DOCKETED	
Docket Number:	19-SB-100
Project Title:	SB 100 Joint Agency Report: Charting a path to a 100% Clean Energy Future
TN #:	234324
Document Title:	Lorraine Paskett Comments - Green electrolytic hydrogen and zero carbon scenarios
Description:	N/A
Filer:	System
Organization:	Lorraine Paskett
Submitter Role:	Public
Submission Date:	8/14/2020 11:16:16 AM
Docketed Date:	8/14/2020

Comment Received From: Lorraine Paskett
Submitted On: 8/14/2020
Docket Number: 19-SB-100

Green electrolytic hydrogen and zero carbon scenarios

Additional submitted attachment is included below.

August 14, 2020

California Energy Commission
California Air Resources Board
California Public Utilities Commission

Docket No. 19-SB-100
SB 100 Joint Agency Report: Charting a path to a 100% Clean Energy Future

Re: Alternate Scenarios in SB 100 Modeling Should Include Green Electrolytic Hydrogen and Zero Emissions

Dear staff and leadership at the California Energy Commission, California Air Resources Board, and California Public Utilities Commission:

We write to urge you to include scenarios in the upcoming SB 100 implementation report that incorporate green electrolytic hydrogen and achieve zero or near-zero greenhouse gas emissions.

Green electrolytic hydrogen is an important element to fulfilling the state's broader strategy around shifting to renewable power and electrification. In addition to providing a key tool for decarbonizing the power sector in its entirety, green electrolytic hydrogen enables renewable electricity to power the entire economy. Green electrolytic hydrogen is amazingly versatile, with the ability to electrify multiple sectors including the gas grid, heavy-duty transportation and industry with renewable power. At the macro level, it is capable of solving daily and seasonal energy storage needs and can enable investment in renewable generation that cannot occur on the merits of selling electrons alone.

Initial SB 100 Scenarios Envision High Greenhouse Gas Emissions

SB 100 directs eligible renewable and zero carbon resources to provide for 100 percent of retail sales by no later than 2045. It also directs the joint agencies to develop a report to the legislature that includes alternate scenarios for achieving the goals of the statute. However, it's important to note that the retail sales metric is not the same as total generation, which leaves the door open for the continued use and reliance on existing fossil fuel power plants for grid balancing perpetually into the future.

This appears to the be the approach being pursued by the state. Preliminary scenarios presented at the SB 100 Technical Workshop all continue to rely on virtually the entire existing

fossil fuel fleet through 2045, and presumably beyond.[1] In these scenarios, greenhouse gas emissions from California's electricity sector range from about 13-19 million metric tons (MMT) CO_2 in 2045.[2] Even before the passage of SB 100, the state set a range of planning targets for the electricity sector of 30-46 $MMTCO_2$/year in 2030, implying the impact of SB 100 potentially could be to reduce emissions from the power sector by little more than one-third beyond previously existing law.

Climate Neutrality Requires Reducing Electric Sector Emissions to Zero

While these scenarios may comply with the letter of the law, they don't comply with its intent. SB 100 specifically references transitioning to a "zero carbon electric system," and at the same time he signed SB 100, then-Governor Jerry Brown signed an Executive Order setting a goal of achieving climate neutrality statewide by no later than 2045 and maintaining net-negative greenhouse gas emissions thereafter. The electricity sector is widely seen as the most likely to decarbonize first and it only makes sense that the state would consider scenarios that achieve zero, near-zero, net-zero, and/or net-negative emissions in the electric sector on at least a similar timeline as planned for all statewide emissions, if not much more quickly.

Based on the initial scenarios, it does not appear that there is a purposeful intent in the modeling to minimize greenhouse gas emissions, explore scenarios with significantly different greenhouse gas emissions outcomes, or contribute to achieving climate neutrality. This is contrary to urgent need to address climate change and the impending effort, as part of developing the next Scoping Plan, to achieve climate neutrality and net-negative greenhouse gas emissions statewide by 2045. SB 100 is the most concrete and significant existing policy that would contribute to these objectives. We encourage you to change course and include zero-carbon scenarios in your analysis this year, so that they may inform the Scoping Plan, and indeed – the market – before the next SB 100 report is due in 2025.

Green Electrolytic Hydrogen is a Cost-Effective, Zero-Carbon Solution for Power Sector

The most direct way to do this would be to include green electrolytic hydrogen in the modeling. Green electrolytic hydrogen is a completely scalable solution for the power sector, which can displace the use of fossil natural gas to provide zero-carbon grid balancing, baseload and dispatchable power, and achieve a fully decarbonized electric sector.

The Los Angeles Department of Water and Power is a leading voice in the effort to truly decarbonize the electric sector and its processes reflect that intention. Every scenario in the Los Angeles 100% Renewable Energy Study includes green electrolytic hydrogen used in fuel cells and combustion turbines, as soon as 2030. What's more, the "LA Leads" scenarios use

[1] https://efiling.energy.ca.gov/GetDocument.aspx?tn=230751

[2] In the preliminary scenarios, greenhouse gas emissions in CAISO territory, which represents about 80% of electricity demand, range from 10.3-15.5 $MMTCO_2$/year in 2045, suggesting electric sector emissions statewide of about 12.9-19.4 $MMTCO_2$/year.

green electrolytic hydrogen to displace all fossil natural gas and achieve a 100 percent zero-carbon electricity system for Los Angeles by 2035.[3] The analysis also highlights the role that hydrogen in combustion turbines can play in minimizing land use impacts.

Several other studies show that green electrolytic hydrogen can be a cost-effective solution for decarbonizing the power sector. A recent study by E3, for example, shows green electrolytic hydrogen power plants could be profitable in the Southern California market as soon as the 2025-2030 timeframe.[4] A study by the Hydrogen Council with McKinsey similarly finds that hydrogen in the power sector could be cost-effective in the 2025-2030 timeframe.[5] An assessment by Bloomberg New Energy Finance (BNEF) estimates that over the long-term, "a carbon price of $32/tCO2 would be enough to drive fuel switching from natural gas to hydrogen, and generate clean, dispatchable power at a competitive price."[6]

Scenarios that Exclude Green Electrolytic Hydrogen are Suboptimal

Meanwhile, the state energy agencies' initial scenarios, which do not include green electrolytic hydrogen, imply a marginal abatement cost of $587/tCO$_2$,[7] 18 times higher than the cost identified by BNEF. Other scenarios presented as part of SB 100 workshops highlight the necessary role of dispatchable generation, which green electrolytic hydrogen can provide without greenhouse gas emissions. One analysis from E3, for example, estimates long-term, marginal abatement costs in a system that only includes wind, solar, batteries and pumped hydro would be 200-600 times higher than the marginal costs identified by BNEF.[8] This has been validated in another recent study that shows that long duration energy storage systems, such as green electrolytic hydrogen, lowers total system costs compared with wind-solar-battery systems and improves the economics of renewable electricity. What's more, strategies that help to bring down the costs of long duration energy storage systems will have twice the impact on overall system costs as will additional efforts to bring down battery costs.[9]

Another study further quantifies the difference between the state's current approach and one that relies on renewable gases, including green electrolytic hydrogen, in repurposed gas power plants. It finds that using renewable gases in power plants can meet the goals of SB 100 by 2040 and fully decarbonize the power sector by 2045 at lower cost, with one-third less land

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[3] https://www.ladwp.com/cs/idcplg?IdcService=GET_FILE&dDocName=OPLADWPCCB726105&RevisionSelectionMethod=LatestReleased

[4] https://www.ethree.com/wp-content/uploads/2020/07/E3_MHPS_Hydrogen-in-the-West-Report_Final_June2020.pdf

[5] https://hydrogencouncil.com/en/path-to- hydrogen-competitiveness-a-cost-perspective/

[6] https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf (pg. 7)

[7] https://efiling.energy.ca.gov/GetDocument.aspx?tn=230751

[8] https://efiling.energy.ca.gov/GetDocument.aspx?tn=230840

[9] Dowling, J.A. et al (2020) Role of Long-Duration Energy Storage in Variable Renewable Electricity Systems, *Joule,* August 6. DOI: https://doi.org/10.1016/j.joule.2020.07.007

use, and with significantly lower cumulative greenhouse gas emissions than currently envisioned in the state's scenarios.[10]

Incorporating Green Electrolytic Hydrogen into Existing Models

We understand that prevailing modeling tools are not designed to incorporate green electrolytic hydrogen or other solutions to achieve zero carbon in the power sector. Still, that is no reason to ignore what is clearly an important solution for decarbonizing the electricity system, achieving climate neutrality, and complying with SB 100 at low costs and with minimal land use and greenhouse gas emissions. Projects are moving forward today,[11,12] and the state should not wait until 2025 to recognize and explore the important role green electrolytic hydrogen will play in the power sector.

Fortunately, while the agencies develop new tools better able to model a decarbonized power system, it can easily include green electrolytic hydrogen in its current analysis by using biomethane as a proxy for hydrogen and other renewable gases, and adjusting costs to reflect the widely expected cost reductions, as referenced above, that green electrolytic hydrogen is expected to achieve over the next 5-10 years.

A preliminary analysis run by UC Irvine, referenced in a recent comment letter to CARB,[13] shows that at $2/kg (which, with sufficient market scale, is expected to be achieved by 2030,[14] or perhaps much earlier[15]), the RESOLVE model would select green electrolytic hydrogen as a low-cost, renewable resource. Including this is in the current modeling effort would also show much lower capacity requirements and capital costs associated with meeting the goals of SB 100, higher utilization of existing infrastructure and new renewable generation, and significantly lower renewable curtailment. We hope you will consider this analysis and use it as a basis to incorporate green electrolytic hydrogen into the state's energy and climate modeling and planning efforts now, and moving forward.

California Needs to Continue Leading, Capture Economic Opportunity

The world and the country are moving forward on green electrolytic hydrogen. Nearly 20 percent of all global stimulus dollars focused on energy are supporting hydrogen,[16] gigawatt-

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[10] https://www.pathto100.org/wp-content/uploads/2020/03/path-to-100-renewables-for-california.pdf
[11] https://amer.mhps.com/intermountain-power-agency-orders-mhps-jac-gas-turbine-technology-for-renewable-hydrogen-energy-hub.html
[12] https://www.greentechmedia.com/articles/read/nextera-energy-to-build-its-first-green-hydrogen-plant-in-florida
[13] https://www.arb.ca.gov/lists/com-attach/10-cn-fuels-infra-ws-AWIHaVEyVGRWM1Q7.pdf
[14] https://www.bloomberg.com/news/articles/2019-08-21/cost-of-hydrogen-from-renewables-to-plummet-next-decade-bnef
[15] https://www.bloomberg.com/news/articles/2020-07-23/cheap-wind-power-could-boost-green-hydrogen-morgan-stanley-says
[16] https://www.axios.com/hydrogen-support-growing-5ee4cfbb-ee83-4494-8561-c172467b7e5e.html

scale projects are moving forward today,[17] and it is capturing attention as an important clean energy solution in the U.S. among agencies,[18] environmental advocates,[19] and as part of Joe Biden's presential campaign (which also includes achieving zero carbon in the power sector, nationwide, by 2035).[20]

California's leadership on climate and clean energy is too important to let lag. The state should not wait until the next SB 100 report in five years to commit to reducing greenhouse gas emissions in the power sector as part of SB 100 implementation or exploring how best to do so. It is clear today that green electrolytic hydrogen has a role to play in cost-effectively decarbonizing the power system and that it offers a tremendous economic opportunity as an emerging clean energy technology for leading jurisdictions to capture. We encourage you to include green electrolytic hydrogen and scenarios for minimizing and achieving zero emissions in your SB 100 planning now, and in all other climate and energy planning moving forward. The country, the world, and the market are watching.

Sincerely,

Lorraine Paskett
True North Renewable Energy

Peter J. Sawicki
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[17] http://www.airproducts.com/Company/news-center/2020/07/0707-air-products-agreement-for-green-ammonia-production-facility-for-export-to-hydrogen-market.aspx
[18] https://www.energy.gov/eere/fuelcells/h2scale
[19] https://www.nrdc.org/experts/rachel-fakhry
[20] https://joebiden.com/clean-energy/