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August 4, 2020

MEMORANDUM

TO: Council Members

FROM: John Ollis, Manager of Planning and Analysis

SUBJECT: 2021 Power Plan Draft Wholesale Electricity Price and Avoided CO₂ Emissions Rate Forecast

BACKGROUND:

Presenter: John Ollis

Summary: This presentation will inform the Council on the results of the 2020 wholesale electricity price forecast and avoided emissions rate study updates for the 2021 Power Plan, and the response from the System Analysis Advisory Committee. These studies have been updated to incorporate plant retirement updates, municipal and utility policies/goals that have been announced since the Seventh Power Plan's Mid-Term Assessment and the 2019 price forecast update. Additionally, this forecast includes climate change data, updated demand WECC-wide, fuel price updates and updated information on generating resources.

Relevance: The Council periodically updates a 20-year forecast of electric power prices and avoided emissions rate studies using the AURORA model. The AURORA model dispatches all resources in the WECC generating a fundamentals-based wholesale electricity price forecast.

The study of avoided carbon dioxide production rates of the northwest power system will evaluate what the implied avoided carbon emissions rate is in the WECC and the implications for regional conservation replacing the need for that production.

Since the development of the midterm and previous avoided emissions rate study, more baseload plant retirements have been announced and further clean policies and goals have been announced. These municipal, utility and state policies/goals along with the retirements and pressures on conventional fossil fuel resources continue to fundamentally change the wholesale market dynamics in the WECC, and this updated price forecast helps Staff incorporate the effects of these changes on Mid-C market prices and the implied avoided market emission rate.

For the 2021 Power Plan, the Regional Portfolio Model will use the power prices from this study to develop electricity price futures which are used as a starting point for resource valuation in the resource strategy analysis. Additionally, the avoided market emissions rate is used in the resource strategy analysis to determine the emissions associated with reliance on the market.

Workplan: Forecast Wholesale Electricity Prices (A.6.3)

Background: The Council's wholesale electricity price 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.

Additionally, the cost of future carbon dioxide regulation has been a significant factor in resource planning in the Pacific Northwest. To avoid making higher cost resource choices, a direct evaluation of this risk requires an estimate of the carbon dioxide emissions avoided by purchasing conservation or another resource. The Council has periodically updated this study using the AURORA model to help inform Council staff and regional stakeholder analysis.

More Info: Slides for this presentation are pending on ongoing studies and recommendations from the August 5th, 2020 System Analysis Advisory Committee meeting.

Previous studies:

[2019 Wholesale Price Forecast Update](#)

[Wholesale Price Forecast in 7th Plan Midterm](#) (see 3-10 through 3-17)

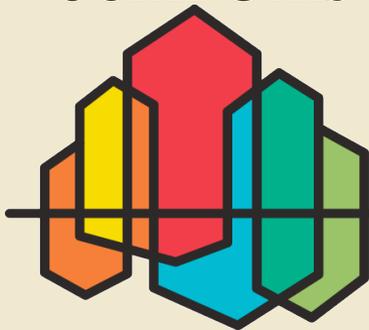
[Avoided Carbon Dioxide Production Rates in the Northwest Power System](#)

2021 Power Plan Draft Wholesale Electricity Price and Avoided CO₂e Emissions Rate Forecast

Power Committee

August 11th, 2020

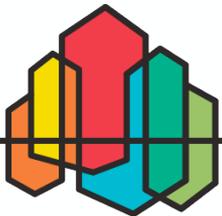
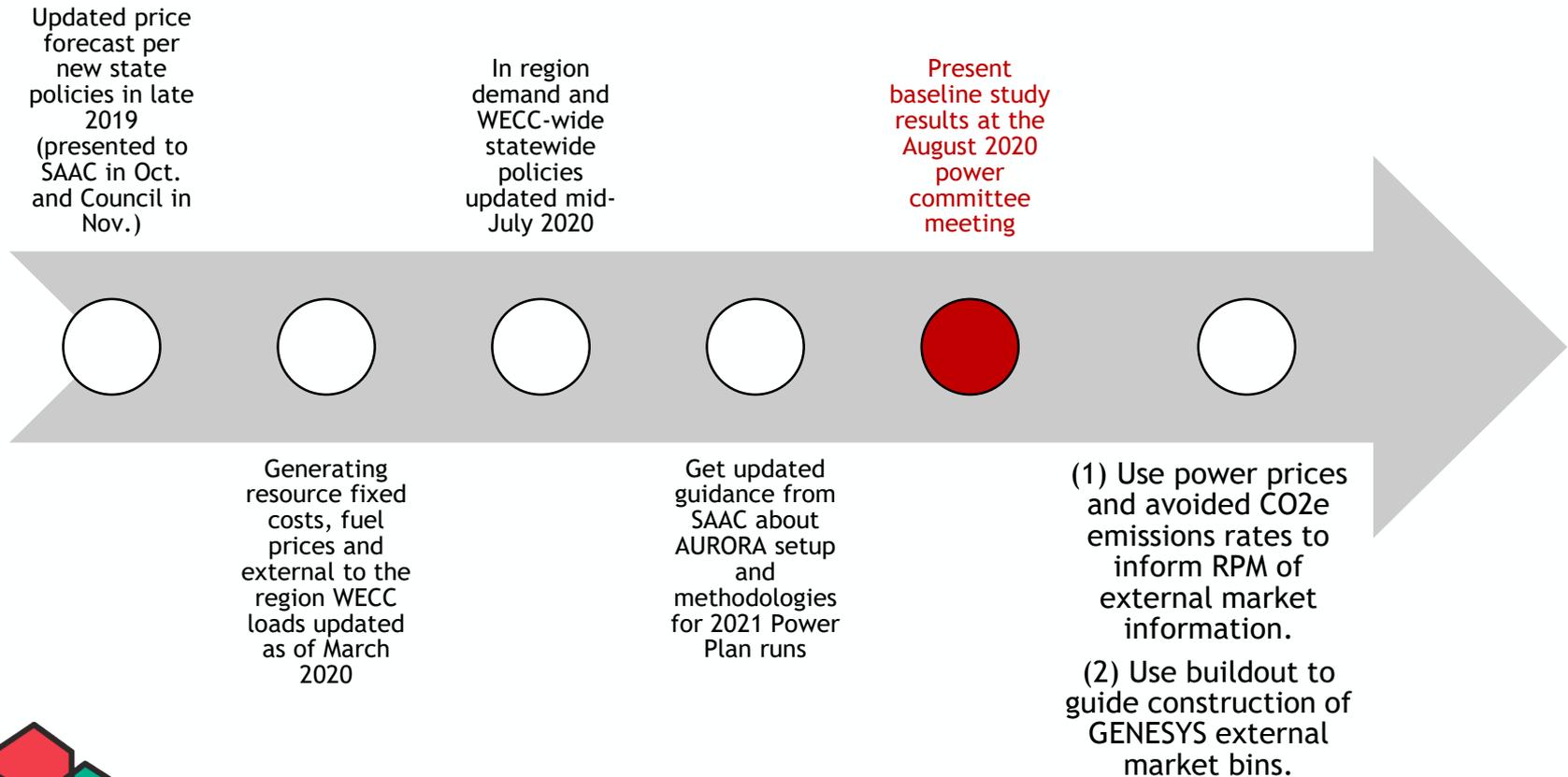
John Ollis



THE 2021
NORTHWEST
POWER PLAN

FOR A SECURE & AFFORDABLE
ENERGY FUTURE

Timeline – *Wholesale Power Price and Market Emissions Rate Forecast*



Recall: Use of the External Market Information in the RPM

- Regional Portfolio Model (RPM) uses the market price forecast information from AURORA as a first step in its economic analysis or resources and equilibrium pricing.
- RPM accounts for the emissions of market purchases via the avoided market emissions rate calculation.
- Keeps the regional portfolio model from having to perfectly meet the supply demand balance of the region.

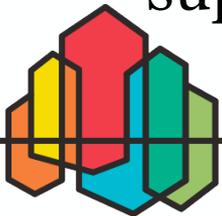
2021 Plan
Regional Strategy



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External Market
Assumptions

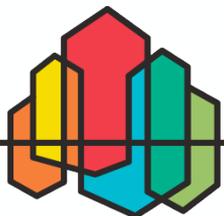




NERC Assessment Areas

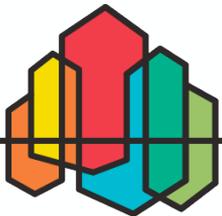
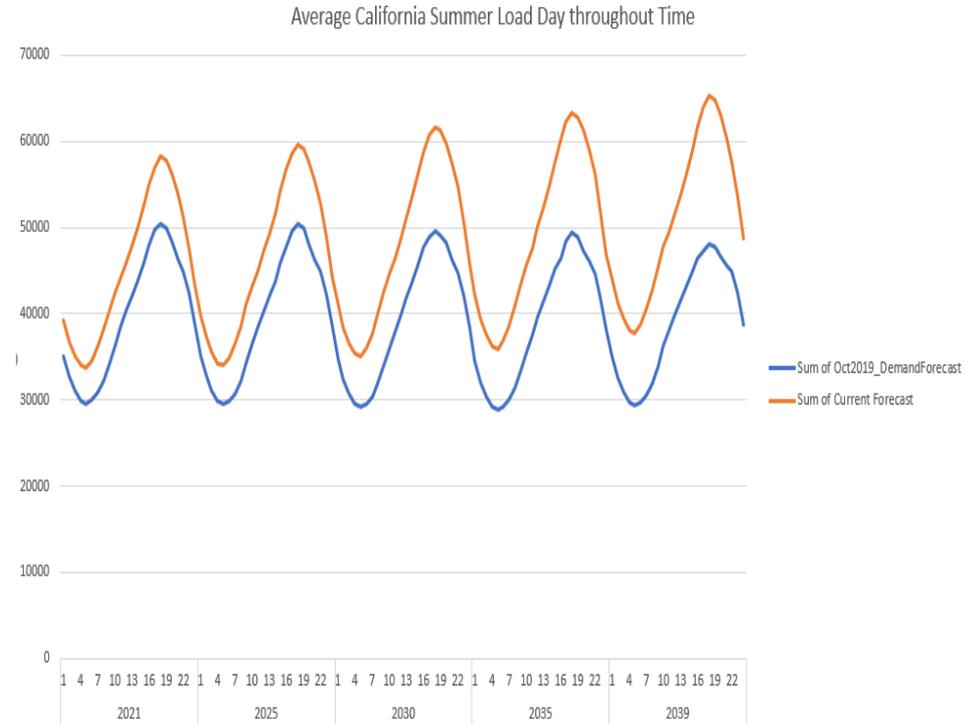
Building out the WECC to Regional Reserve Margins

- Before we can run prices, we need to simulate likely plant buildout in all of the WECC.
- Key reasons to build.
 - 1. Planning Reserve Margins for each reserve sharing group.**
 - Southwest Reserve Sharing Group
 - Rocky Mountain Reserve Sharing Group
 - California ISO (includes part of Baja California)
 - Northwest Power Pool US
 - Northwest Power Pool Canada
 - 2. WECC clean and RPS policy levels.**
 - 3. Peaking capability/need timing**

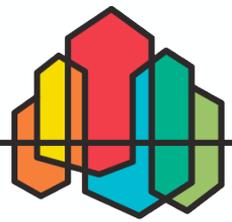
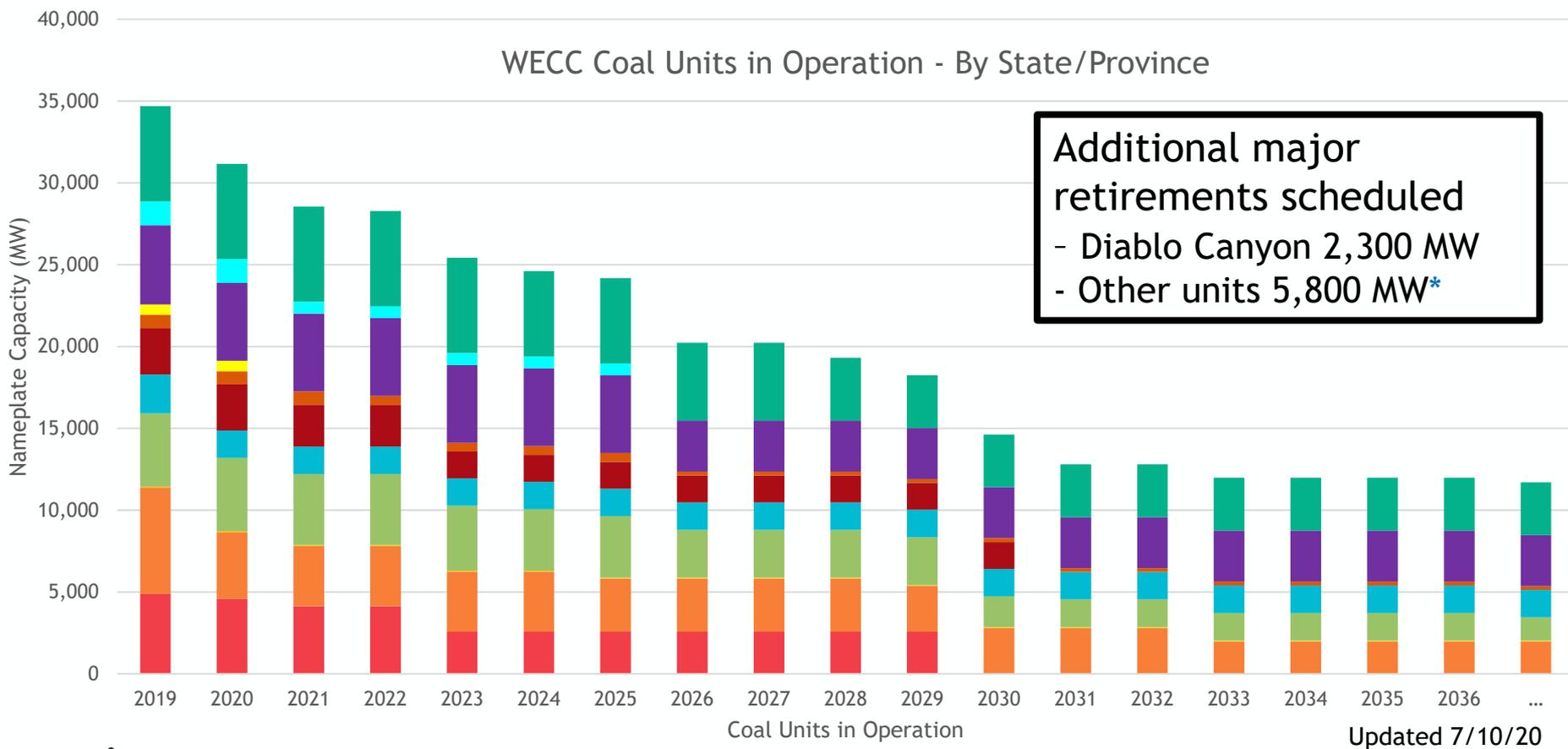


Data Updates of Note Since Last Price Study

- More announced resource retirements
- Higher Clean/RPS targets
- Seasonal hydro, wind and demand shifts due to climate change data in the NW
- Higher demand forecast for California
- Hourly demand shapes from AURORA



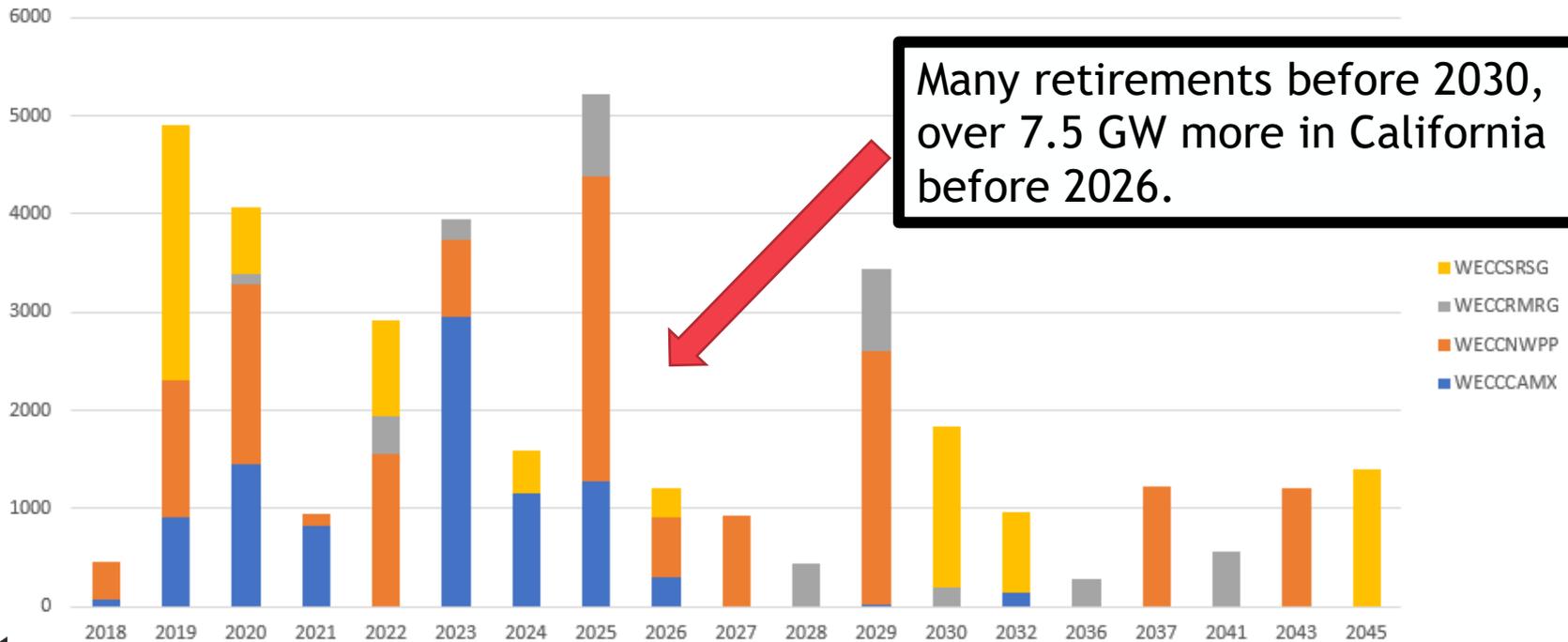
WECC coal units in operation, decreasing over time...



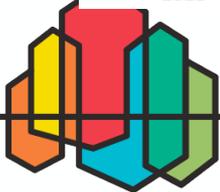
*Over 1,300 MW of gas units in CA replacing OTC retirements

Retirements in WECC: 37 GW Nameplate of Capacity

Dispatchable Plant Retirements By Nameplate MW by Reserve Sharing Group

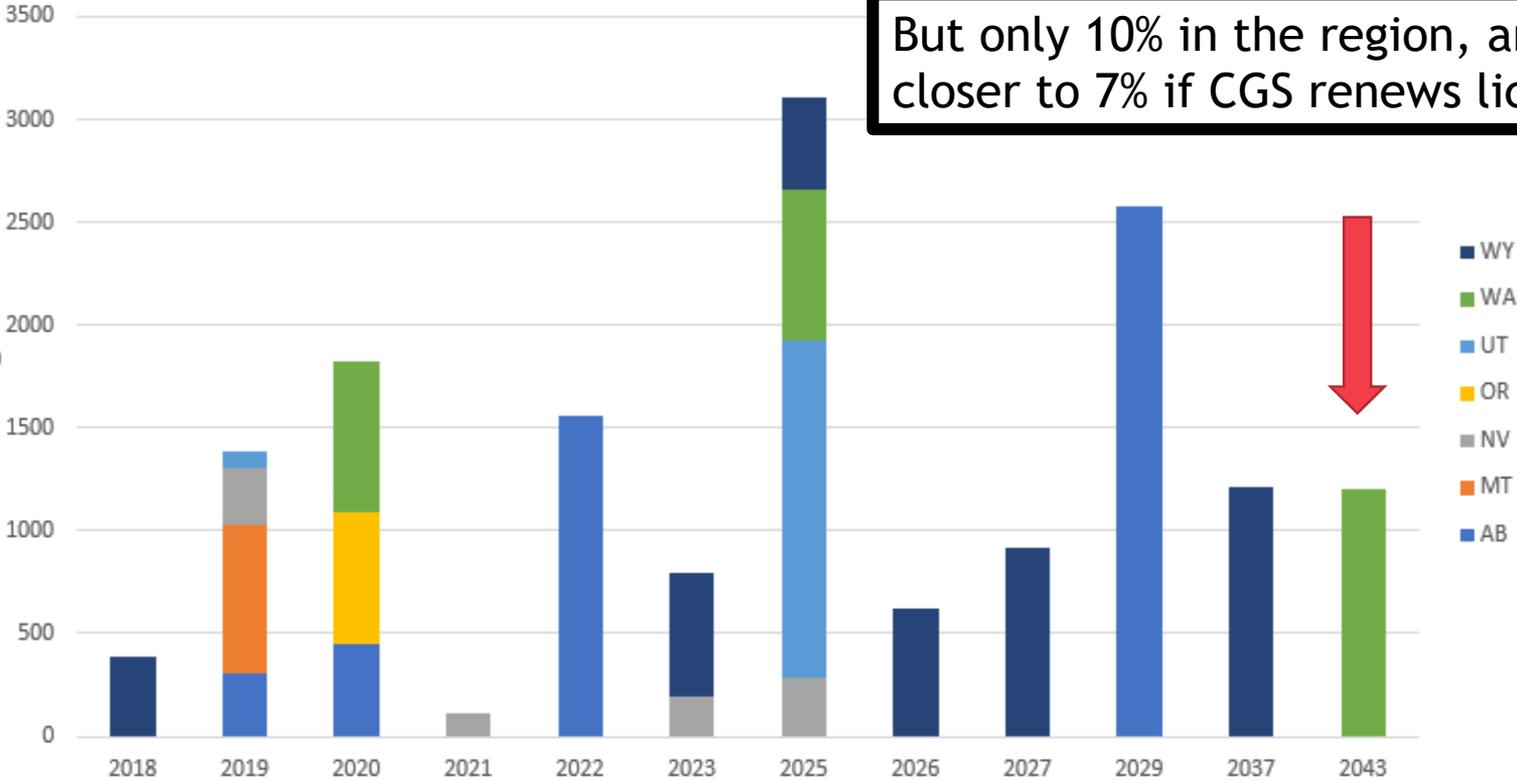


Many retirements before 2030, over 7.5 GW more in California before 2026.



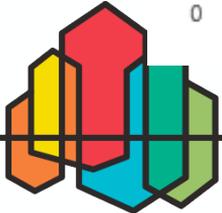
Over Forty Percent of Retirements in the Northwest Power Pool

Dispatchable Plant Retirements By Nameplate MW in NW Power Pool

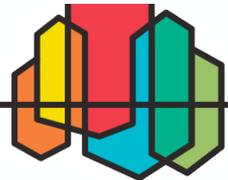
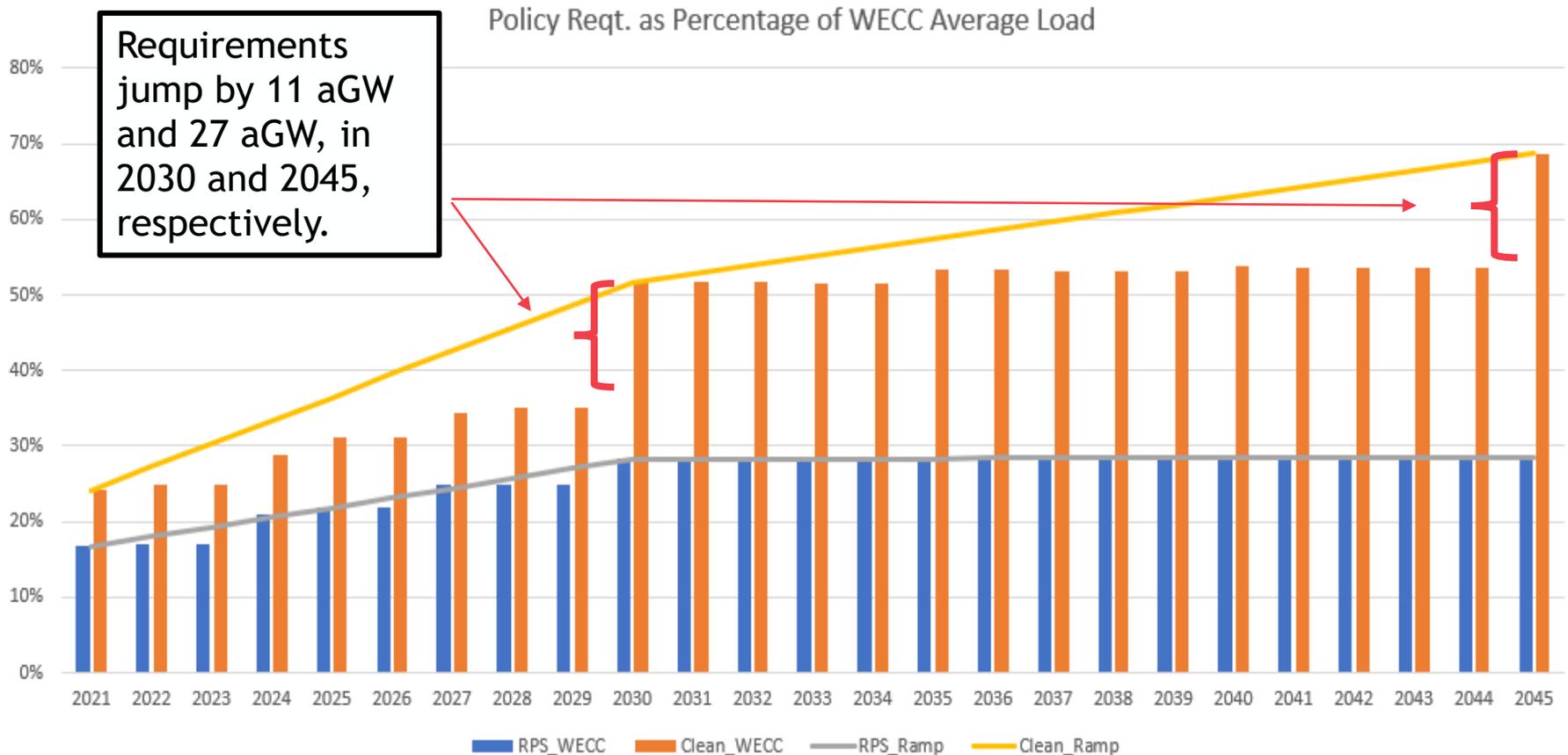


But only 10% in the region, and closer to 7% if CGS renews license

~11,700 aMW in Alberta, Nevada, Utah and Wyoming



Clean/RPS Policies: *Direct Interpretation Versus Interpolation for Modeling*



Without some interpolation the model has a hard time solving the problem.

Buildout Chat with the System Analysis Advisory Committee

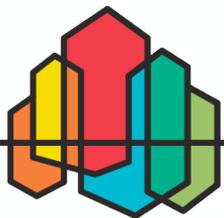
Presented preliminary results to the SAAC.

- Both staff and the SAAC were uncomfortable with multiple aspects of the AURORA buildout.

Main Suggestions:

1. Back off high electrification assumptions on post 2030 loads in CA.
2. Interpolate policy targets instead of direct interpretation.
3. Explore further use of dynamic peak credit in AURORA
4. Apply further limitations to gas builds.

Staff has followed up with the SAAC via email with updates on results of the early simulations implementing the suggestions, and will follow up further as more is known.



Buildout Comparison Presented at the SAAC

Cumulative Buildout in Nameplate MWs by Year

Limited Gas per Regulatory and Policy Climate (October 2019)

Year	Solar	Natural Gas	4 Hour Battery	Wind	Solar with Battery	Geothermal
2025	16,050	17,082	6,100	38,600	12,300	0
2030	30,900	19,362	8,100	68,800	18,500	0
2035	39,000	20,220	8,100	91,400	22,100	546
2040	42,150	20,649	8,100	100,900	22,700	858
2045	46,350	20,649	8,100	102,400	22,800	1,170

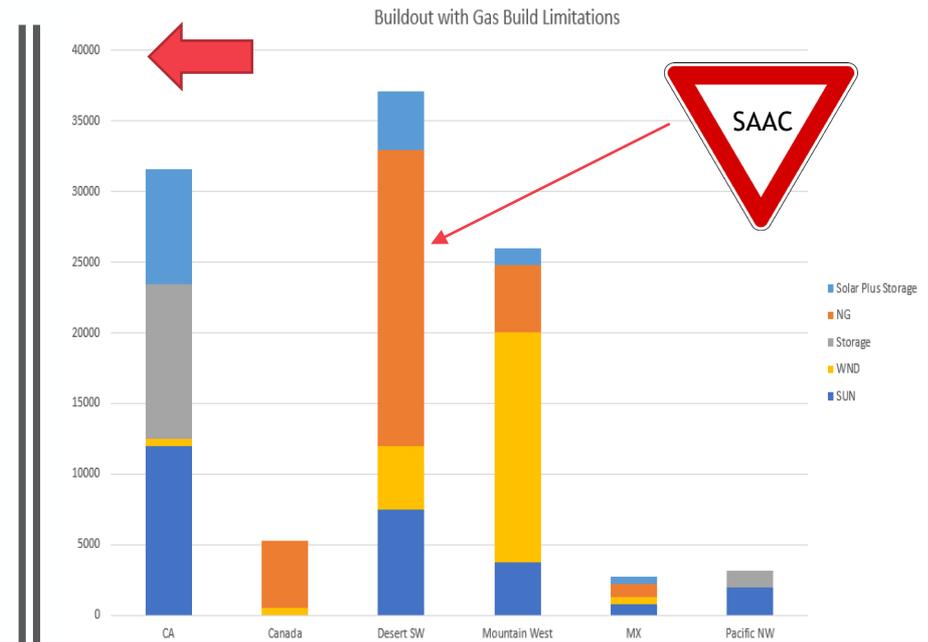
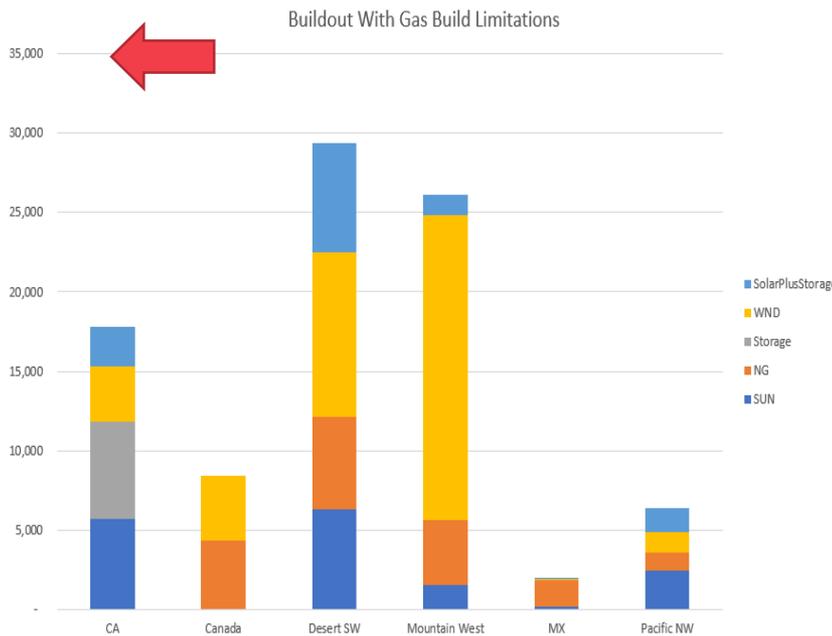


Limited Gas per Regulatory and Policy Climate (August 2020)

DRAFT

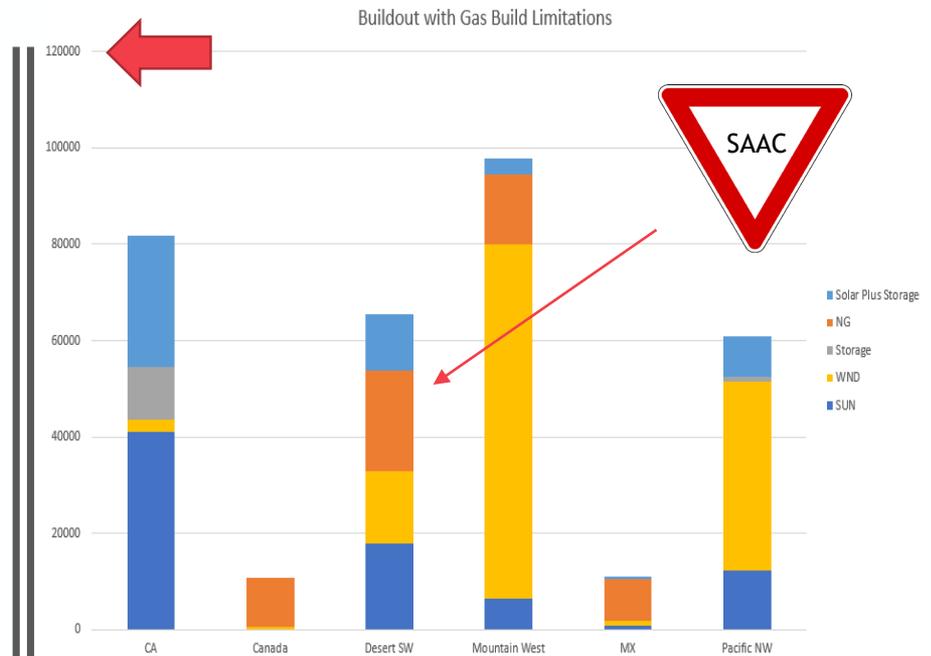
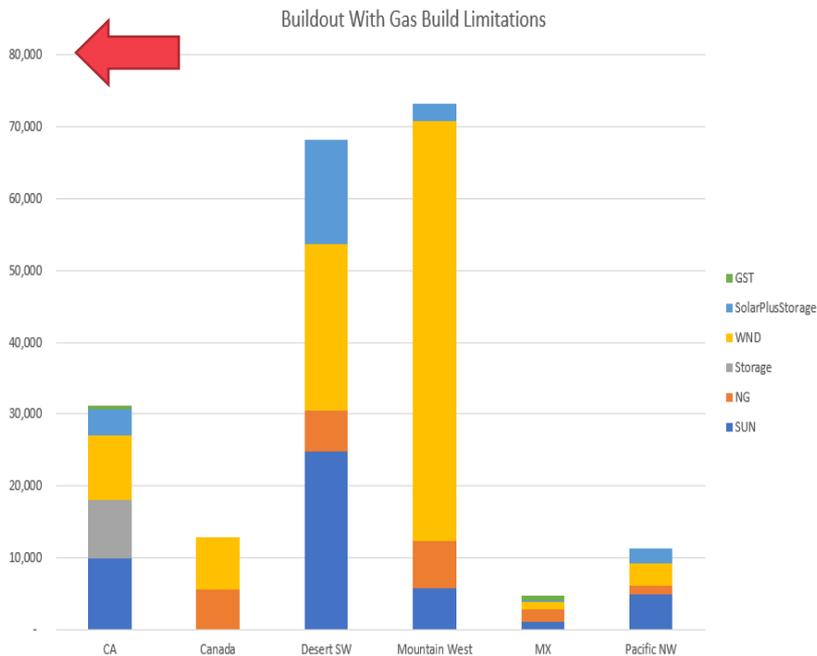
Year	Solar	Natural Gas	4 Hour Battery	Wind	Solar with Battery	
2025	25,950	31,423	12,100	22,300	14,100	
2030	45,450	39,545	12,100	47,400	25,800	
2035	69,300	46,481	12,100	67,200	43,700	
2040	77,250	51,514	12,100	109,400	50,300	
2045	78,450	54,517	12,100	131,600	51,200	

Where and what new resources are built by 2025?

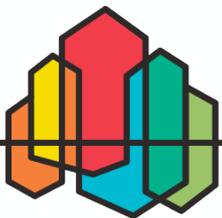


During Action Plan time period buildout is of similar magnitude with more new gas resources filling in for thermal retirements and load increases.

Where and what new resources are built by 2045?

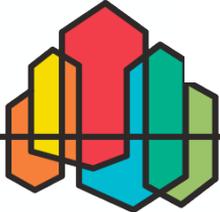
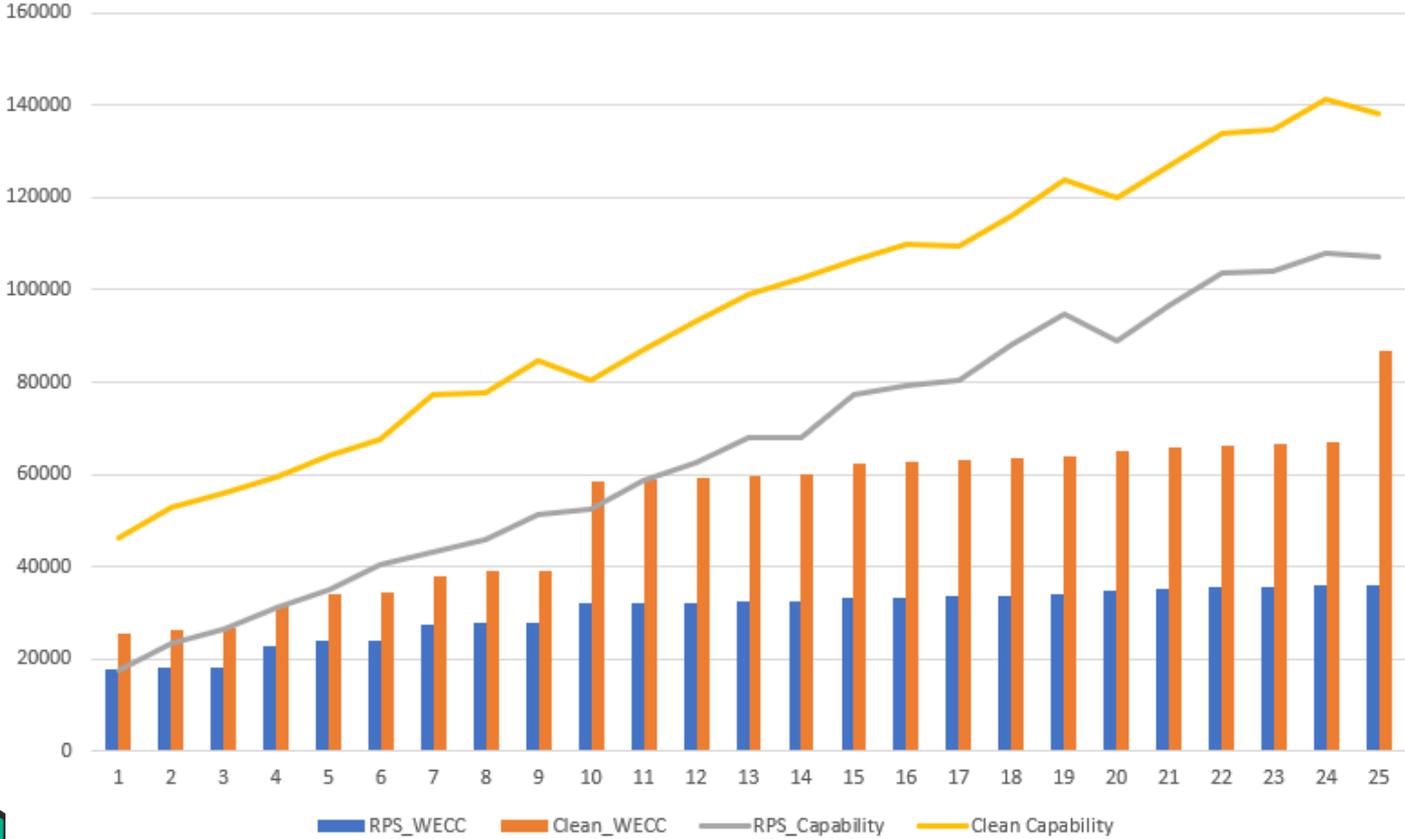


NW hydro contributes less and the NW demand is higher during times when the rest of the WECC is peaking leading to more builds in the NW.



Capability more than Requirements on Policies/Goals

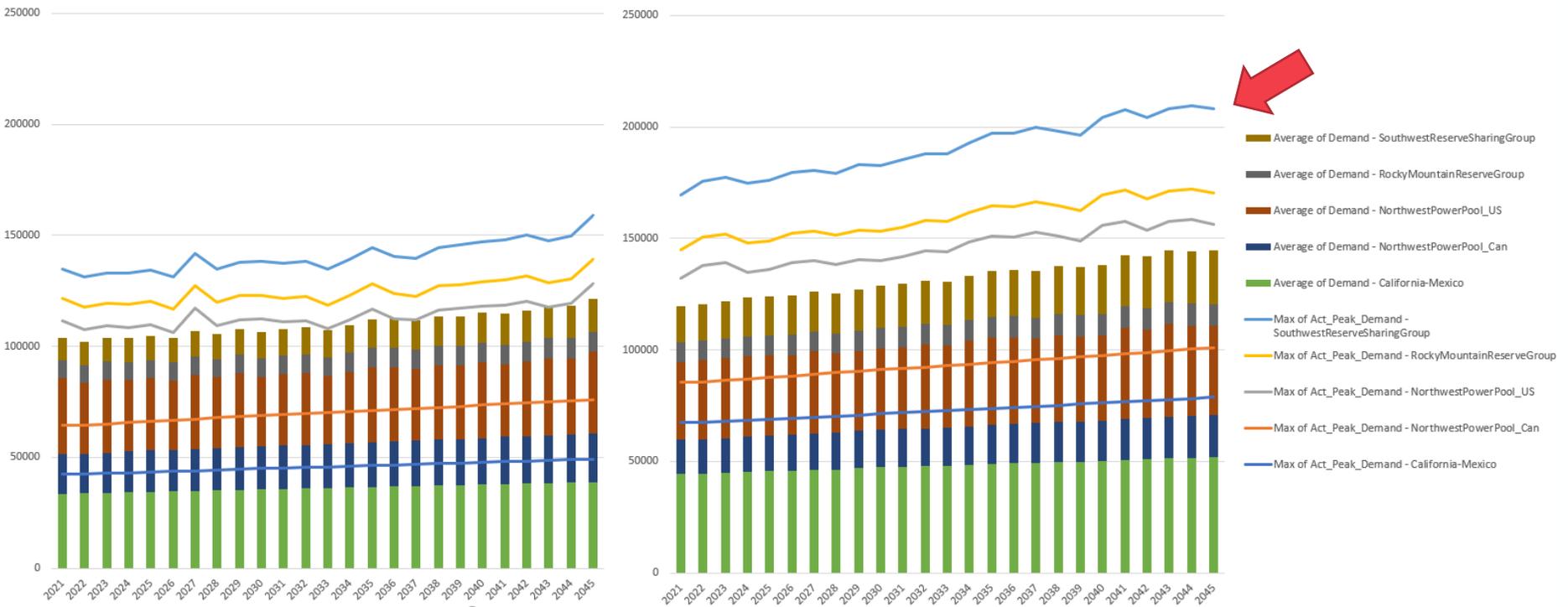
RPS/Clean Policies versus Capability in aMW



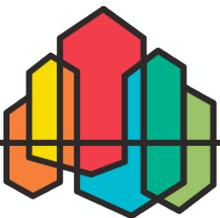
WECC Plans to Peaks in the Summer

Q1 Loads by Reserve Sharing Pool

Q3 Loads by Reserve Sharing Pool

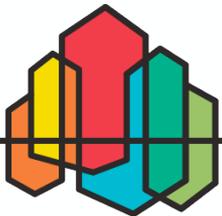


Traditionally NW peak has been diverse to WECC peak.



Attempting to Itemize Build Reasons

- **Economics (energy only)** –
 - 1,681 MW (4 CCCT gas plants in Alberta replacing coal retirements)
- **Economics (energy, capacity)** –
 - 3,750 MW of solar (in NWPP) and 15,922 MW of gas (Alberta and Baja CA).
- **Clean/RPS Policies**
 - 70,950 MW of solar, 51,200 MW of solar plus storage and 131,600 of wind (~90 to 100 aGW of renewable energy) qualify.
 - Only ~62% of that build is necessary, why build over 51 aGW too much
- **Planning Reserve Margin and Load Growth**
 - Approximately 12 GW of Battery, 96 GW of renewables and 22 GW of gas built to maintain reserve margins



Buildout Issues

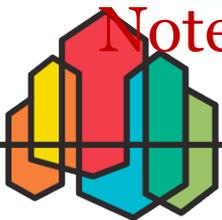
- Gas build in Desert SW seems unlikely, however further limitations seem to exacerbate the problems elsewhere.
- Overbuild of renewables expected to some extent but seems slightly larger than needed to meet policies.
 - Current AURORA setup does not have EE, DR, wind plus battery or other hybrid clean resources.
- California policy will likely include more demand but also more currently unknown demand side measures and behind the meter shaping that may mitigate daily shape issues.



Preliminary Price Discussion

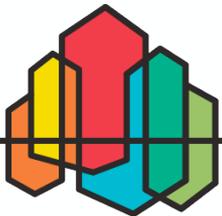
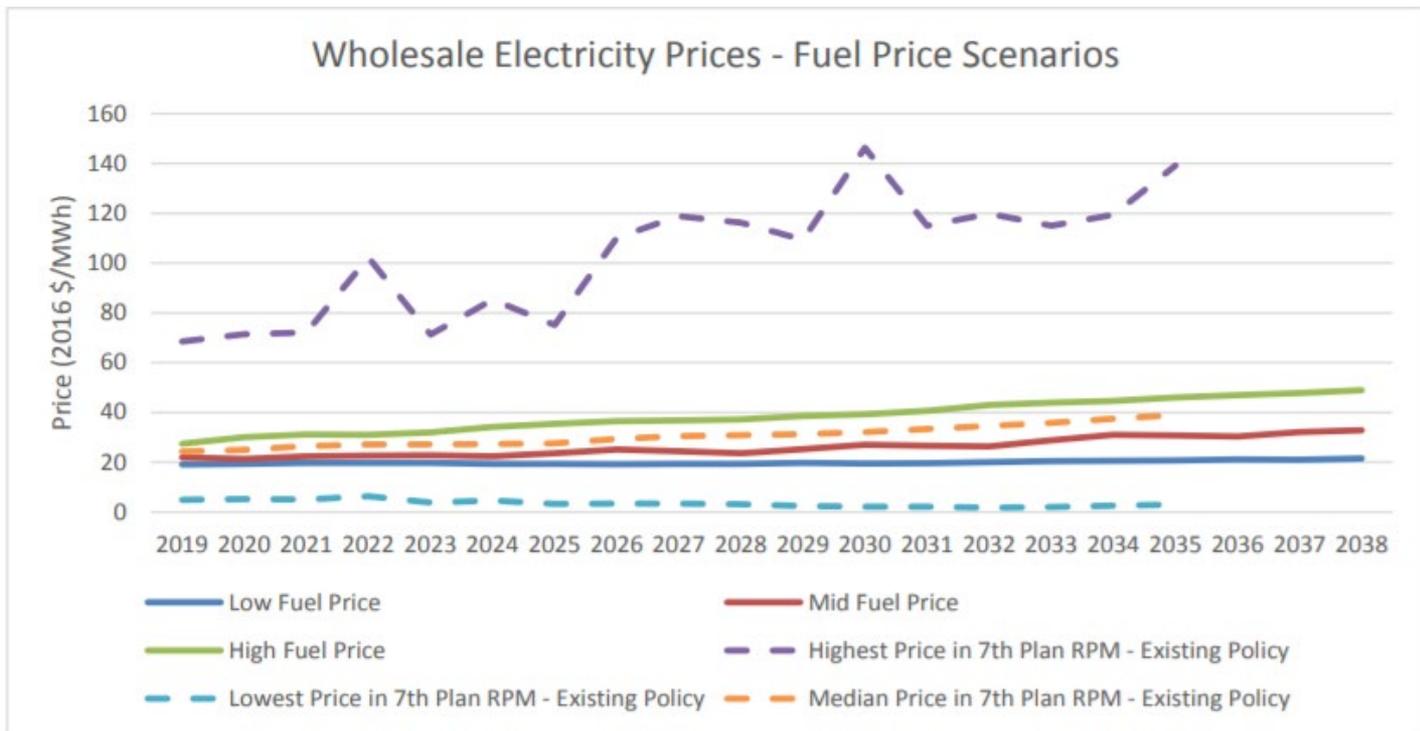
- Previous study pricing for context
- Prices are starting point for developing RPM price futures
- Do not have to be perfect, but need a buildout in AURORA that is resource sufficient and complies with policies to get realistic pricing.

Note: All prices are in 2016 dollars per MWh.



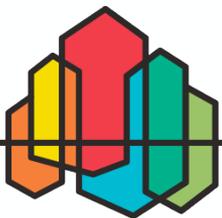
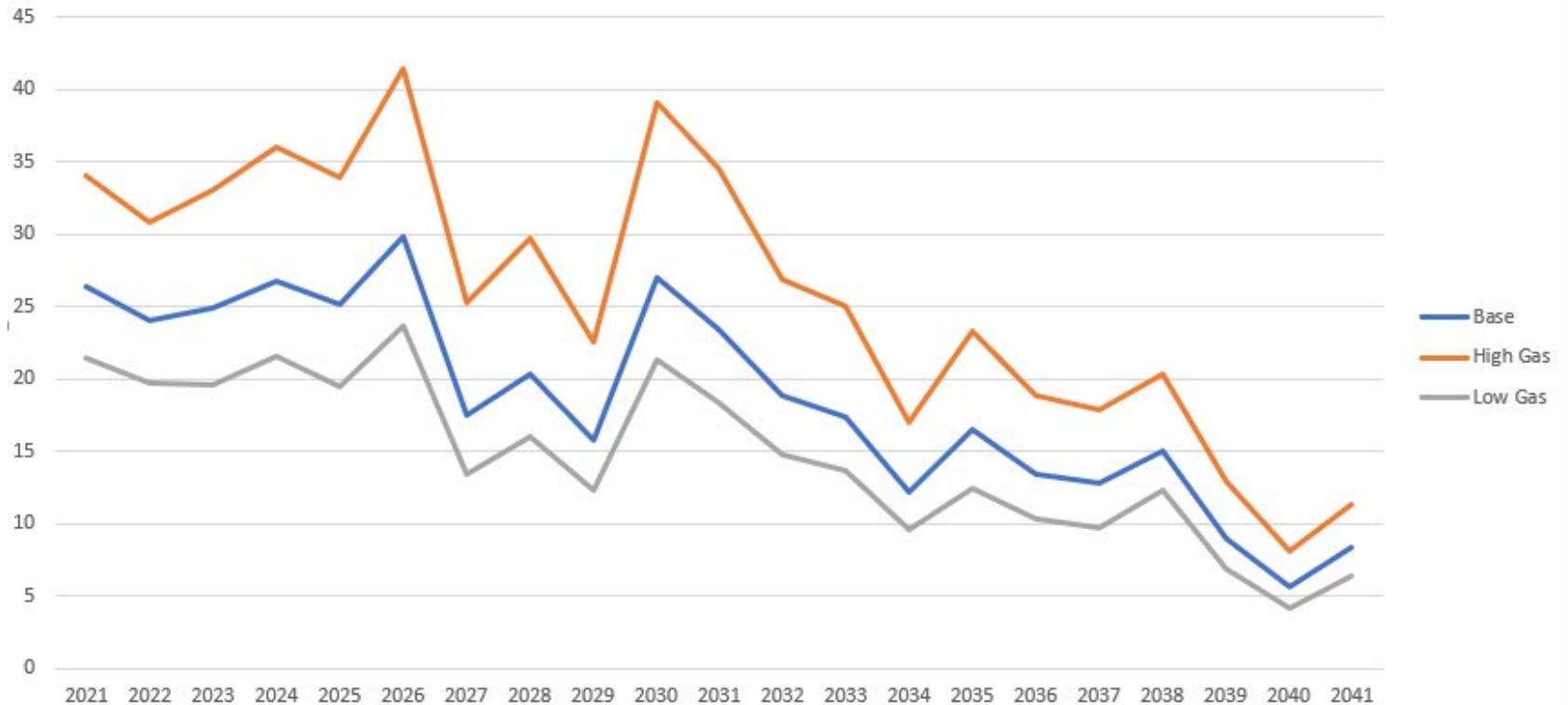
Price Ranges in Midterm and Seventh Power Plan

Figure 3 - 7: Annual Wholesale Electricity Prices Under Different Natural Gas Price Forecasts



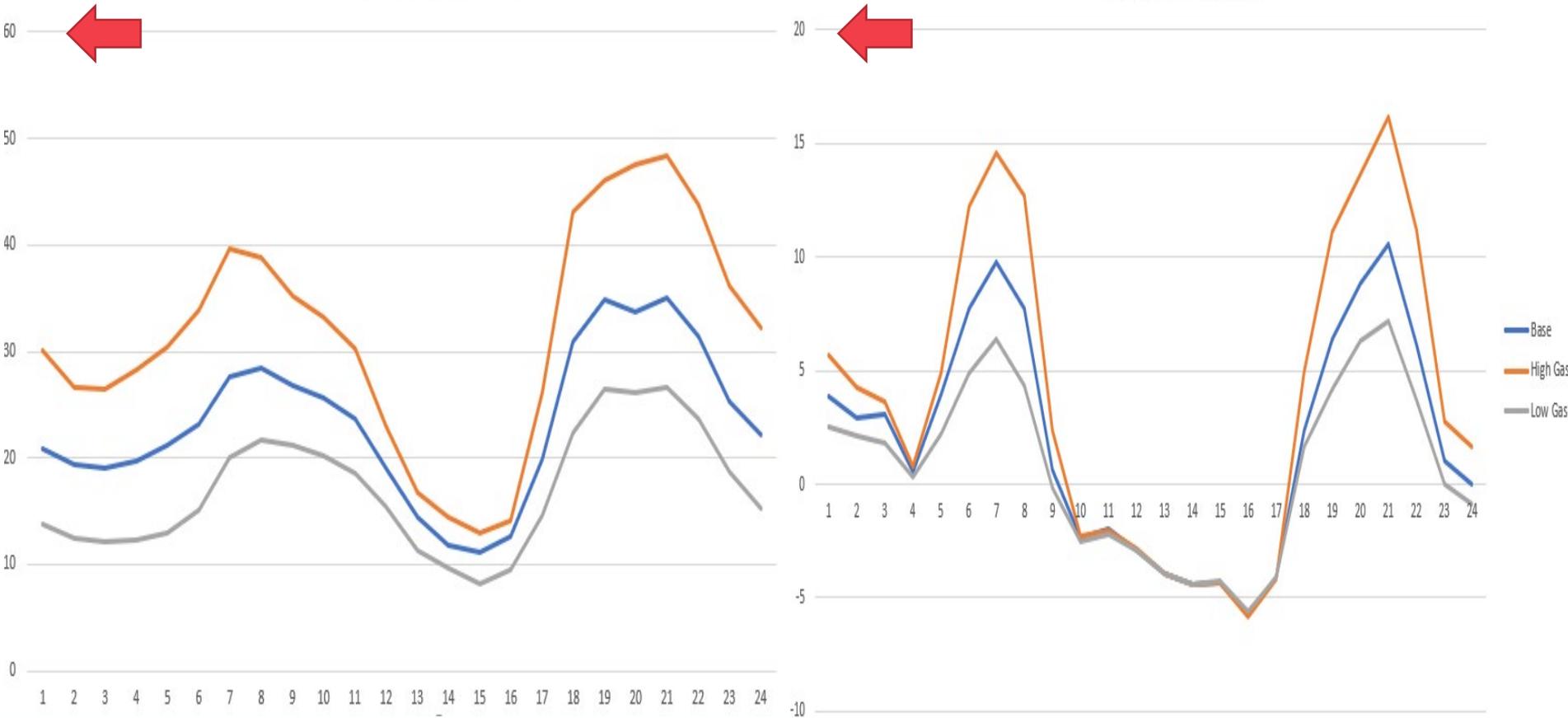
Preliminary Price Forecast (1 CC Scenario)

Prices (in 2016 \$/MWh)

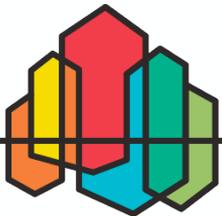


Prices (in 2016 \$/MWh)

Prices (in 2016 \$/MWh)

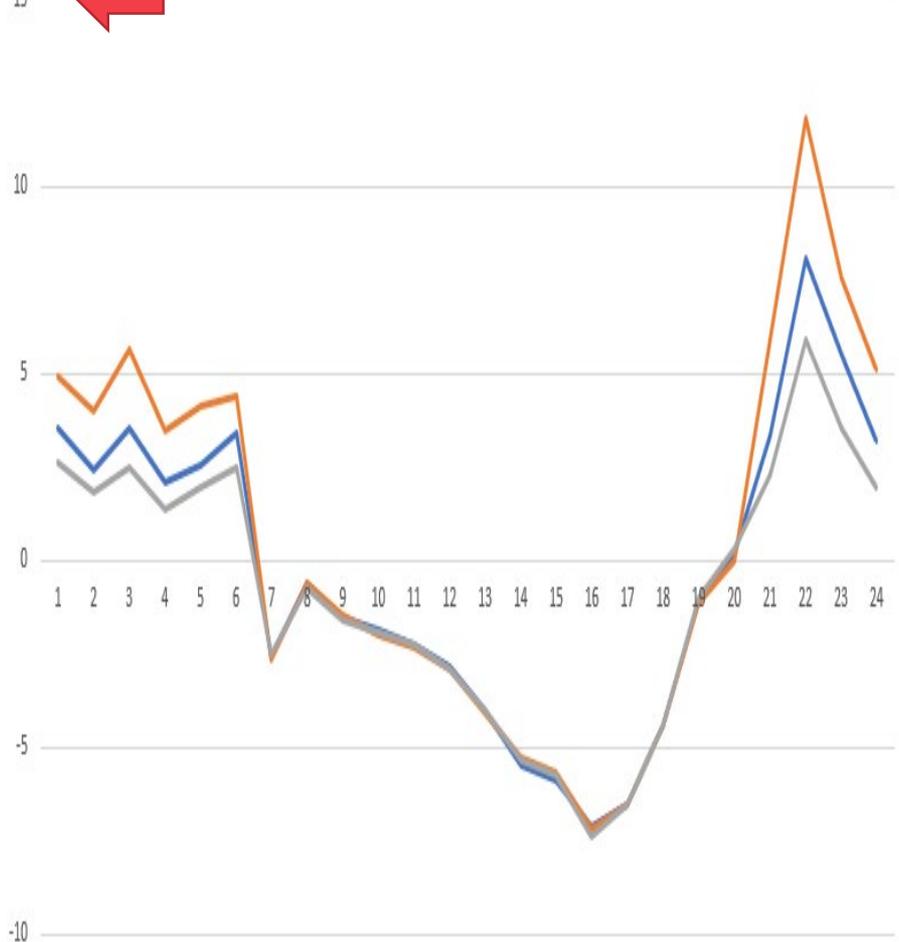
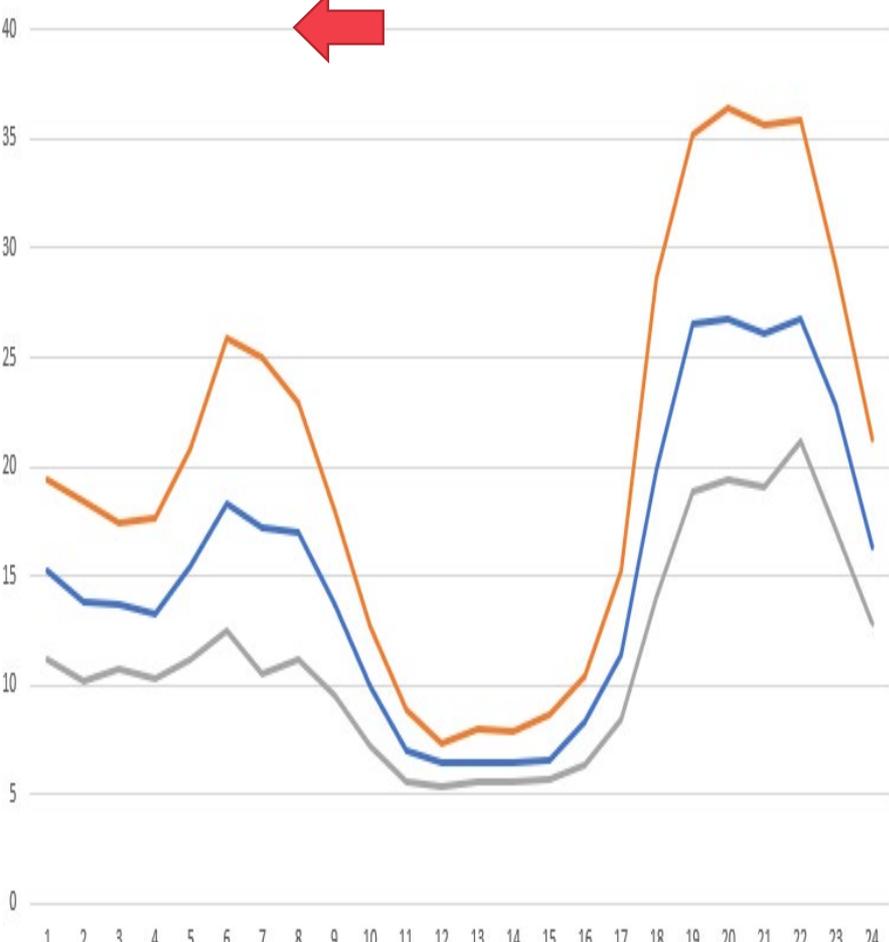


Daily Price Shape Q1 (2025 and 2041)

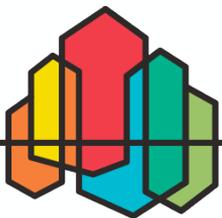


Prices (in 2016 \$/MWh)

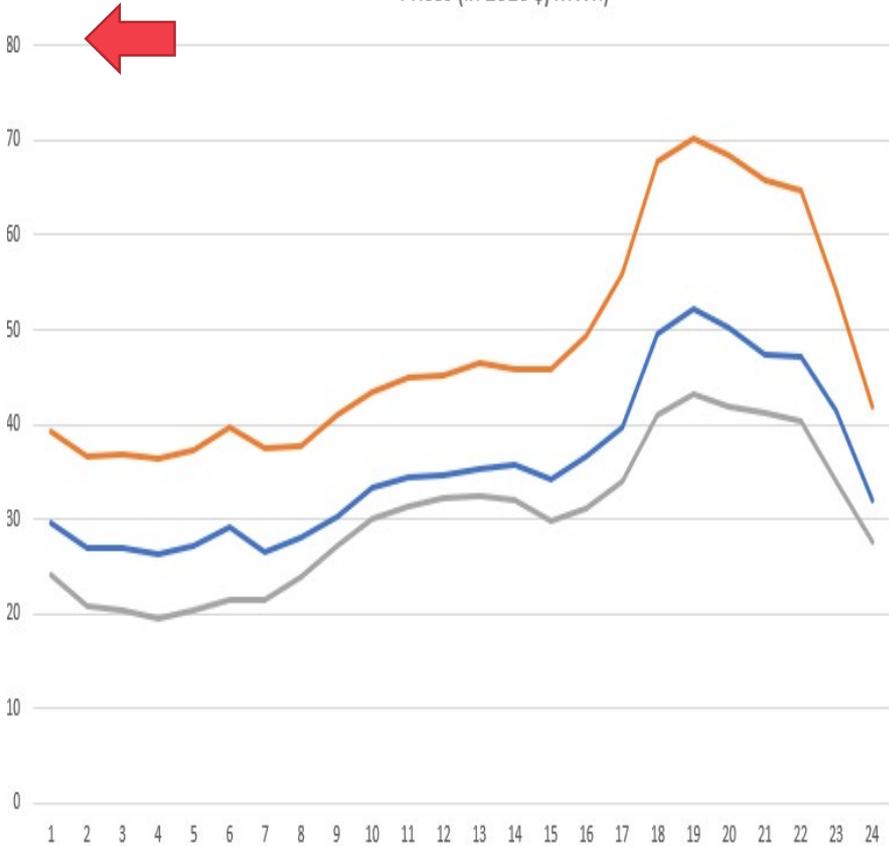
Prices (in 2016 \$/MWh)



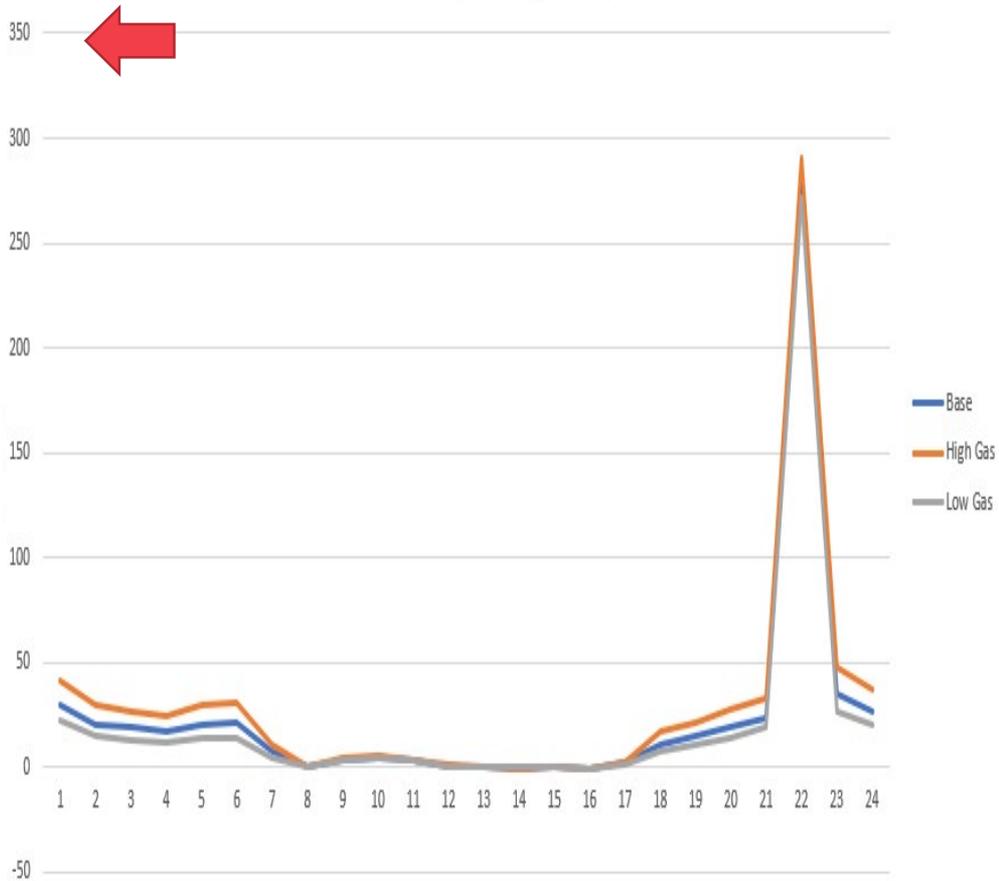
Daily Price Shape Q2 (2025 and 2041)



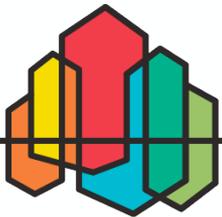
Prices (in 2016 \$/MWh)



Prices (in 2016 \$/MWh)

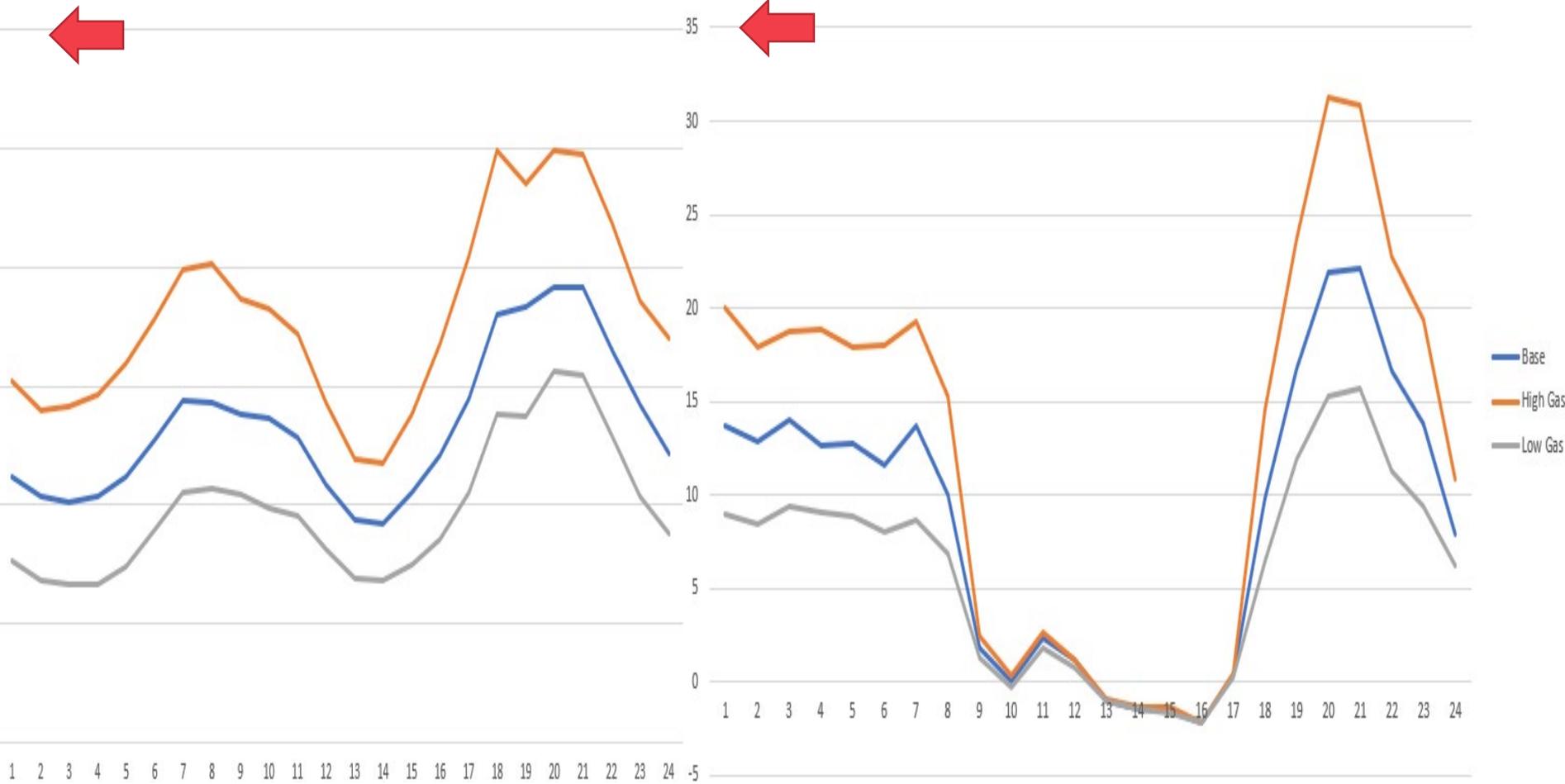


Daily Price Shape Q3 (2025 and 2041)

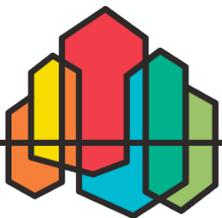


Prices (in 2016 \$/MWh)

Prices (in 2016 \$/MWh)

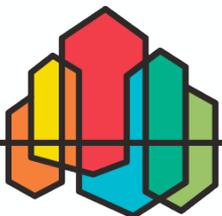
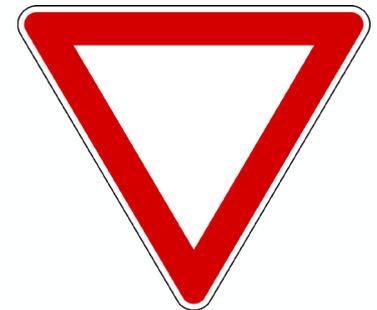


Daily Price Shape Q4 (2025 and 2041)



Emissions Rate (Very preliminary)

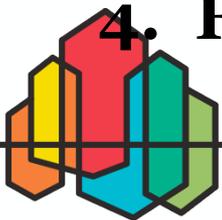
	lbs per kwh (CO2e)	lbs per kwh (CO2)
2021	1.82	0.16
2022	0.49	0.46
2023	0.20	0.32
2024	1.07	0.21
2025	0.12	0.90
2026	1.20	1.07
2027	0.58	0.21
2028	0.26	0.89
2029	0.40	-0.30
2030	0.56	0.45
2031	0.84	0.58
2032	2.11	0.41
2033	1.19	0.36
2034	0.95	0.25
2035	1.19	0.23
2036	0.96	0.29
2037	0.47	0.40
2038	0.67	-0.11
2039	0.25	0.14
2040	1.04	0.20
2041	-0.30	-0.33



Conclusions

1. Buildout needs further examination.
2. With a vast renewable buildout Mid-C power prices will decrease over time and become very volatile intra-day.
3. Emissions rate methodology may have to be slightly revised.

4. Follow-up with SAAC



Timeline – *Wholesale Power Price and Market Emissions Rate Forecast*

