RELIABLY REACHING CALIFORNIA'S CLEAN ELECTRICITY TARGETS

STRESS TESTING ACCELERATED 2030 CLEAN PORTFOLIOS

FACT SHEET

WHAT ARE THE CHALLENGES THE REPORT RESPONDS TO?

California's Senate Bill 100 sets targets of 60% renewable energy by 2030 and 100% carbon-free electricity by 2045. In December of 2020, the California Agencies SB100 report indicated that this timeline could be accelerated in a cost-effective manner; however it noted that the reliability impacts of an accelerated target needed to be better understood. This study develops analysis to understand the reliability impacts of accelerated clean electricity portfolios (85% clean electricity in 2030, equivalent to a 75% renewable portfolio standard) in terms of whether these resources can meet future energy demand and when the system is subjected to different kinds of stressors, like low hydro, less gas availability, and less import availability.

HOW DOES THIS REPORT DIFFER FROM THE JOINT AGENCIES SB100 REPORT?

The SB100 report used a tool called RESOLVE which is the planning tool that the CPUC uses in its Integrated Resource Planning proceedings. As a "capacity expansion model", it determines the most cost-effective resources to build over a utility's planning time horizon. To make the problem tractable, these models take a few sample days across the year. In our study, we developed three portfolios using RESOLVE (a "base", "diverse clean resources" and "high electrification") but then use a production cost model (PLEXOS), which emulates operations of the power system every hour of the year for several weather years across the entire West. We proceed to "stress-test" these portfolios against several factors that could impair the ability of a clean power system to serve demand, such as low hydro, reduced availability of in-state gas or imports, increased weather variability, and if coal is retired across the West. We emulated the August 2020 conditions as an additional test, and ran one more stress test in which the system faces all of these stress factors in combination. Overall, we ran 260+ simulation years of 8760 power system operations. We also looked at how demand flexibility (load shifting) can help operations.

WHAT ARE THE KEY FINDINGS OF THE REPORT?

1. Reaching 85% clean electricity is feasible and reliable
2. A diverse clean portfolio has reliability and development benefits
3. Gas remains important but some environmental justice units could be retired
4. California still has sufficient imports if clean energy replaces coal across the West
5. The system is reliable against varied weather conditions
6. The system is reliable against simultaneous stressors
7. Demand flexibility is a tool for reliability and can lower storage needs
8. Modeling and planning tools need to evolve

Additional analysis using more weather data and assessing grid stability is needed

CAN CALIFORNIA REACH AN 85% CLEAN ELECTRICITY TARGET AND STILL SERVE LOAD?

Yes, that was our main finding. We found that each portfolio and "stress test" condition was able to serve load across many weather years of operation. We did find one exception which was that when we threw all of the stress conditions together, we started to see a small amount of unserved load. But this case included everything—low hydro, less gas, limited imports, retired coal across the West. Even in this situation, if California was able to import during mid-day hours, when there was ample surplus capacity across the West, the system would have served load during the evening peak load.

WHAT KINDS OF RESOURCES DOES CALIFORNIA NEED TO BUILD?

California's future clean portfolios rely significantly on solar and battery storage resources, and we also see modest amounts of wind. In our diverse clean resources and high electrification cases, we plan for, and see benefits from, offshore wind and geothermal. These resources, even when in small amounts, are

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really helpful to lowering the levels of solar, which can be hard to build due to siting challenges, and also bring benefits in terms of lower dependence on imports and in-state gas, and lower levels of dependence on inverter based resources at any point in time.

It's important to note the importance of battery storage as it is the newcomer on the system. Battery storage not only defers or reduces the need for installed gas capacity to reduce net peak demand, but significantly reduces the additional ramping and reserve requirements on the system. For example, the evening net load ramp, which today is served by natural gas units, hydro, and imports, is reduced from an average of 26.8 GW over a three hour period to 15.5 GW. This is a reduction in the "duck curve" ramping requirements of 42% on average.

We did not try to optimize between types of solar, such as fixed tilt vs. tracking solar, or winter dominating wind vs. summer wind and some of the research that others have done in California show that if we have more diversity on geography and time in the capacity expansion modeling step, we can potentially lower our storage needs significantly.

DOES CALIFORNIA NEED TO KEEP ITS GAS FLEET TO HAVE A RELIABLE POWER SYSTEM?

Yes and no. In one of our sensitivities we found that we were able to retire close to a third of the in-state gas fleet and still be resource adequate in the conditions we analyzed—provided the state is comfortable relying on imports without contracts for reliability. In general, the remaining gas is used sparingly but consistently for reliability purposes across the year. There's a tradeoff between instate gas and imports—you need either in-state gas or economic imports (which are, currently, generally out of state gas resources) to meet load across the full year. Eventually we can replace the full gas fleet but will need to replace those resources with other resources of comparable service. Several options exist and could be explored, such as a mix of shorter and longer duration storage resources, more firm clean resources (like geothermal, biomass, hydrogen, and/or nuclear), and peaking wind resources. These choices need to be explored in terms of their performance and costs in the context of the system as a whole.

WILL CALIFORNIA CONTINUE TO IMPORT FROM THE REST OF THE WEST?

Yes, California has been historically dependent on imports and our modeling shows that a clean California future power system functions most optimally in terms of minimizing costs across the entire West if power is shared between California and the rest of the West. This could be through a combination of dedicated imports (with contracts associated) and economic imports. Our modeling shows that even when a future clean power system is dependent on economic imports, the rest of the West has more than sufficient resources ("WECC wide hourly reserve margin"). The benefits of load diversity, geographic diversity of renewables, and resource sharing vastly outweigh a "go it alone" approach to decarbonization.

WHAT WILL HAPPEN IF THE AUGUST 2020 CONDITIONS OCCUR AGAIN?

We analyzed how future clean portfolios would fare against the August 2020 conditions and even analyzed these against different levels of limited imports and found that we were able to meet load in all these conditions. Although our simulated August 2020 event applied to a future clean portfolio did not rely on load flexibility, we note that as in the August 2020 event, load flexibility and demand response are important operational tools to account for uncertainty in load and renewable forecasting.

DID YOU CONSIDER DISTRIBUTED ENERGY RESOURCES IN MEETING THIS TARGET?

Yes, we relied on the CEC's California Energy Demand forecasts from the Integrated Energy Policy Report. These forecasts include assumptions on behind the meter (BTM) solar, storage, and electric vehicles. We maintained consistency with this forecast and all of our portfolios included the same levels of BTM solar (more than 20 GW of solar in 2030), storage, and electric vehicles. In our high electrification portfolio we included even more electric vehicles (consistent with 100% EV sales by 2035) and more electrified building loads (consistent with the CEC's AB3232 study). Our demand flexibility sensitivity analyzed the benefits of load shifting towards serving load.

WHAT'S NEXT?

This study is not an end-point in understanding the reliability impacts of an 85% clean electricity target for California. Overall, our analysis shows that an 85% clean electricity standard is operable and with the assumptions made here, is resource adequate, even without additional in-state gas being built. However, successful implementation of an 85% clean electricity standard will require understanding local transmission needs, and a thoughtful plan on how to retire gas resources that maintains reliability, while achieving equity and economic objectives.