum 3,500 MW)
- No objection using up to 1,000 aMW of EE, if necessary
- General agreement that for a high decarb scenario more EE will be cost effective
- OK to analyze only the reference case without plan resources
- OK to use interpreted plan resource for all scenarios except the high decarb case

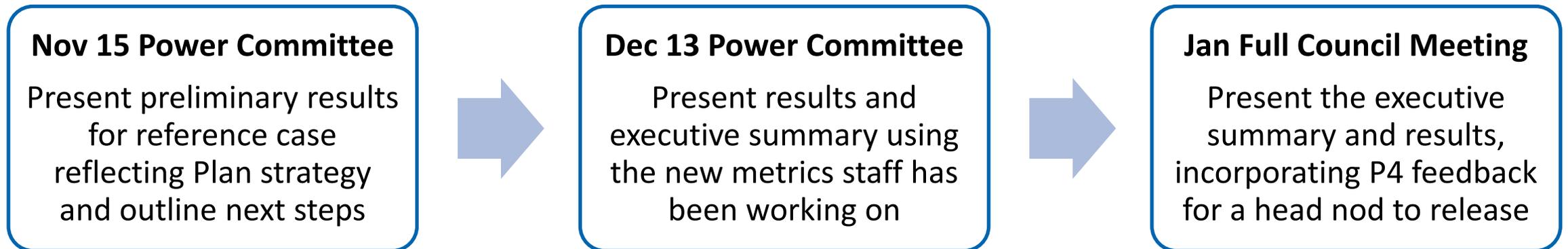
Iterations Since the RAAC

- Further work has been done to hone the interpretation of the strategy to test per the discussion in the RAAC.
- The following is the staff proposed interpretation of the resource strategy to test in the assessment:
 - **1,000 aMW EE**
 - **6,500 MW of renewable resources**
 - **8,500 balancing up reserves**
 - **720 MW of TOU and DVR Demand Response**

High level Observations from Preliminary Analysis

- Appropriately determining and assigning reserve quantities (for both generation and transmission) continues to be a key element in ensuring enough thermal plants commit to address changes in load and renewable generation due to forecast error.
- Hydro operations seem to be less flexible than in the plan setup during most hours which hinders reserve response
- Seems to be generally less low-priced market surplus but still a considerable amount midday most days.

Adequacy Assessment Timeline and Deliverables

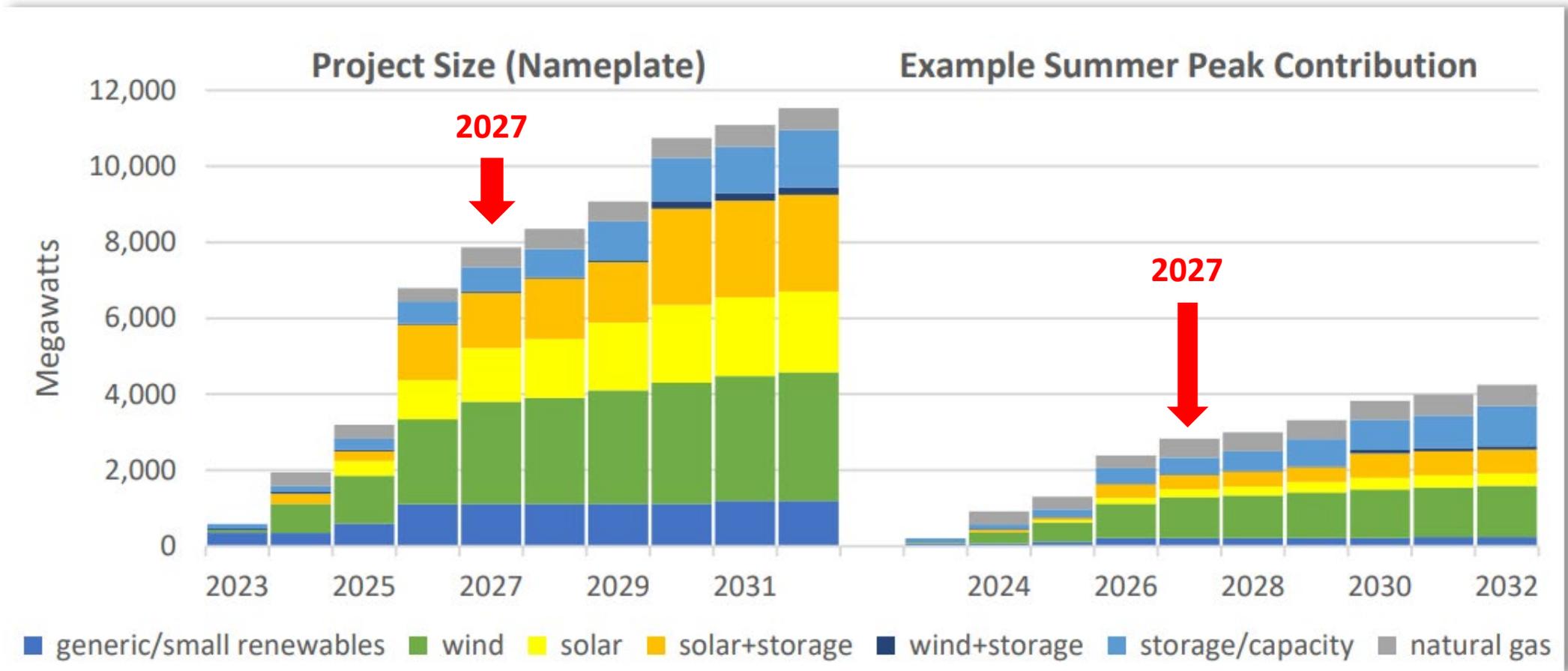


Goal for January

- Staff is seeking a head nod to release the resource adequacy assessment
 - Council will have opportunity to refine the Executive Summary
 - Staff will finalize the technical report, as needed, and release
- Staff proposes in this year's assessment to focus on the new metrics that staff has been working to develop
 - Recognize the limitations with our existing LOLP standard
 - Believe the new set of metrics better reflects the risks the region needs to manage for
 - These metrics would be use provisionally (i.e not formally adopted) as staff continue to research and refine with regional input

Additional Slides

Pacific NW Planned Resources¹



¹PNUCC 2022 Northwest Regional Forecast, Figure 6: Planned/Preferred Resource Portfolio Future Resources
<https://www.pnucc.org/wp-content/uploads/2022-PNUCC-Northwest-Regional-Forecast-final.pdf>