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August 9, 2022

MEMORANDUM

TO: Council Members

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

SUBJECT: Update on Annual Study Progress and Discussion on Direction

BACKGROUND:

Presenters: John Ollis, John Fazio

Summary: Staff are in the process of developing the Council's annual resource adequacy assessment. 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" and this year's assessment is an important check on implementation of the Council's 2021 Power Plan. The resource adequacy assessment relies on outputs from two other Council annual studies: (1) the fuels price forecast updated in spring of 2022 and (2) the wholesale power market build-out and price forecast, which is ongoing. The purpose of this presentation is to update the Power Committee on the progress of these annual studies. Staff will discuss the adequacy study scope and advisory committee feedback, and the process to utilize the WECC wide buildouts from the market price forecast to support the adequacy assessment.

Relevance: Wholesale power markets outside the region were highlighted as a key data point to monitor coming out of the 2021 Power Plan in which policy changes throughout the western states impacted not just wholesale power markets in the long term, but also in the short term. This update reviews

the process of the next wholesale power price forecast study for which some work has already commenced and how the results support the Council's upcoming adequacy assessment.

The Resource adequacy assessment continues to be a critical component of our work. The Council established a [resource adequacy standard](#) in 2011, which is used both as an early warning to gauge whether resource development is keeping up with demand growth and as a guide in developing the Council's resource acquisition strategy. As part of developing this year's resource adequacy assessment, staff are exploring moving to a new multi-metric standard to better capture adequacy considerations for the current power system.

Background: The Council has periodically updated its wholesale electricity price study using the AURORA model to help inform Council staff and regional stakeholder analysis.

The Council's forecast is a fundamentals-based forecast that reflects actual power system operation, relationships of supply and demand for, and transmission of electricity. In addition, underlying a wholesale electricity price forecast in this region would be an understanding of the operating characteristics of future and existing supply and demand-side resources, as well as unit commitment, ancillary services, fuel prices, hydro, wind and solar conditions. The AURORA software captures many of these characteristics of the power system well and has a periodically updated WECC database, and thus, AURORA has been the Council's wholesale market electricity price forecasting model.

Due to significant clean and RPS policies and less dependence on new baseload generation to meet growing loads, the market price forecast studies from the 2021 Power Plan scenarios consistently showed extremely large buildouts of new resources, especially solar generation outside the region. These buildouts implied a persistence of market fundamentals that seemed to be just emerging at the time of the plan's development, like significant renewable generation curtailment and negative pricing mid-day. This market update is an early look at how the plan work compares to current market behavior and highlights some of the data sources the staff uses to monitor this behavior for reference.

The Council's adequacy model, GENESYS now relies on understanding the capabilities of resources external to the region to incorporate the WECC-wide supply and demand fundamentals. Different assumptions on these fundamentals of market supply may affect system adequacy and are under consideration by the Resource Adequacy Advisory Committee.

An adequate power supply has the ability to 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 many different combinations of future resource availabilities and demands. This metric, 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 significant changes in the power industry (e.g., increasing 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.

The frequency, duration, magnitude, and seasonality of potential shortfalls are significant considerations when assessing an acceptable level of risk. For example, a system deemed to be adequate using the current standard (i.e., LOLP is less than 5 percent) may have shortfall events that are unacceptably large or lengthy. Conversely, a system deemed to be inadequate may have shortfall events that are small and relatively easy to mitigate. Today's discussion provides reflections on feedback from the RAAC Steering Committee on potential revision of the Council's adequacy standard.

More Info: [July 27th SAAC/RAAC Meeting](#)

[July 8th RAAC Steering Committee Meeting](#)

[Wholesale Power Price Forecast](#) from the 2021 Plan

Three Potential Adequacy Metrics for the PNW

<https://nwcouncil.box.com/s/lwweiyj6y2vs7hrcwht92rtp2sdzq3g7>

Economics of Adequacy

<https://nwcouncil.box.com/s/7k9fv1eum2vjju19zu341wbw9ingnkf>

IEEE Interpretation of the LOLE Adequacy Metric

<https://nwcouncil.box.com/s/hn8chh2ixlhi3d90fphlwkppniv0ug6w>

Update on Annual Study Progress and Discussion on Direction

August 16, 2022

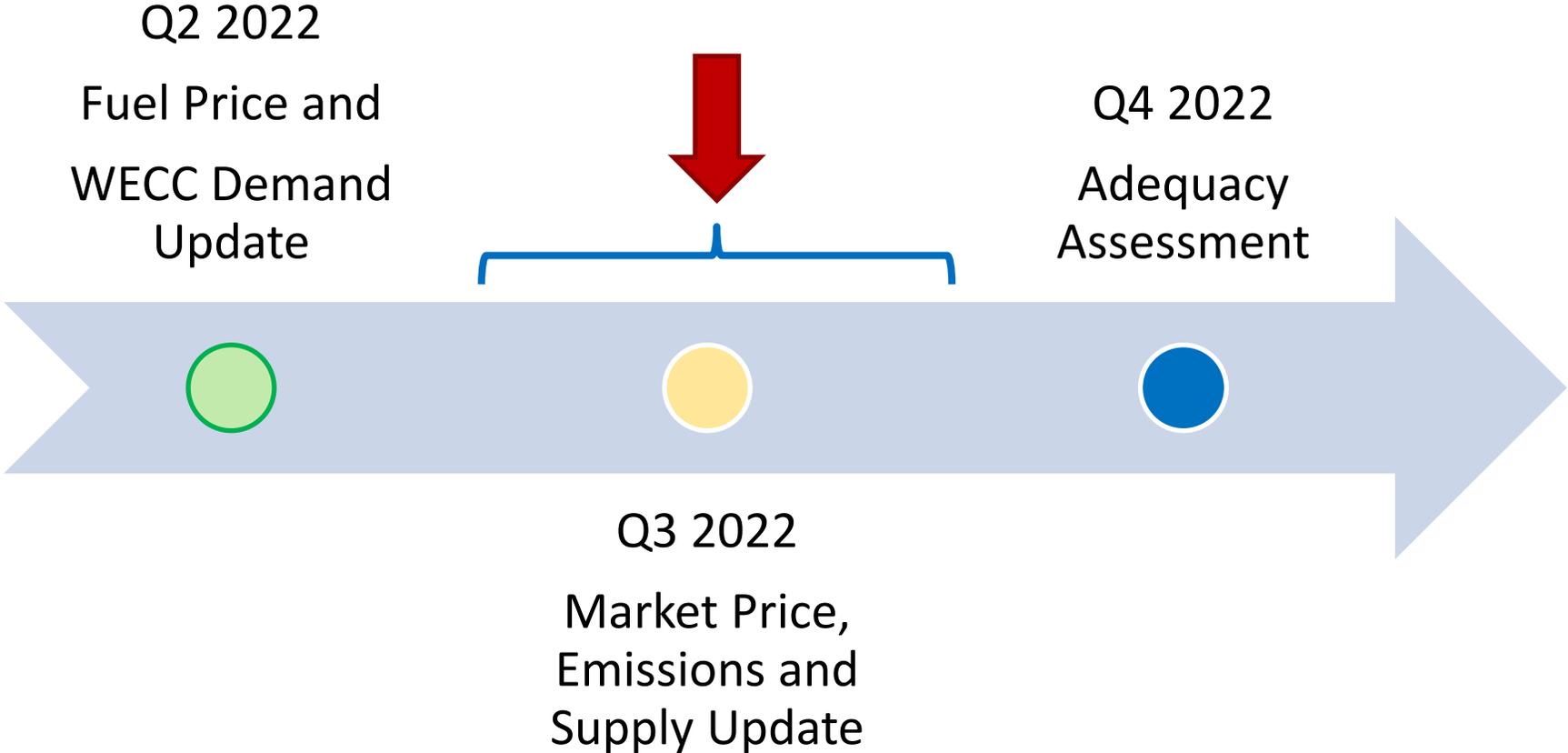
Power Committee

John Ollis and John Fazio

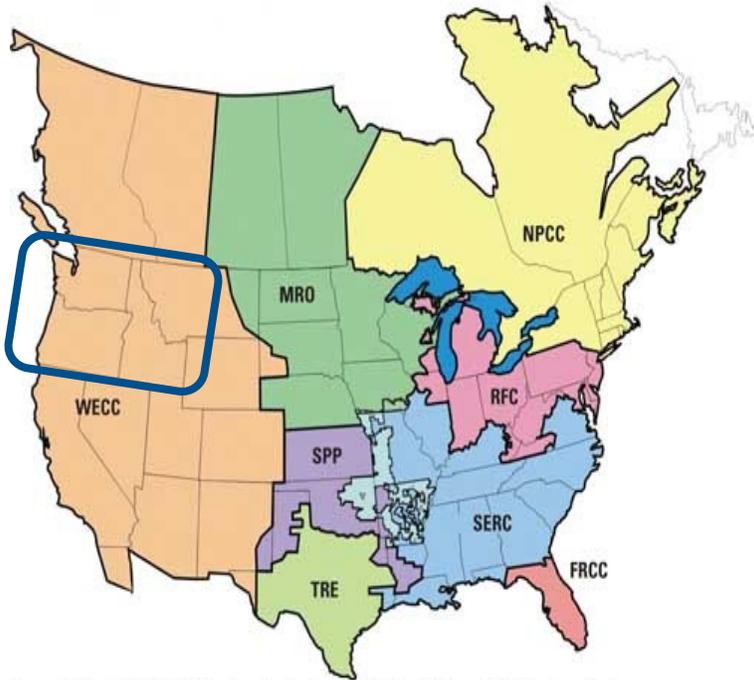
Topic Objective

- Staff are in the process of completing their annual studies that all feed into the resource adequacy assessment
- Today we wanted to provide an update on progress to date and reiterate the timeline for completion
- **Ask of the Committee:** Seeking early feedback on questions you want addressed in this year's Resource Adequacy Assessment

2022 Timeline

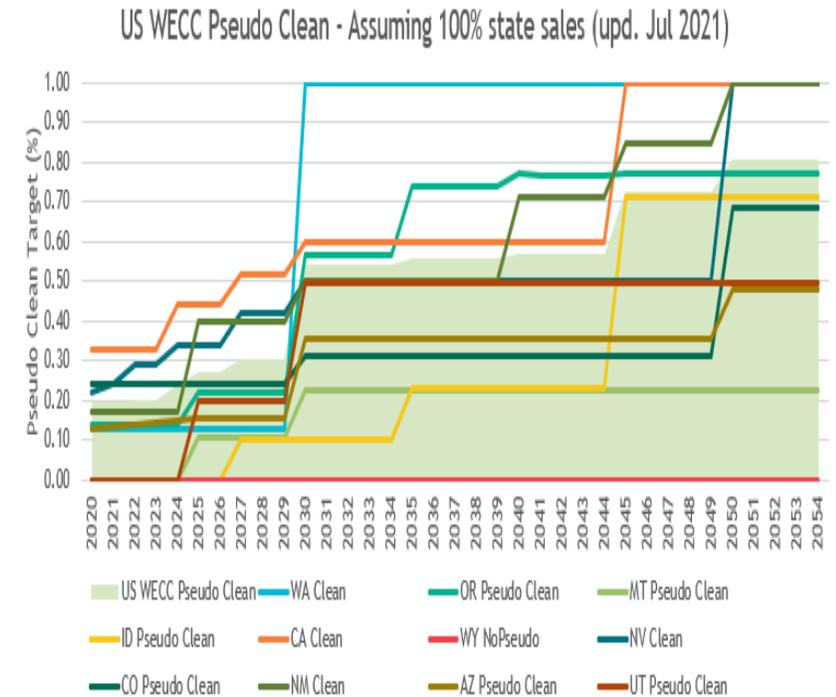


Major Drivers that Change Market Fundamentals Forecasts



Notes: FRCC = Florida Reliability Coordinating Council, MRO = Midwest Reliability Organization, NPCC = Northeast Power Coordinating Council, RFC = Reliability First Corp., SERC = SERC Reliability Corp., SPP = Southwest Power Pool, TRE = Texas Regional Entity, WECC = Western Electric Coordinating Council.

1. Changes in existing system resources or transmission
2. Changes in timing or magnitude of net peak
3. Changes in reserve margins
4. Changes in policies
5. Changes in new resource availability or **costs**



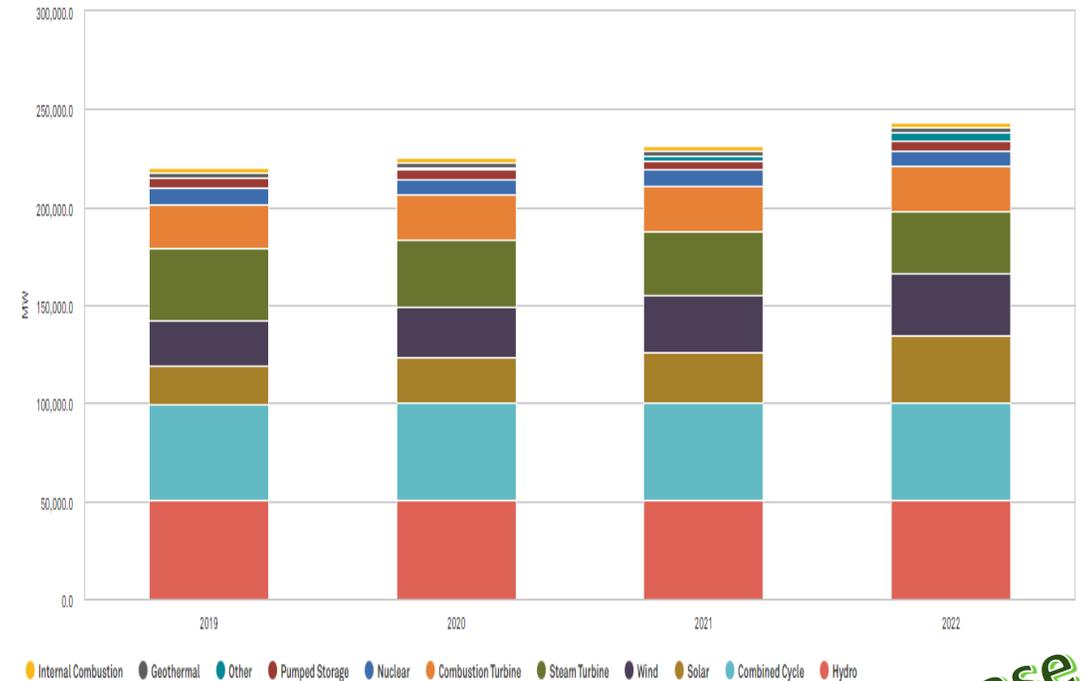
Adequacy Questions Guide the Updates and Questions For the Market Forecast

- What has already changed since the power plan?

More Resources Built Between 2019-2022

- Approximately 25 GW of new WECC-wide resources built
 - Mostly renewable generation and short duration storage
 - Over 6 GW of new, upgraded or converted generation, mostly in Alberta.
- Approximately 1.6 to 2.8 GW of new regional resources, mostly wind

Historical & Future Power Plant Capacity
NERC Region: Western Electricity Coordinating Council (WECC)
Period: 2019 - 2022



Likely Will Decrease
Total WECC Build

Adequacy Questions Guide the Updates and Questions For the Market Forecast

Reserve Sharing Group	2021 Plan Assumptions	2022 Market Study Update*
WECC CA/MX	16.16%	18.08%
WECC NWPP-US	16.32%	13.5%
WECC SRSG	15.82%	10.01%
WECC NWPP-Canada	11.03%	12.88%
WECC RMRG	14.14%	Part of NWPP-US

- What has already changed since the power plan?

Planning Reserve Margin Changes

- Northwest Power Pool and Rocky Mountain Reserve group combined to form one reserve sharing pool
- California reserve margin increased

*Likely Will Decrease
Total WECC Build*

Adequacy Questions Guide the Updates and Questions For the Market Forecast

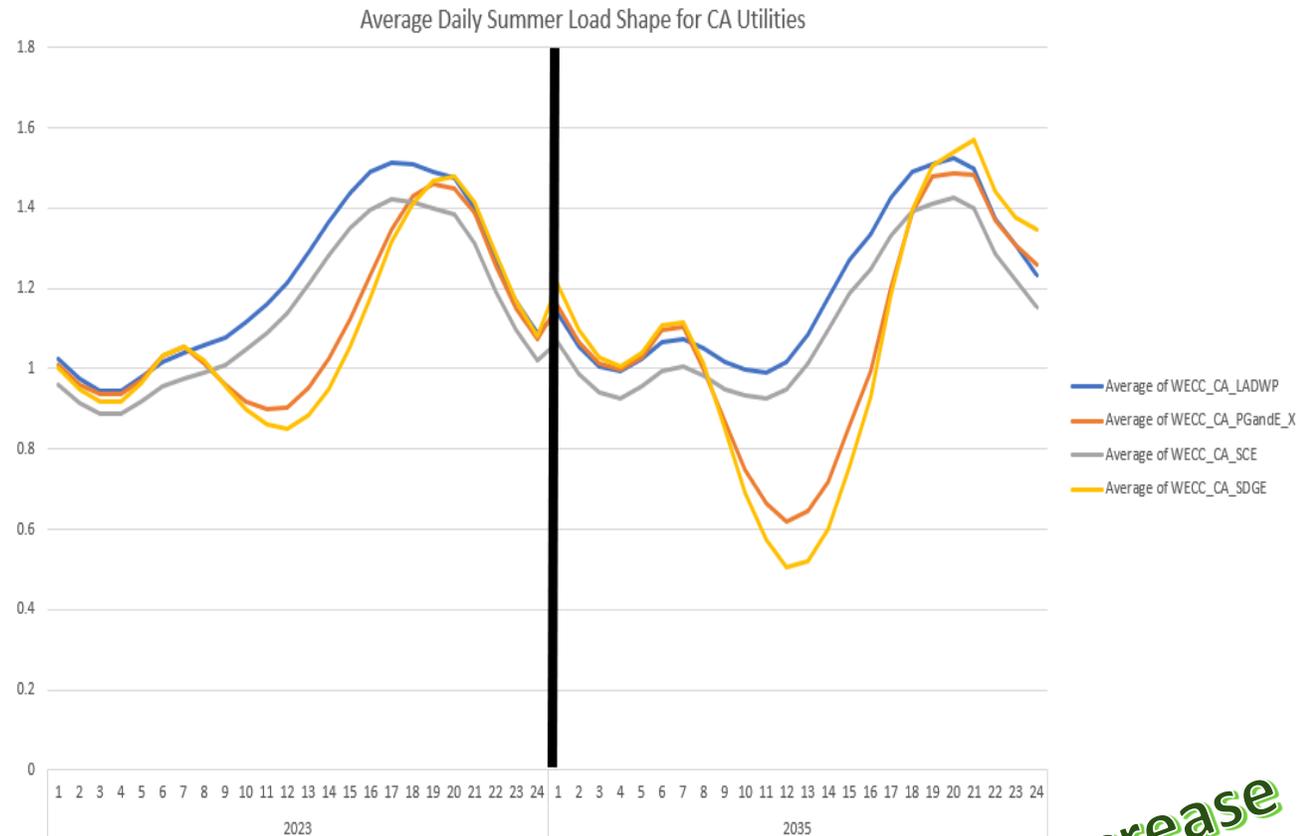
- What was highlighted by stakeholders in the power plan that we are taking a closer look at?

California Hourly Loads

- Major increases in EE, DR, electrification, and behind the meter solar and storage significantly decreased midday load requirement and pushed net peak to later in the day.
- California net peak is now a few hours later in the day than much of of the West

Reduce Hydro Spill

- Price hydro and clean resources similarly to renewables to meet annual policies.



Likely Will Decrease Total WECC Build

Adequacy Questions Guide the Updates and Questions For the Market Forecast

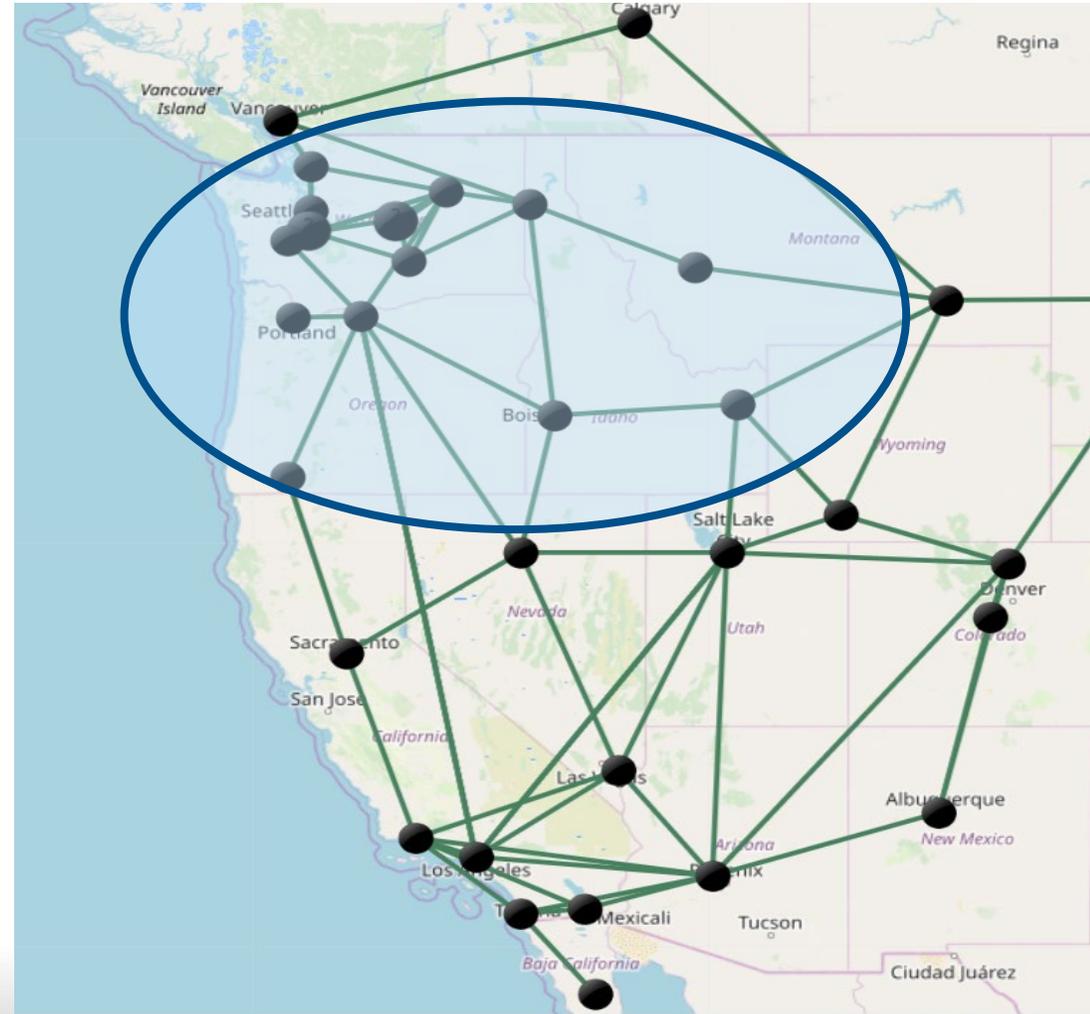
- What are the major areas of uncertainty or developments that have emerged since the plan?
 - Electrification of Loads Throughout WECC
 - Developing a scenario with higher projections of electrification outside the region
 - Supply Chain and Fuel Price Uncertainty
 - Testing implications via scenario(s)

*Likely Will Significantly
Increase Total WECC
Build*

*Likely Will Delay Some
Builds into 2030s*

What Does This Mean for Adequacy?

- The **non-regional portion** of the WECC builds will provide the available net market import capability at a particular price point with availability limited by fuel, transmission and local demand.
 - Availability has traditionally also been limited by a net market reliance limitation
 - The buildout ensures that we are acknowledging the effect of outside policies on market availability
- **Smaller builds likely means less surplus energy outside the region available for import** within approved market reliance limits during or near times of need.
 - In some scenarios, the fundamentals may limit the market more than the limits suggested by the RAAC, but it depends on when the issues occur.



RESOURCE ADEQUACY ASSESSMENT UPDATE

Outline

- Role of the Resource Adequacy Assessment
- Summary of July 8th RAAC Steering Committee
 - GENESYS update
 - Scenarios for the RA assessment
 - Proposed revision to the Council's RA standard
- Workplan and Timeline

Role of the Adequacy Assessment

- In 2011 the Council formally adopted a resource adequacy standard for the regional power supply.
- The purpose of the standard is twofold:
 1. To provide an early warning should resource development fail to keep pace with demand growth and
 2. To ensure that the power plan's resource strategy will result in adequate future power supplies

What is the Adequacy Assessment?

A resource adequacy assessment is a measure of the ability of a power system to meet the electric energy requirements of its customers within acceptable limits, considering a reasonable range of uncertainty in resource availability and in demand.

- *An adequacy standard is composed of two parts*
 - Metrics (measure of probability, frequency, magnitude or duration of shortfalls)
 - Thresholds (limits for each metric)
- *No industry-wide standard*
 - Most common metric is the Loss of Load Expectation (number of days with a shortfall)
 - Most common threshold for LOLE is 1-day-in-10-years
- *Council's current adequacy standard*
 - Metric = Annual loss of load probability (LOLP)
 - Threshold = 5 percent maximum

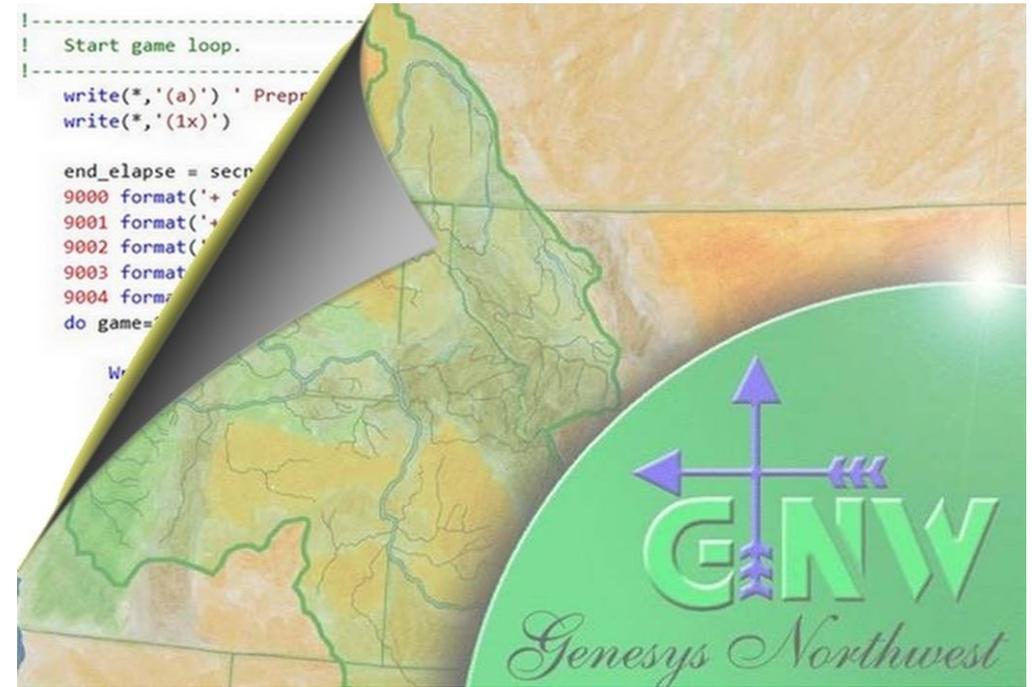
Assessing Resource Adequacy for the PNW

GENESYS Model

Performs a Monte-Carlo chronological hourly simulation of the PNW electrical power system

- Single operating year
- Random variables can include river flows, temperatures/loads, wind and solar generation and resource forced outages
- Non-stochastic simulation of other WECC power systems
- User-specified seasonal PNW import capability limitations

The PNW power supply is deemed to be adequate if the likelihood of having one or more shortfalls in a year is less than or equal to 5%, i.e., when the annual loss of load probability (LOLP) is less than or equal to 5%.



NOTE: LOLP is not the probability of a blackout – it is more accurately defined as the likelihood of having to take non-modeled emergency actions to keep the lights on.

RAAC Summary: GENESYS Update

- *General approval of model enhancement*
 - Better representation of market availability and price
 - More granular representation of the PNW
 - Agreement to add more detail to the model's WECC data
- *Concerns*
 - Potential overestimation of market availability
 - Artificial limitation on market imports
- *Anticipation of a more detailed review of hydro simulation*

RAAC Summary: Scenarios

- *Reference case* – 2027 or 2028 with current decarbonization policies
- High decarbonization or high-load
- Market variability (no or moderate WECC buildout, stressed WECC, different PNW import limit assumptions)
- Early PNW coal plant (or other large resource) retirement
- Revised expected resource and expected EE assumptions
- Planned resources (add power plan and/or IRP planned resources)

Decision on a final set of proposed scenarios has not yet been made.

RAAC Summary: New Adequacy Standard

- General support for moving to a multi-metric standard
- RAAC will investigate a variety of options including
 - Shortfall event metrics
 - Annual average shortfall metrics
 - Shortfall probability distribution tail-end metrics
 - Cost of curtailment (value of lost load) metric

Next Resource Adequacy Assessment

- *RA assessment will be based on the current standard*
 - Is the existing power supply adequate?
 - If not, then how inadequate is it?
 - Are the plan resources sufficient to maintain an adequate supply?
- *Assessment will include a proposal for a new standard*
 - Council to consider proposed design (metrics) for a new standard
 - Thresholds for the RA metrics to be refined early next year

Draft Workplan & Timeline for RA Assessment

Aug-Sept 2022

Staff reviews hydro operating constraints and market fundamentals, engages with system experts to refine GENESYS simulation.

Nov 2022

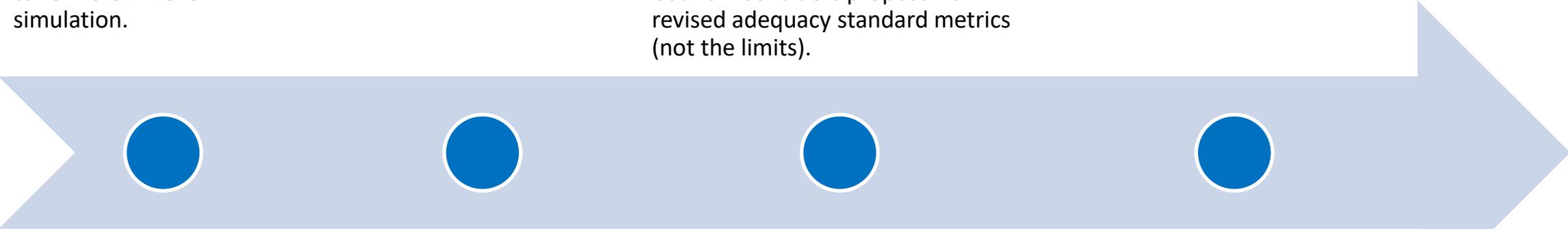
Power committee reviews RA assessment and RAAC comments. Prepares recommendation for full Council. Considers proposal for revised adequacy standard metrics (not the limits).

Sept-Oct 2022

Advisory committees review preliminary RA assessment and discuss proposal to revise the Council's adequacy standard.

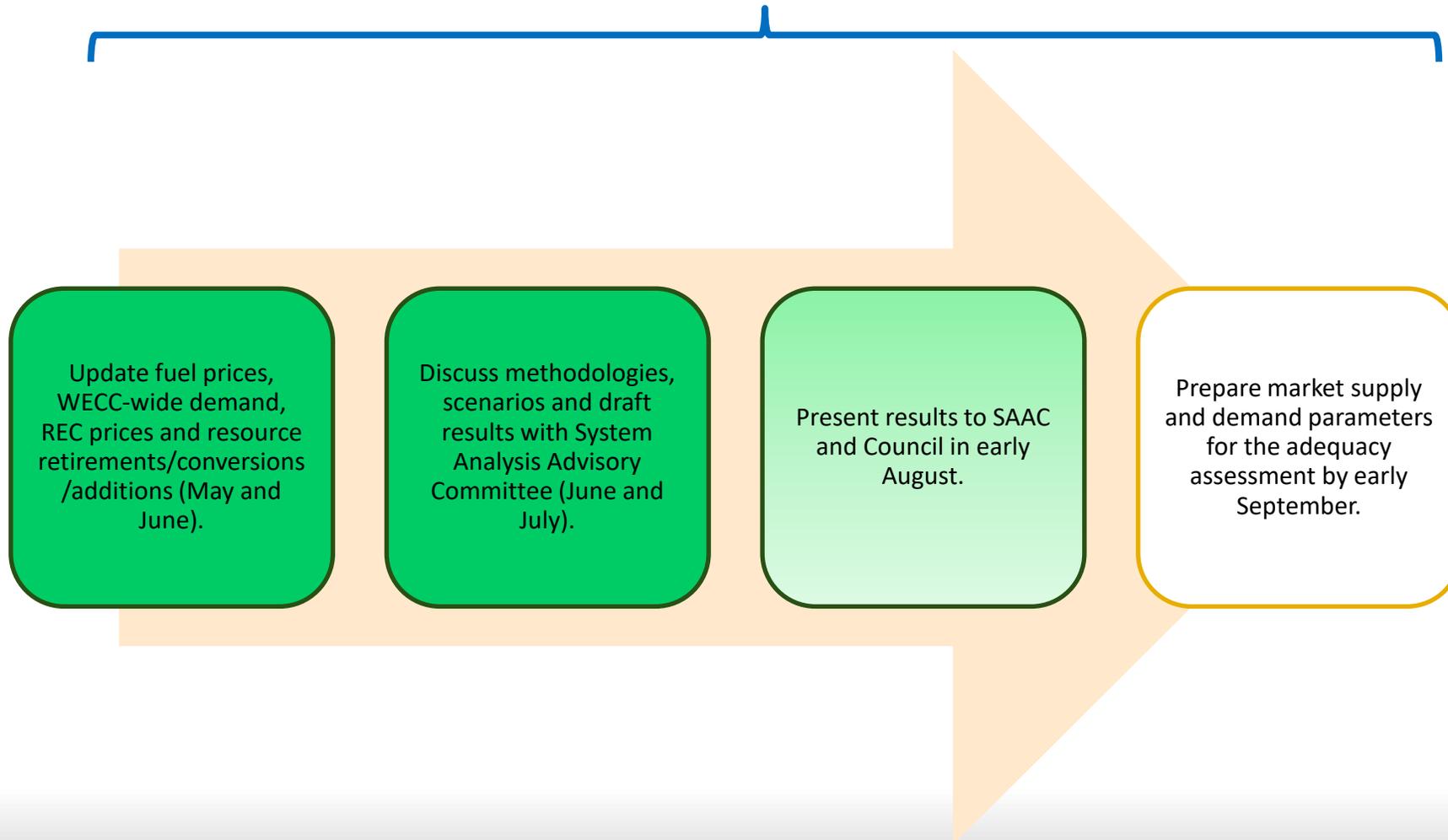
Dec 2022

Council reviews power committee's recommendation and approves release of RA assessment. Considers proposal for revised adequacy standard metrics, with the intention of finalizing the revised standard in 2023.



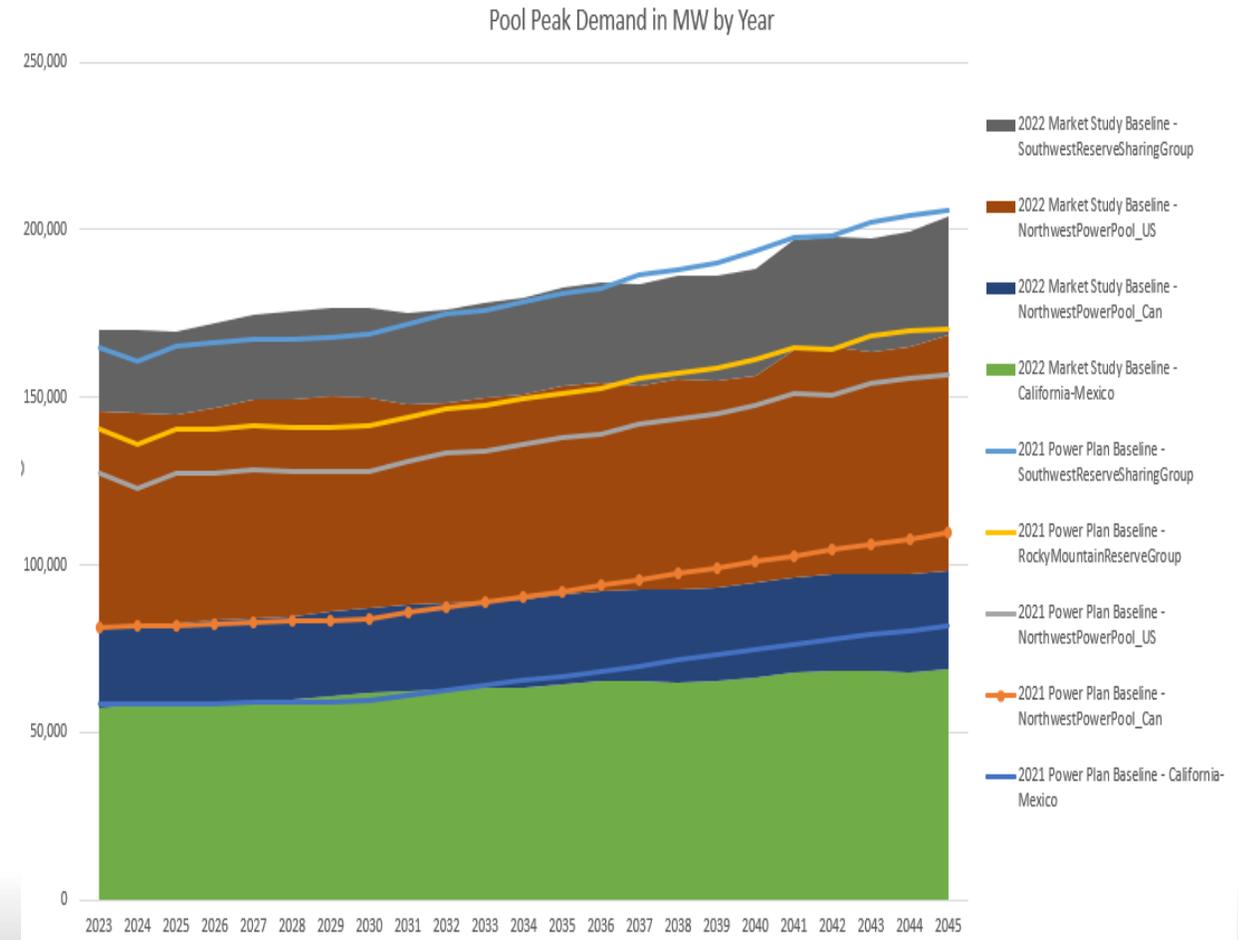
MARKET PRICE FORECAST UPDATE

High-Level Market Price Forecast Project Plan



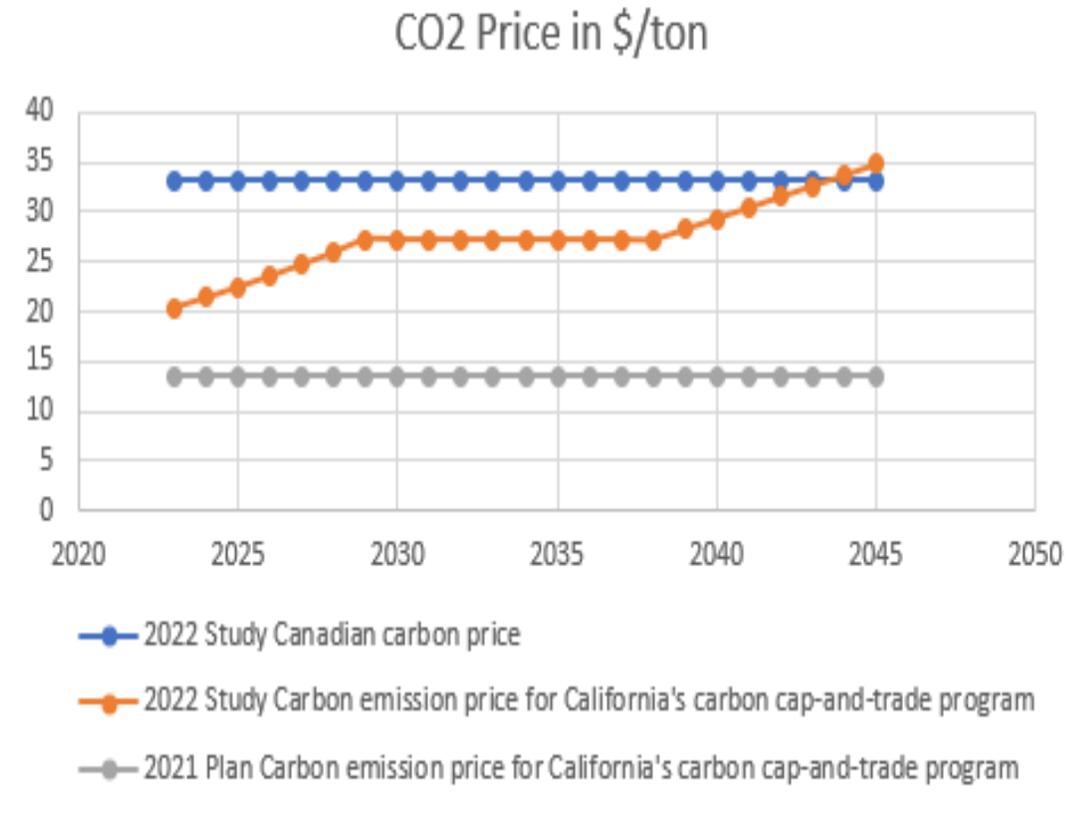
Key updates and discussion items during SAAC/RAAC Meeting on 7/27/2022

- WECC load update
 - California BTM solar, EE, and DR change hourly shape and coincident peak
 - Annual load growth is similar to previous study
- Update of existing resources
 - 25 GW of new resources since 2019
- Update of implied pricing associated with resources meeting clean/RPS policies
- Scenarios related to adequacy assessment
 - Discussion on interpretation on supply chain issues scenario



Key updates for discussion in SAAC Meeting on 8/10/2022

- Updated planning reserve margins for all reserve sharing groups to NERC reserve targets
 - NERC 2021 Long Term Reliability Assessment
 - RMMSG part of NWPP
 - California, NWPP-BC and AB reserve margins go up, NWPP-US and SRSG
- Canadian and California carbon price increases
- Impact of California hourly load shape update.



Updated Draft Buildouts Are Available But Not Yet Final

Check for updates here for the most recent information.

July 27th SAAC/RAAC

<https://www.nwcouncil.org/meeting/resource-adequacy-and-system-analysis-committee-meeting-2022-07-27/>

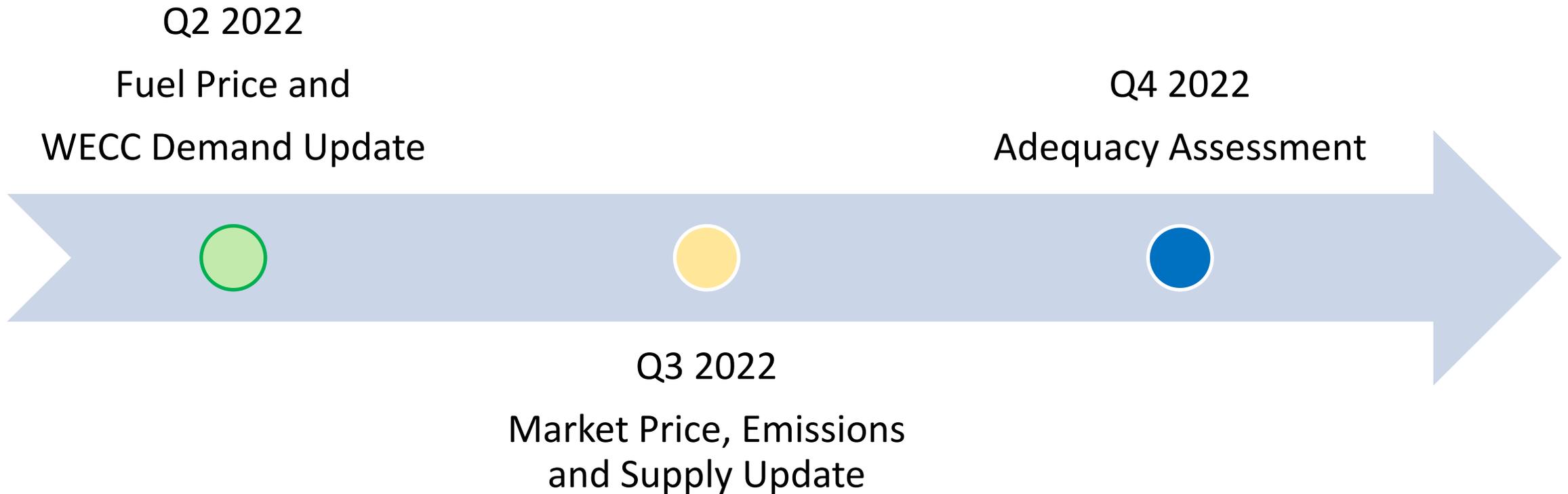
August 10th SAAC

<https://www.nwcouncil.org/meeting/system-analysis-advisory-committee-2022-08-10/>

High Level Summary of Outstanding SAAC Concerns

- Current buildouts are meeting energy and policies requirements as expected, but continued work is needed to ensure the following requirements are met in a reasonable way are required.
 - Deliverability (where resources are built)
 - Peak needs (where and how much resource is built)
- SAAC participants also interested in the following related to buildouts:
 1. How buildouts from AURORA will be used in adequacy assessment.
 2. Implications of counting on capability of thermal generation as a reserve if too expensive to retain (IPPs).

Reminder of Timeline



Scenarios to Inform Adequacy Assessment

Scenarios in black require a buildout, those in red do not

Set up scenarios that will help the RAAC frame market risk in 2027-2028 time period

- Plan Scenarios:

- Baseline ← *Control*
- Limited Markets (No PRM enforcement, policy compliance) ← *Lower supply*

- New Scenarios:

- **Increased Electrification Throughout WECC (High WECC Demand)** ← *High demand & supply*
 - Supply chain issues (delay and limit early builds, high gas prices) ← *Lower supply?*
 - *CA/Desert SW Drought (no or low hydro)*
 - *Gas Pipeline Issues Desert SW (gas plants not available)*
 - *No new WECC builds (per SAAC/RAAC request)*
- } *Lower supply*

Discussion

- Are there any other questions we should be exploring in these annual studies this year?