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

December 4, 2018

MEMORANDUM

TO: **Council Members**

FROM: **John Ollis, Gillian Charles, Mike Starrett**

SUBJECT: **Report on California's 100 Percent Clean Energy Act**

BACKGROUND:

Presenter: John Ollis

Summary: On September 10, 2018, California Governor Jerry Brown signed Senate Bill 100 – also known as "The 100 Percent Clean Energy Act of 2018" – into law. The legislation is comprised of two major components: (1) it strengthens and accelerates California's existing renewable portfolio standard, setting a new target of 60% by 2030, and (2) it commits California to a 100% clean energy mix by 2045, through the supply and generation of zero-carbon resources.

Staff will present the second part of a multi-part analysis on the potential effects of California's new 100% clean energy act. This first presentation focused on the background of the legislation and how it compares to renewable and greenhouse gas initiatives and policies in other states, California's current generating resource portfolio – including imports from the Pacific Northwest, and California's current carbon emissions and carbon intensity of its electricity system. In this presentation, staff will discuss the results of analysis on the potential effects this policy may have on market dynamics in the WECC.

Relevance: As the Council readies to kick-off development of its Eighth Power Plan early next year, it is important to understand and analyze the potential effects of this legislation.

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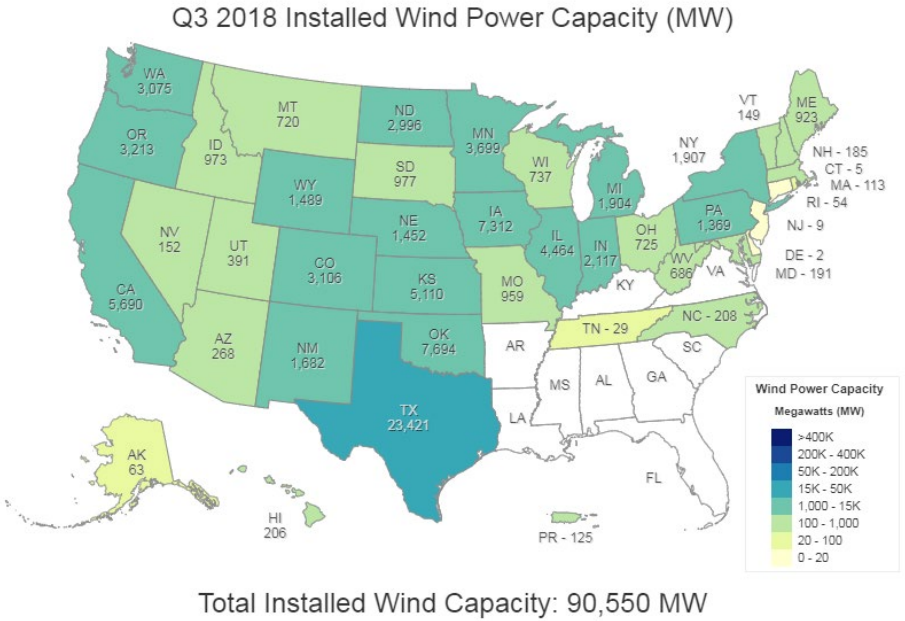
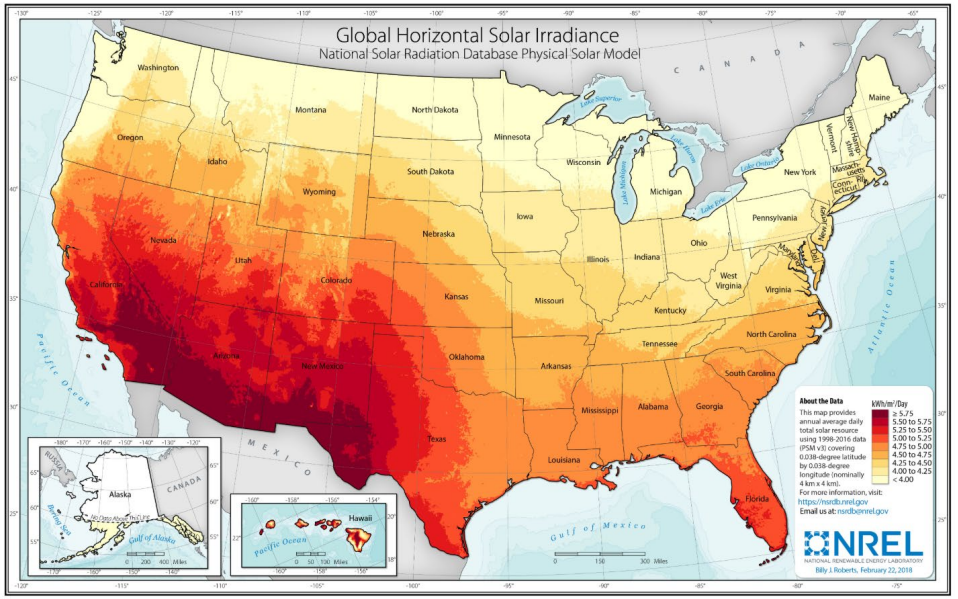
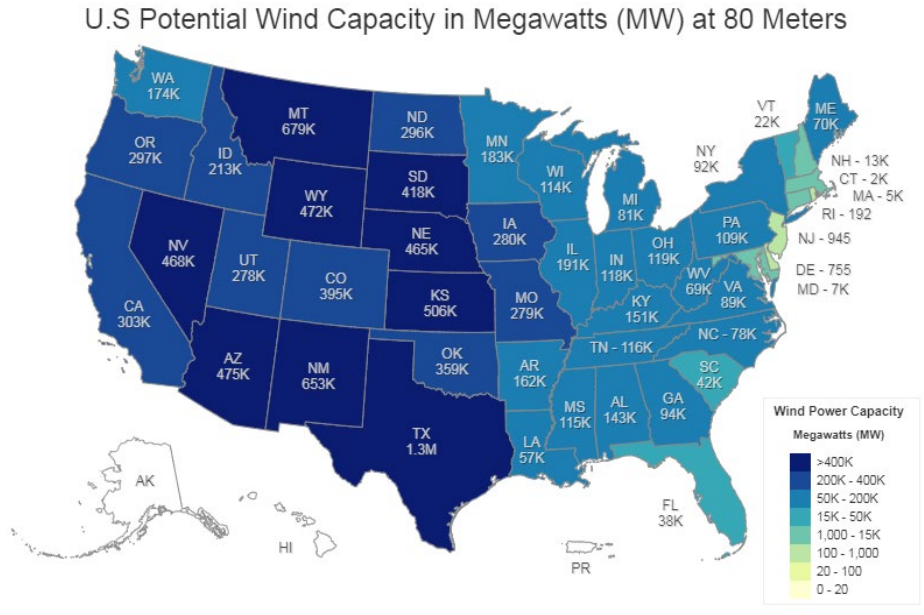
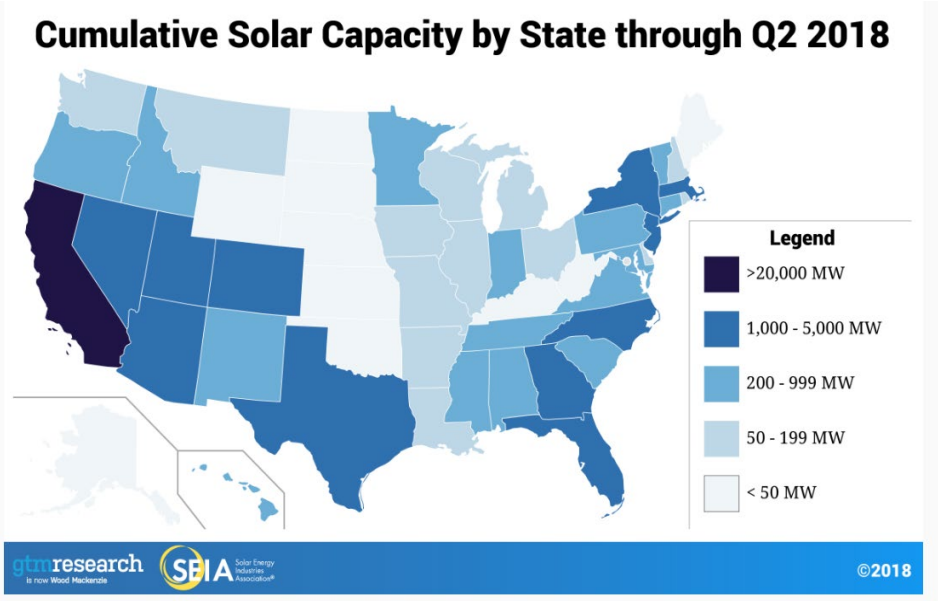


Total Installed Wind Capacity: 90,550 MW







Review of California's SB 100 "*The 100 Percent Clean Energy Act*"

- Increases the 2030 RPS target to 60%, and accelerates the intermediate targets.
- By 2045, RPS resources *and zero-carbon resources* will supply 100% of retail sales of electricity
  - Without increasing carbon emissions elsewhere in the western grid or allowing resource shuffling
  - Eligible zero-carbon resources beyond RPS-eligible resources include large hydro, natural gas w/ carbon capture and storage, nuclear

Scope of Staff Analysis

What We Did

- Long-term resource buildout in the WECC with existing transmission infrastructure, demand-side management and load information.

What We Did Not Do

- Forecast transmission system expansion
- Forecast increased demand-side management measures.
- Forecast load impacts of carbon neutrality goals in Gov. Brown's Executive Order B-55-18
- Forecast increased reserve requirements associated with higher renewable penetration.

Outline of Staff Analysis

1. WECC-wide buildout of resources
2. Wholesale Prices – shape and seasonality
3. Expected regional import/export dynamics
4. Carbon emissions and production costs in the WECC.

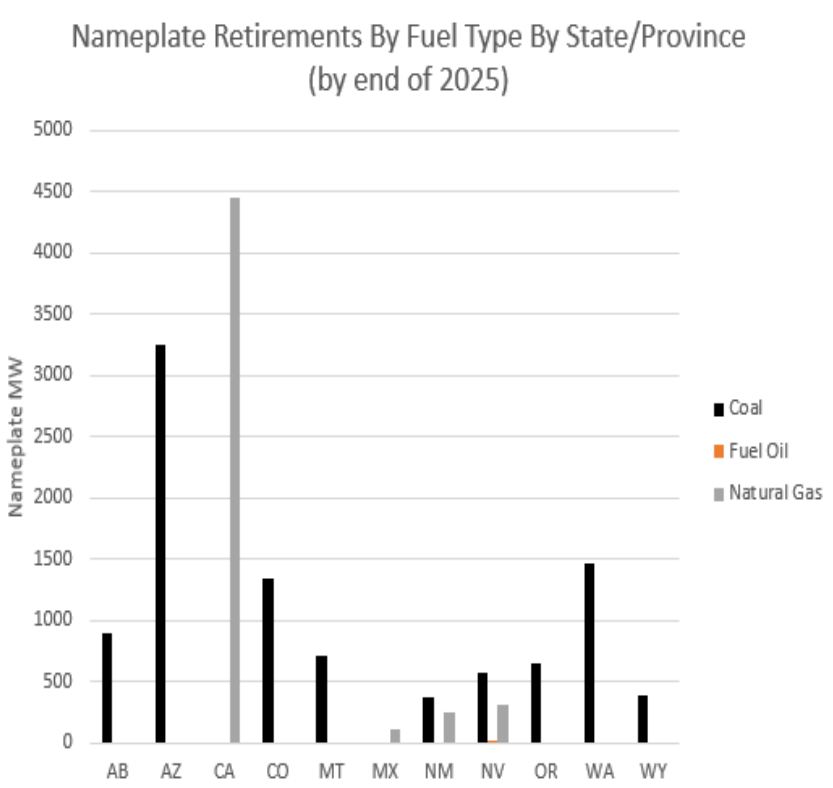
WECC-wide Buildout Caveats

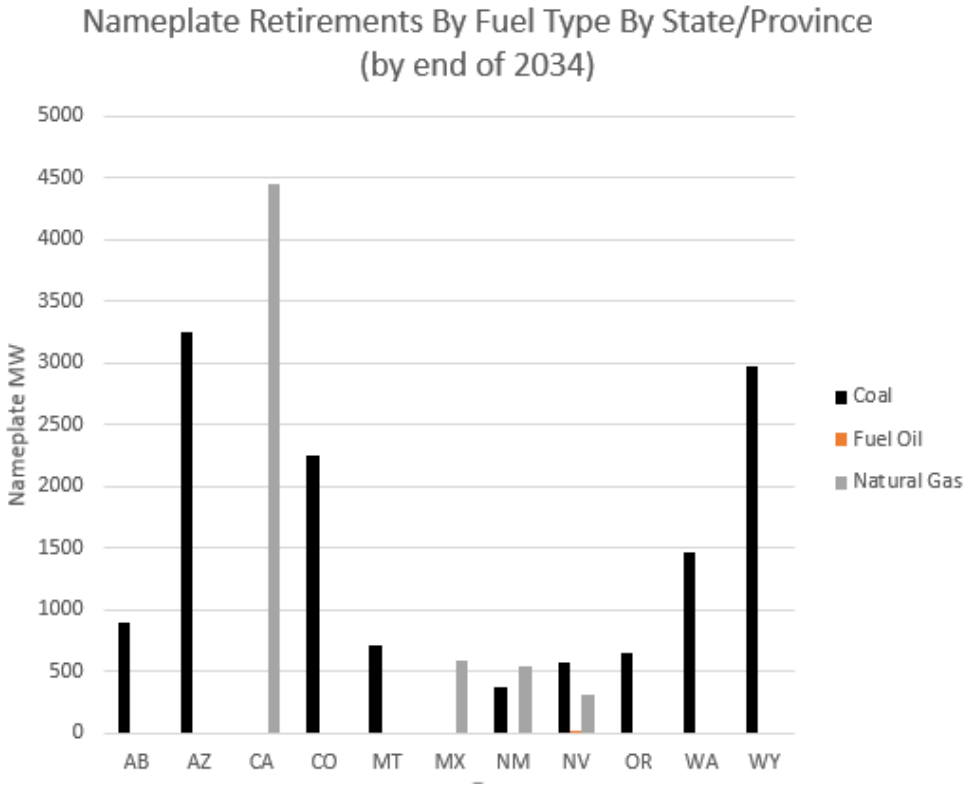
- Long-Term Capital Expansion is directional, but much is unknown
  1. CA import policies on "clean" and RPS resources
     - Transmission expansion needed for "least cost" clean resources?
  2. Expanded buildout of conservation and other demand side resources highly likely.
  3. Likely increased reserve requirements and variability of different renewable generation sources even when considering diverse WECC-wide siting.
  4. Market structure changes may be required to facilitate.
     - Will there be an incentive for resources to be built primarily for capacity and reserve products?

High Level Takeaways

- Nearly 145 GW of renewable energy built by 2045, almost all wind (101 GW) and solar (44GW).
  1. Less than half the natural gas plants built in the SB 100 case compared to final midterm run (21.5 GW vs. 46 GW, resp.), but gas prices still drive wholesale power market prices for most conditions.
  2. Prices stay low in general, and extremely low in the middle of the day.
  3. 19 GW of coal and gas retirements (mostly in CA, Southwest, Mountain West) are replaced mostly by renewables which significantly lowers CO_2 emissions.
  4. PNW will likely face more competition from Southwest and Mountain West in providing "clean" energy to California, but may have growth potential in providing capacity.
  5. Production costs go down by 6.5 billion dollars on average, but fixed costs go up by 10.3 billion dollars.

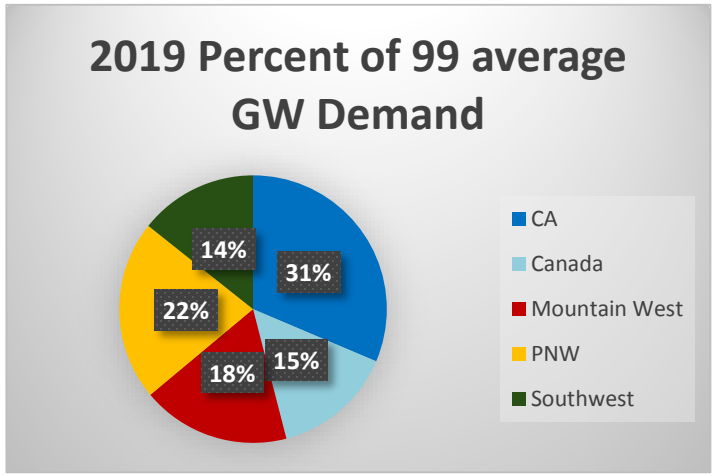
WECC Planned Retirements

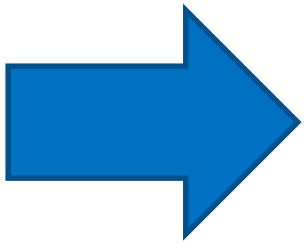


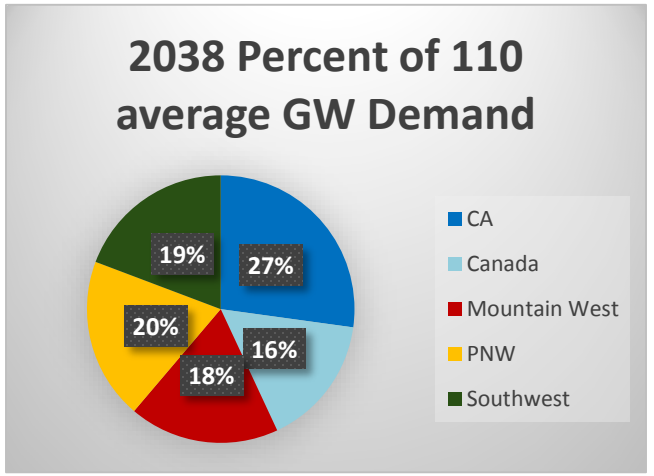


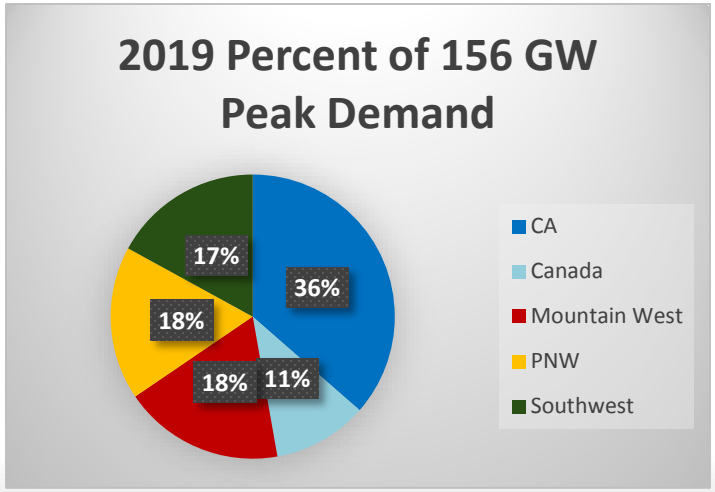
- In the next 15 years, the WECC is facing over 19,000 MW of nameplate thermal plant retirement of which 13,000 MW is coal.
- In the next 6 years, 14,700 MW nameplate thermal capacity will be retired of which over 9,600 MW nameplate is coal.

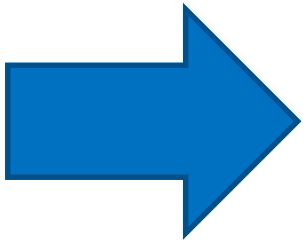
Demand Summary

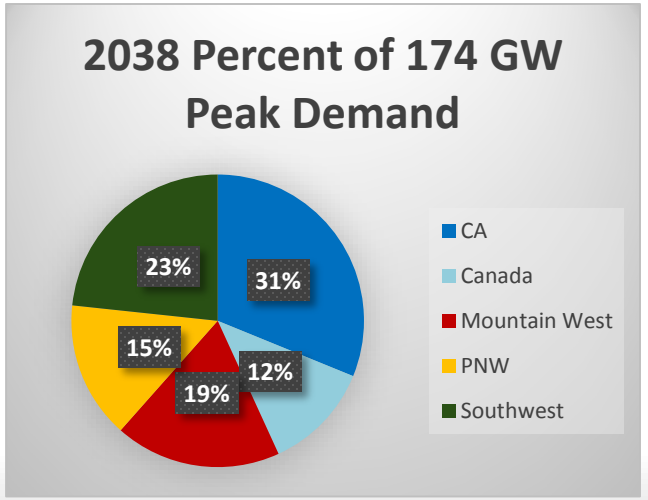






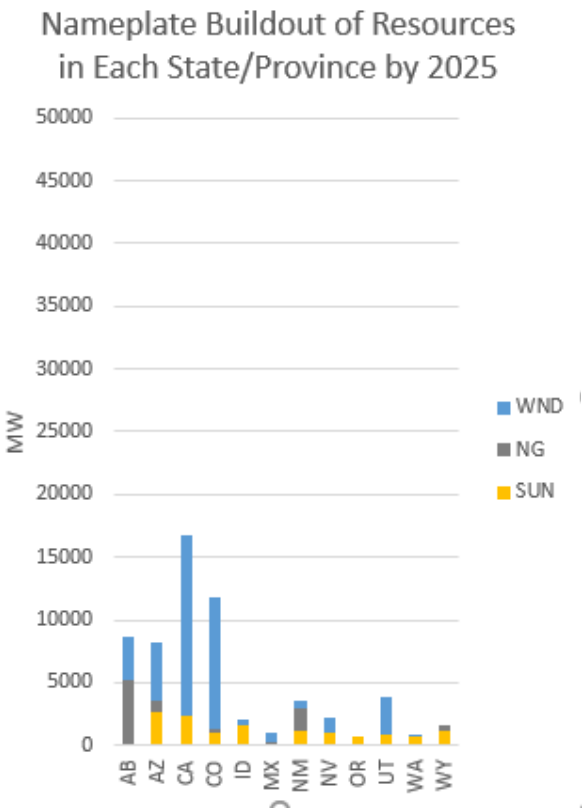


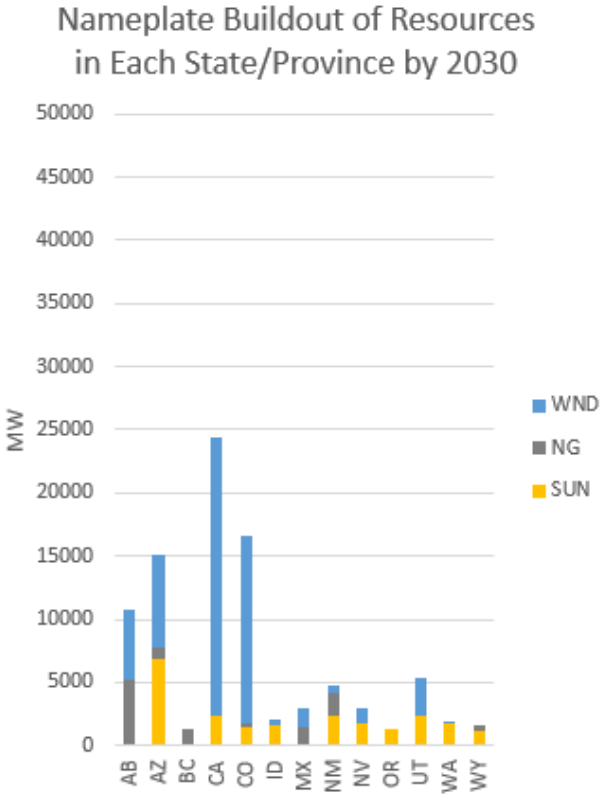


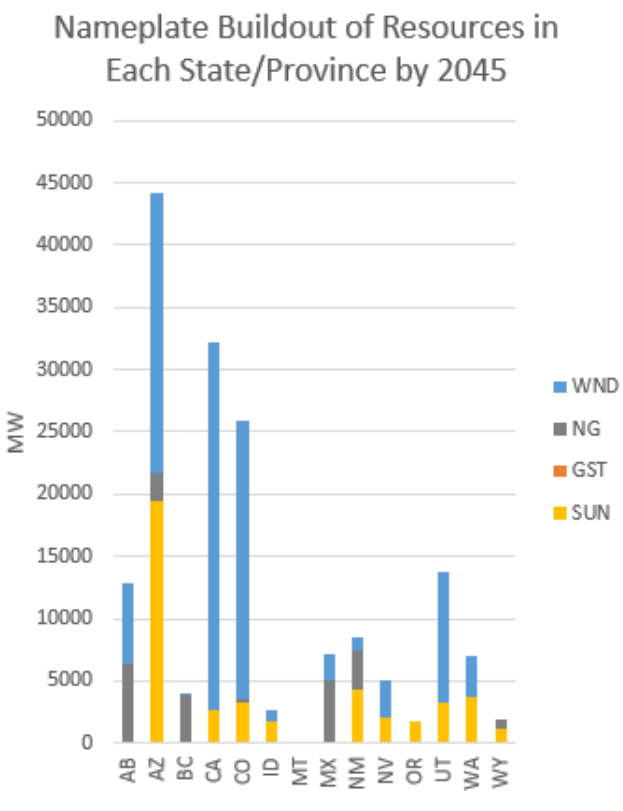


Long-Term Expansion Results

- *By 2045, 61% of new resources built are wind, 26% are solar and 13% natural gas.*
- *These results represent builds for energy, capacity and RPS*

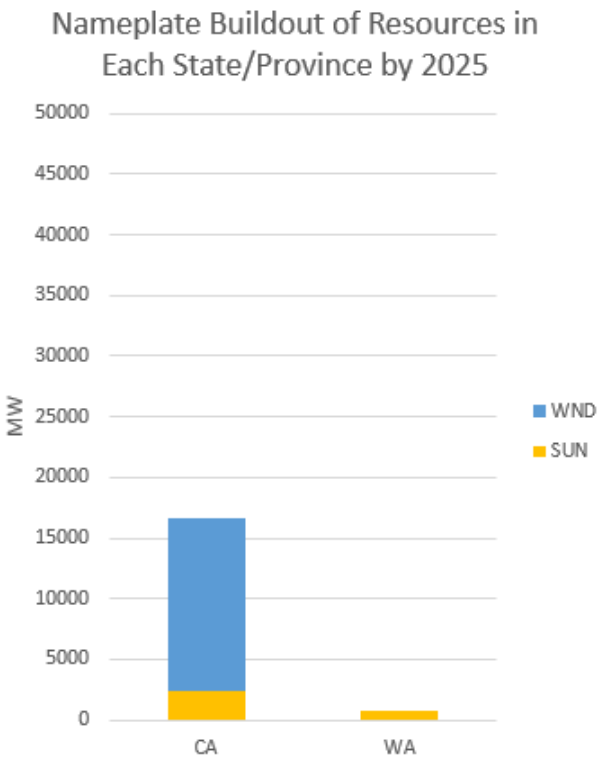


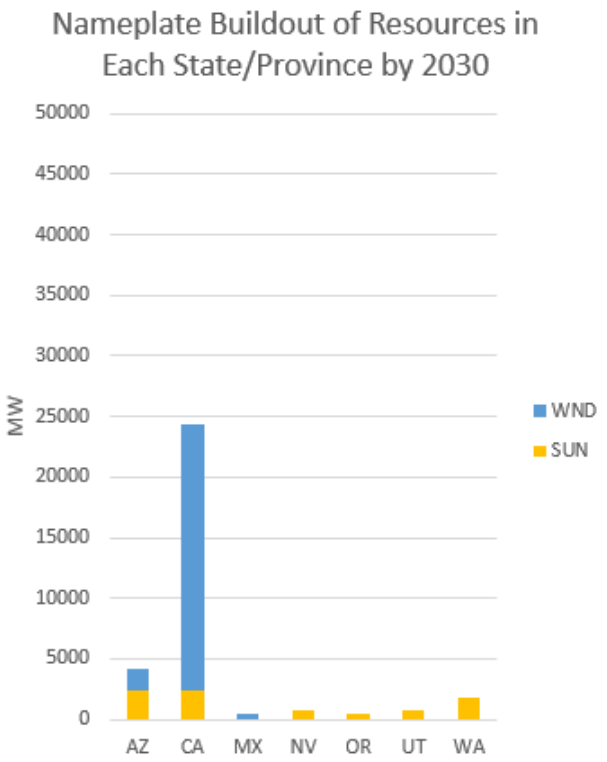


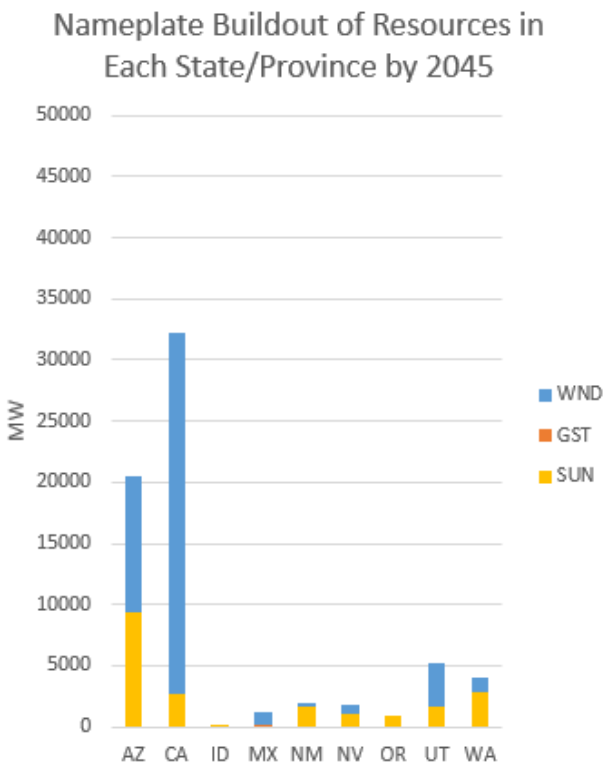


Long-Term Expansion Results – SB100 Related

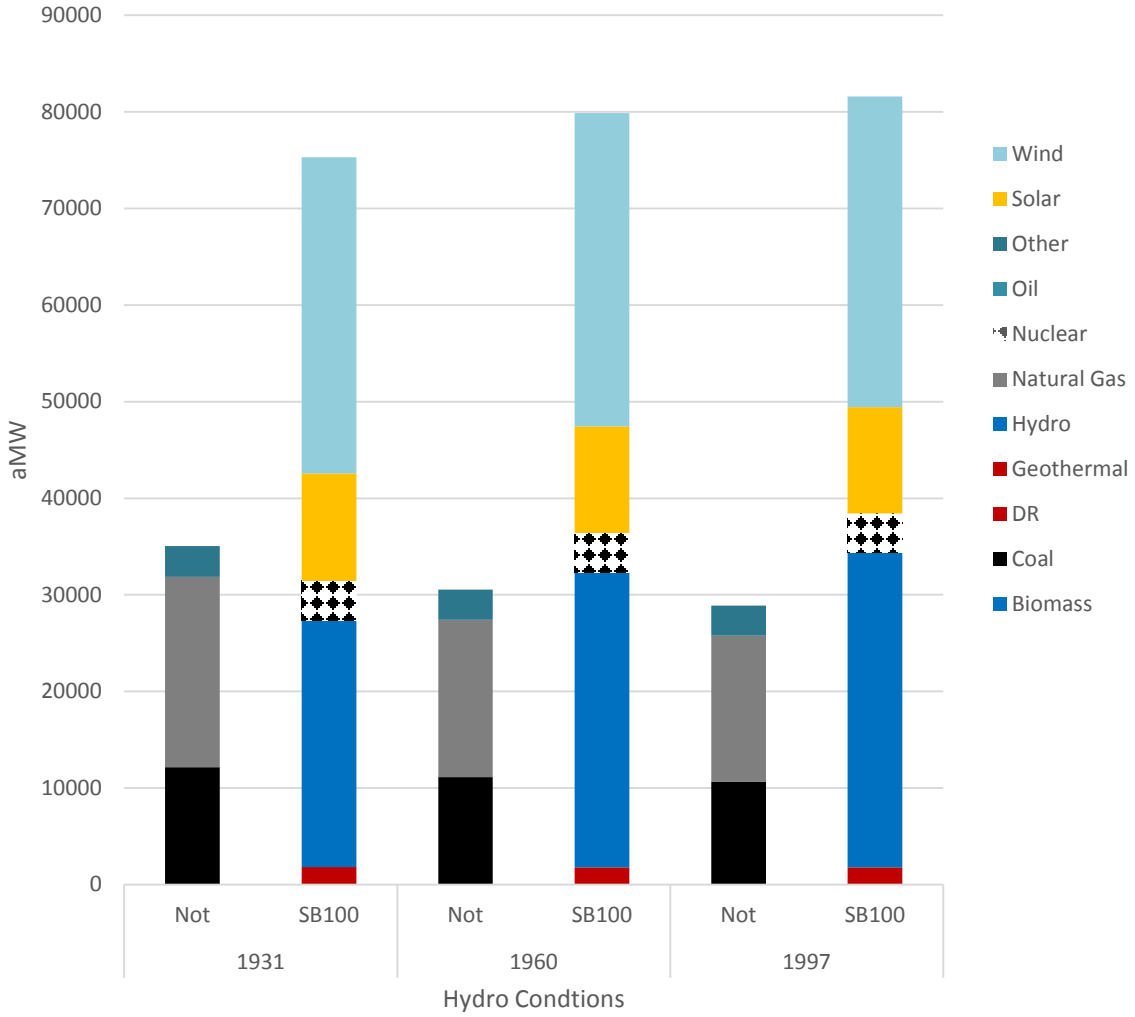
- *By 2045, 70% of new resources built are wind and 30% are solar.*
- *These results represent builds to meet SB 100 needs*







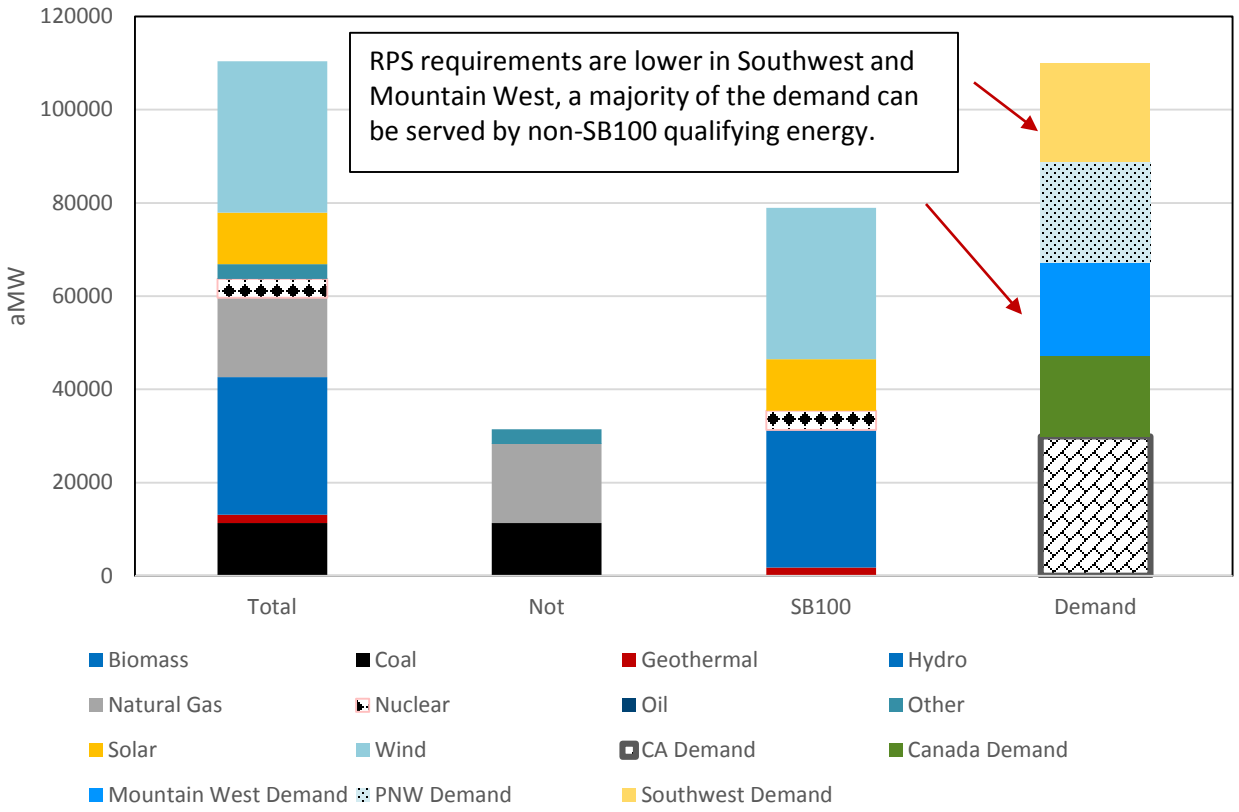
2038 Generation By Fuel Type



Wind overtakes hydro as largest average MW generation source in WECC except in high hydro years.

Fuel type	Percent of WECC total
Biomass	0.06%
Coal	10.21%
Geothermal	1.63%
Hydro	26.74%
Natural Gas	15.37%
Nuclear	3.72%
Oil	0.00%
Other	2.83%
Solar	10.00%
Wind	29.44%

2038 Generation Mix Compared to Demand Area



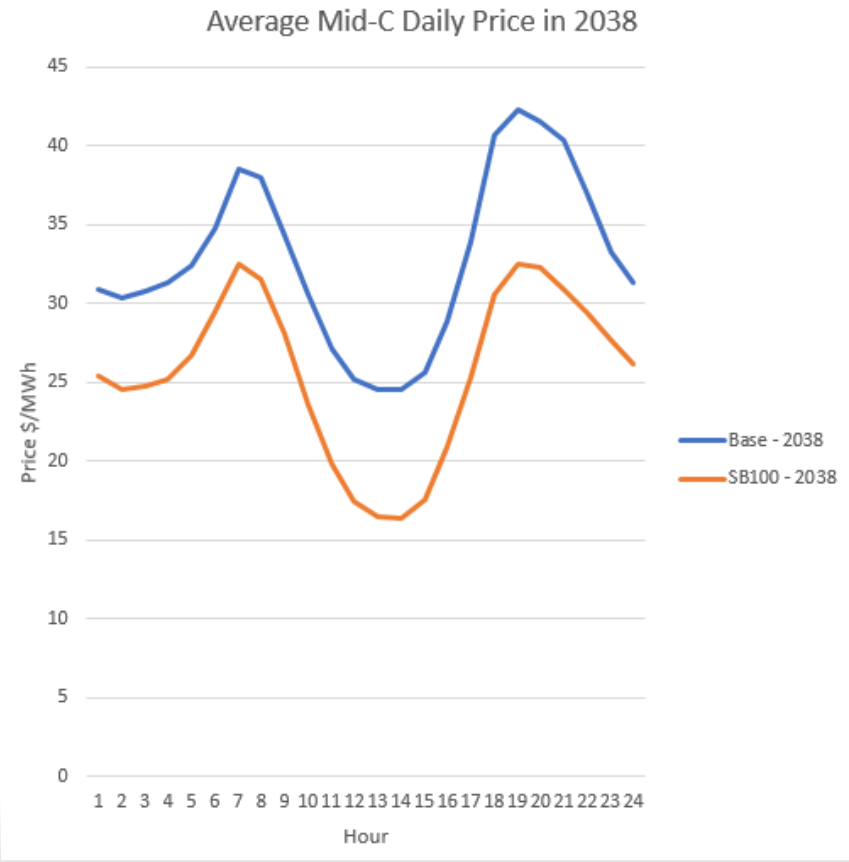
State	Standard
California	60% by 2030
Oregon	50% by 2040
Colorado	30% by 2020
Nevada	25% by 2025
New Mexico	20% by 2020
Montana	15% by 2015
Washington	15% by 2020
Arizona	15% by 2025
BC	93% by 2010
Alberta	30% by 2030

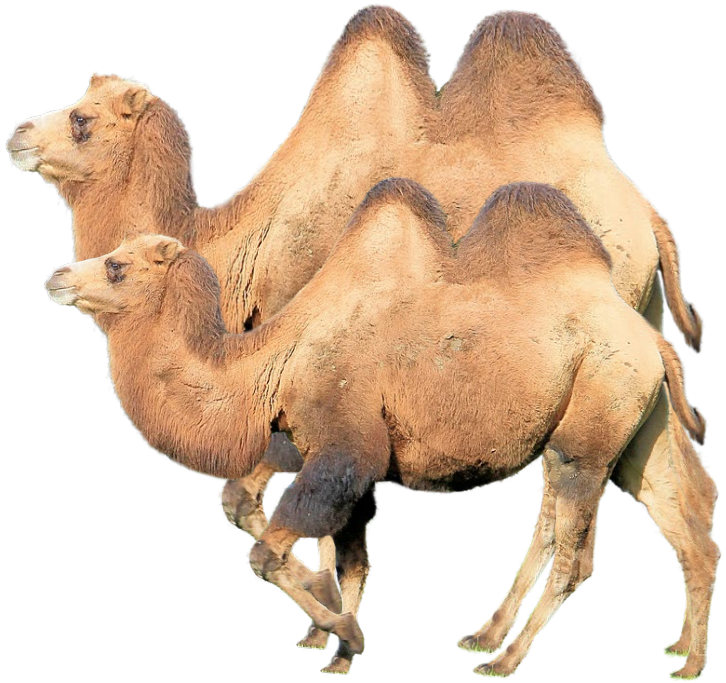
Wholesale Power Prices

- Power prices drop on average compared to final midterm analysis results (pre-SB 100).

- Daily shape is similar on an average basis but has more variation from day to day.

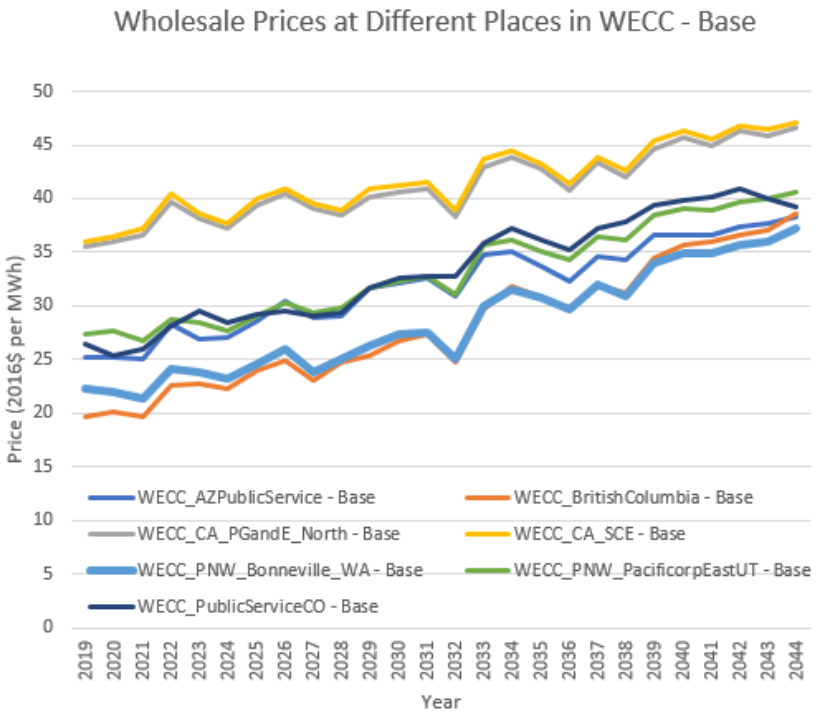
Two daily ramp periods contain most of the high prices (in 2016 $/MWh).

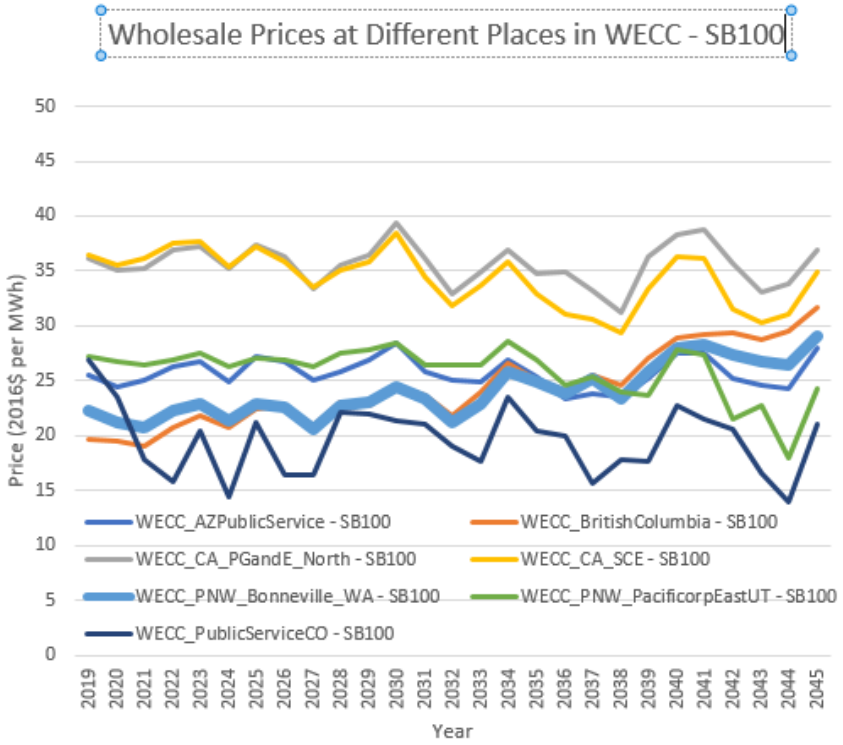




Middle of the day prices are often lower than traditional off-peak period pricing.

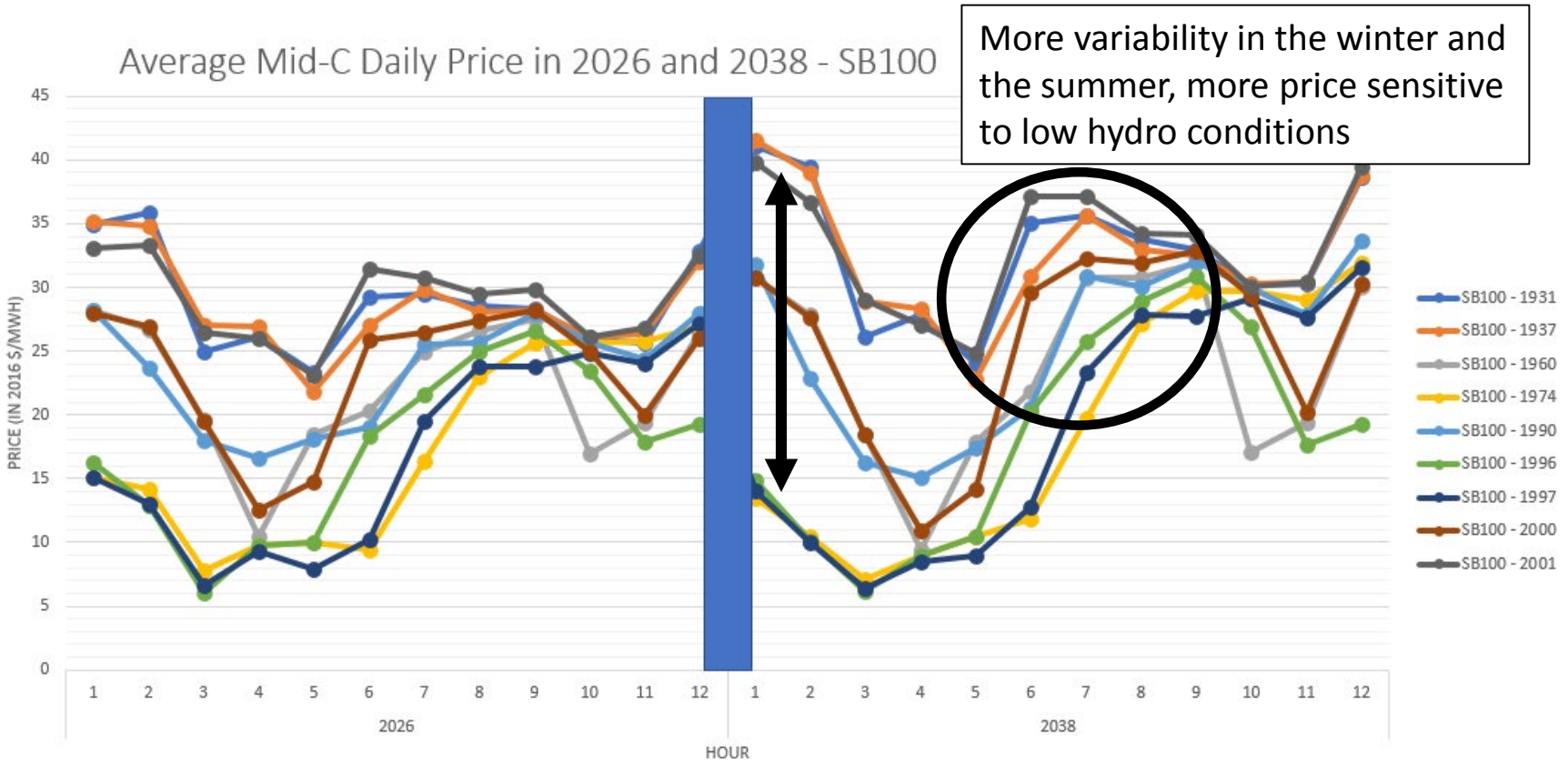
What do all those renewables and low gas prices do to the electricity price?





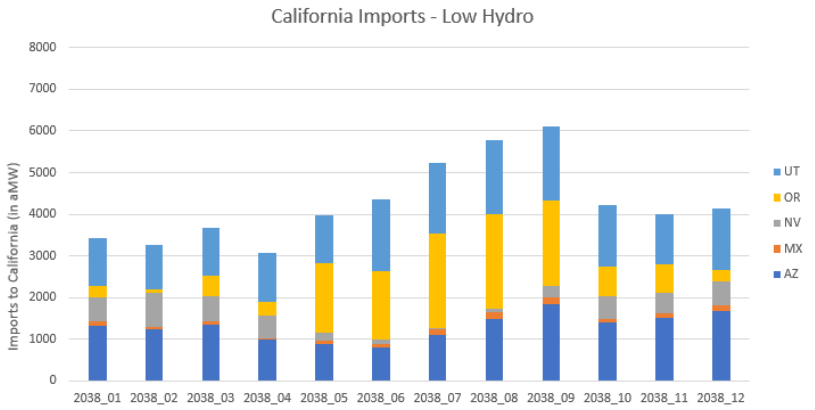
By adding low cost resources, prices stay flat and decline in some areas (although not at Mid-C). Also have more variation from year to year.

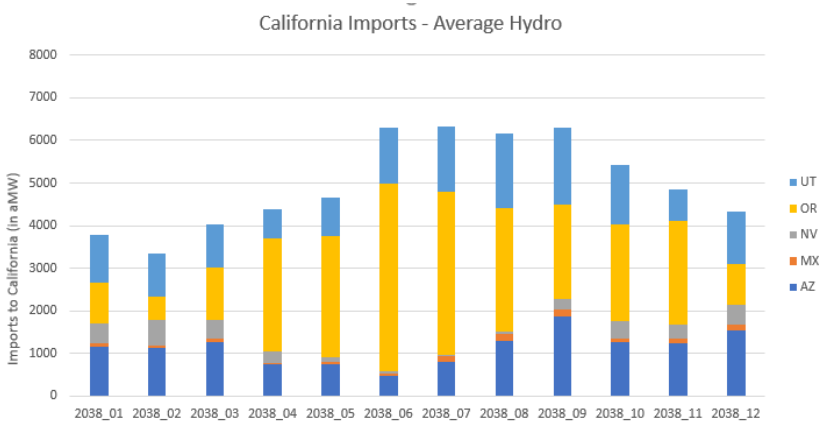
Minimal Seasonal Price Changes

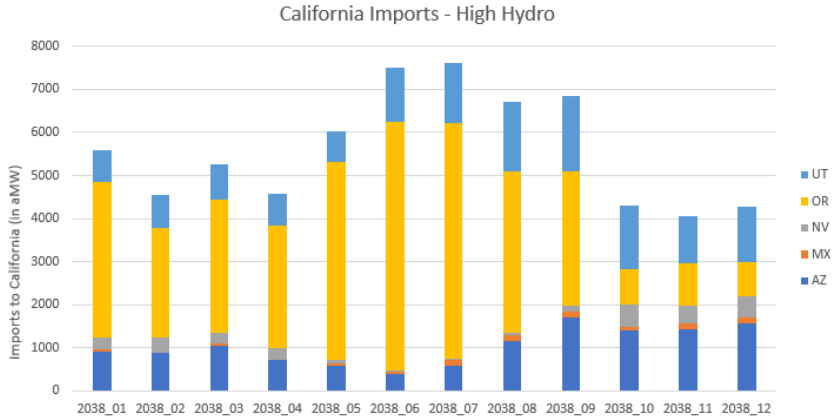


More variability in the winter and the summer, more price sensitive to low hydro conditions

CA Imports Monthly - 2038





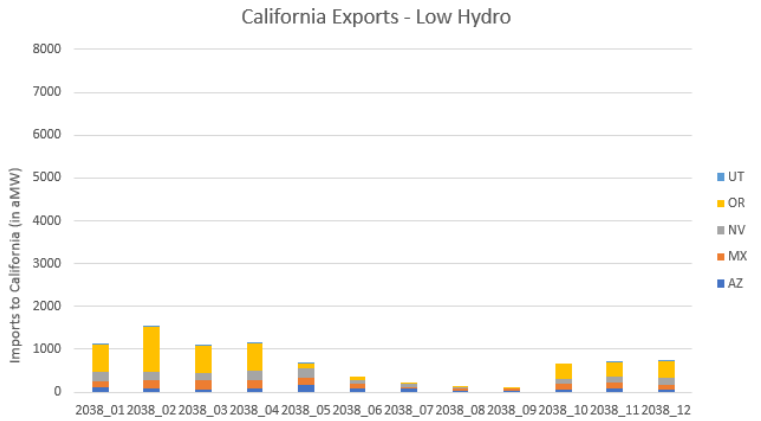


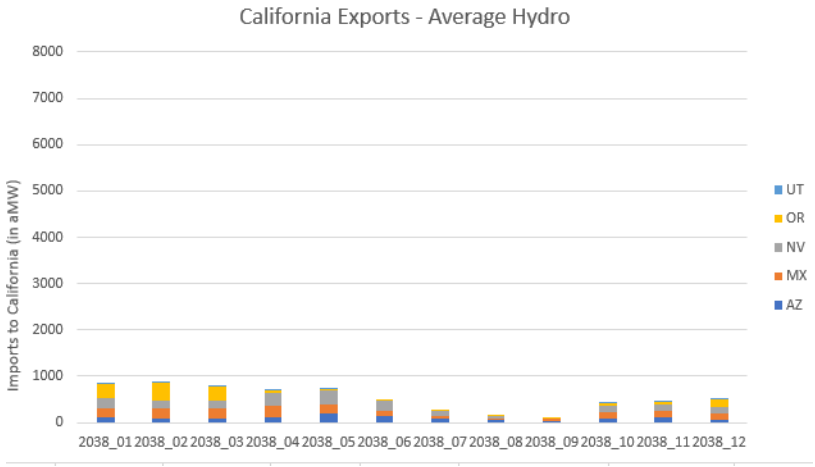
PNW sources the largest amount of CA imports except in poor hydro conditions.

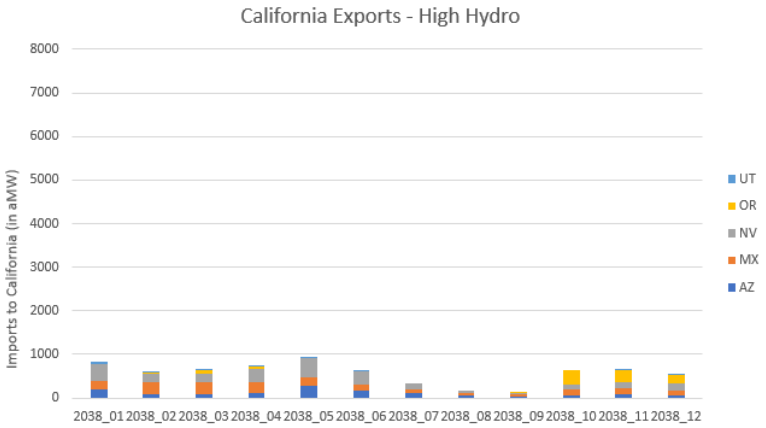
Mountain west imports come through Utah and Nevada and southwest imports come in from Arizona.

Note: CA carbon policy effects import prices which currently favors generally low carbon imports from the PNW. Changes in fuel mix in Southwest and Mountain West may change this dynamic.

CA Exports Monthly - 2038

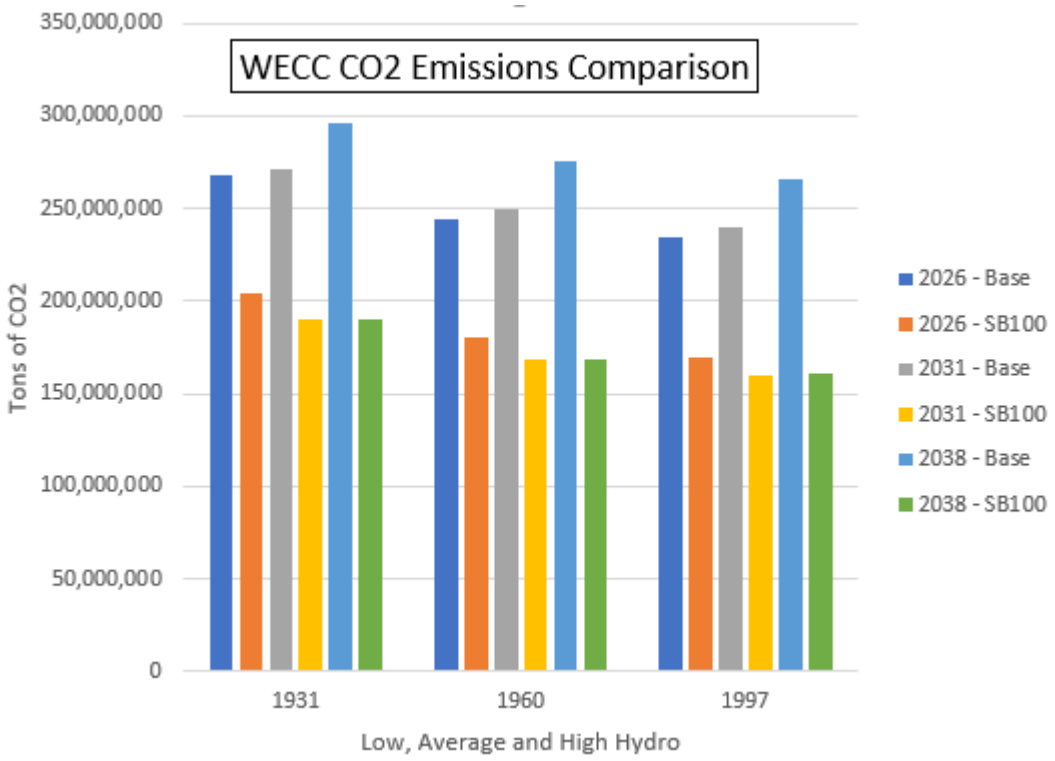






California only exports more than a few hundred aMW when there are poor hydro conditions in PNW. And then mostly in the winter to the PNW.

Carbon Dioxide Emissions



1. WECC CO_2 emissions increase throughout the study in the final midterm price runs (pre-SB100), while decreasing throughout the study in the SB100 case.
2. Low hydro (1931) conditions still results in significantly higher CO_2 emissions than high hydro (1997) conditions.

Production Costs vs. Fixed Costs

	Change in WECC Production Costs (2016$)	Percent Change in WECC Production Costs	Change in WECC Fixed Costs (2016$)	Percent Change in WECC Fixed Costs
2026	-3.0 billion	23% decrease	+4.6 billion	38% increase
2031	-4.4 billion	32% decrease	+6.6 billion	47% increase
2038	-6.5 billion	40% decrease	+10.3 billion	67% increase

Low or high hydro conditions can change production costs by plus or minus 350 million dollars, respectively.

Final Observations

- SB100 significantly effects the buildout in the WECC (100 GW more renewables and 25 GW less gas than previous policy).
  1. In general, wholesale prices and CO_2 emissions go from definitively increasing to flat and decreasing respectively.
  2. Production costs are 40% less than pre-SB100 levels by 2038.
  3. Did not test variability in renewable production nor increased reserve requirements. Both of these factors would likely increase capacity requirements, price and costs.