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SB 100 Scenarios and Report Must Include Green Electrolytic Hydrogen

Additional submitted attachment is included below.

September 15, 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: SB 100 Scenarios and Report Must Include Green Electrolytic Hydrogen

True North Renewable Energy, Mitsubishi Power and Ørsted appreciate the opportunity to provide these comments in response to the public workshop and materials released related to the SB 100 Draft Results.

Summary of Comments and Recommendations

Thank you for the opportunity to comment on the SB 100 Scenarios review process and report. We are grateful for the efforts of CEC staff and the joint agencies to create an open statewide process to accept comments via regional workshops, and we appreciate your open and accessible posture for the past year while developing the first SB 100 Report to the Legislature. We look forward to more interaction with the CEC and joint agency teams and more opportunities to share data and analysis in order to inform your on-going process and assist in long-term energy planning for a 100 percent zero-carbon electric future.

We do have some concerns regarding the modeling, which does not completely consider reliability, the value of resource diversity and resiliency, or deeply explore opportunities beyond the immediate and obvious need to add significant amounts of solar, wind and batteries to the grid. The real challenges for the joint agencies to explore in the modeling and SB 100 Report is how we most efficiently and cost-effectively ensure reliability in a grid increasingly powered by intermittent renewable resources and what we can do to quickly and fully decarbonize the electricity sector.

We think more analytical work remains to be done before definitively answering these questions. Accordingly, we request that the CEC and joint agencies avoid making policy conclusions based on this set of scenarios. We further ask that you extend the analytical process after the report to the Legislature is due, in order to more deeply explore options for decarbonizing the electricity sector, and that in doing so, you solicit input from a range of models, organizations and assumptions.

In particular, we remain concerned that the SB 100 modeling only explicitly considers hydrogen as a transportation fuel and leaves out green electrolytic hydrogen as a key strategy for decarbonizing the electricity sector and providing an additional route to market for new-build renewable generation assets that will otherwise struggle to get built in a transmission constrained and ever-increasing curtailed electricity market. There is tremendous momentum for green electrolytic hydrogen around the world, with several commercial projects moving forward, including the Intermountain Power Project as a direct result of SB 100. There are an increasing number of studies illustrating the necessary and beneficial role that green electrolytic hydrogen can play in cost-effectively achieving zero carbon emissions in the power sector. These include every SB 100 compliance scenario under consideration by LADWP as part of its detailed, 3-year planning process[1] as well as studies by E3 elsewhere, including a dedicated report on hydrogen in June[2] and most recently in climate neutrality scenarios developed for CARB.[3] E3's hydrogen assessment found the market potential for green electrolytic hydrogen serving California's electricity sector to be as much as 10 GW, and potentially more to achieve zero carbon emissions sector-wide, with projects becoming profitable as soon as the 2025-2030 timeframe. What's more, the joint agencies have a statutory obligation to consider green electrolytic hydrogen as an eligible form of daily and seasonal energy storage that batteries alone cannot fully achieve.[4]

The SB 100 scenarios clearly highlight the significant role that wind, solar and batteries will play in decarbonizing our grid. However, they also demonstrate that additional strategies will be needed practically and efficiently achieve a zero-carbon power sector. Dispatchable, thermal generation and capacity will remain an important part of an efficient decarbonized electricity grid. These existing plants can be decarbonized, too, while continuing to serve their necessary role of providing grid reliability, by using green electrolytic hydrogen or other strategies. Targeted efforts to do so would lead to lower costs, lower emissions, and greater reliability than many of the scenarios presented in the draft results.

We were heartened to hear the Governor's call last week to accelerate the state's climate targets and understand grid reliability remains a key concern given the state's recent rolling blackout experiences. We agree with the Governor and have previously made similar requests both in this docket,[5] and in response to the recent climate neutrality workshop at CARB.[6] However, achieving faster, deeper decarbonization requires deploying additional strategies, including green electrolytic hydrogen. This is an important topic to include in the state's energy

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[1] https://www.ladwp.com/ladwp/faces/ladwp/aboutus/a-power/a-p-cleanenergyfuture/a-p-renewableenergystudy?_adf.ctrl-state=t6cvdyefj_38&_afrLoop=154248809271166

[2] E3 (2020) Hydrogen Opportunities in a Low-Carbon Future: An Assessment of Long-Term Market Potential in the Western United States, Energy+Environmental Economics, Inc., June. https://www.ethree.com/wp-content/uploads/2020/07/E3_MHPS_Hydrogen-in-the-West-Report_Final_June2020.pdf

[3] Climate neutrality scenarios developed by E3 for CARB use hydrogen to achieve zero emissions in the power sector. https://ww2.arb.ca.gov/sites/default/files/2020-09/e3_cn_draft_report_supp_data_aug2020.xlsx

[4] 2.3 PUC § 400 (2018)

[5] https://efiling.energy.ca.gov/GetDocument.aspx?tn=234324&DocumentContentId=67172

[6] https://www.arb.ca.gov/lists/com-attach/28-cn-e3-report-ws-WjkAZ1IhV2ZVDAdk.pdf

and planning models, and it is time that the joint agencies begin taking steps to support green electrolytic hydrogen as a climate solution.

Accordingly, we urge you to take the following important steps:

- **Revisit the modeling process and update the scenarios to include green electrolytic hydrogen in the power sector for both storage and as a zero-carbon fuel for baseload and dispatchable generation.** We are hopeful that the Governor may soon ask you anyways to update scenarios to achieve a potentially accelerated SB 100 target and to consider resource diversity, reliability and investments needed for resiliency. As you revisit scenarios, we urge you to specifically explore opportunities for green electrolytic hydrogen to not just meet the retail sales requirements of SB 100, but to also further decarbonize existing power plants and achieve zero carbon emissions across the power sector, in line with the state goal to become carbon neutral economy-wide.

- **Clearly state in the SB 100 Report that minimizing cumulative greenhouse gas emissions and taking them to zero or near-zero as soon as practical – in the electricity sector as a whole and in other sectors – is an objective of the joint agencies and will guide SB 100 implementation.** Achieving this goal requires looking beyond the rapid and necessary growth in markets for solar, wind and batteries and additionally developing targeted solutions to decarbonize a limited set of currently fossil-fueled gas plants that will be needed to provide reliability indefinitely into the future.

- **In the SB 100 Report, clearly define green electrolytic hydrogen as a renewable and zero-carbon resource and highlight the role that it can play in helping rapidly decarbonize the power sector in its entirety while supporting reliability.**

- **Separately, immediately take steps at each of your agencies to support deployment of green electrolytic hydrogen and other zero-carbon gases with the urgency that the climate crisis requires and that we expect the Governor may soon direct.** This includes:
    - Implement SB 1369 to ***deploy green electrolytic hydrogen as long duration energy storage*** and in other applications.
    - Adjust rate structures and market rules to ***put curtailed and surplus renewable power to use***, generating green electrolytic hydrogen for use as long duration energy storage, decarbonize gas power plants, and reduce overall fossil gas use in California, especially for large industrial gas users who can switch from fossil natural gas to green hydrogen.
    - Through the SB 1440 implementation proceeding, ***develop biomethane procurement standards that support CalRecycle's organics diversion regulations and develop hydrogen injection standards*** allowing green electrolytic hydrogen to be safely injected into the natural gas pipeline.

- Establish an ***electrolyzer deployment target*** in-line with the policy need and market scale required to achieve zero-carbon emissions in the power sector and achieve broader cost-parity with fossil-based gases.
- As part of SB 1440 implementation or separately, create a ***zero-carbon gas procurement program*** that is broadly inclusive of all zero-carbon gas and includes specific procurement requirements for green electrolytic hydrogen, to create steady markets that will help rapidly reduce electrolyzer costs and help green electrolytic hydrogen emerge as a cost-effective alternative to fossil-based gases within the next 5-10 years. This program should include infrastructure targets and price controls to minimize cost.
- Through the Scoping Plan or other process, ***develop a strategic plan for green electrolytic hydrogen*** to help make it a cost-effective, widely available climate solution within the next decade and a driver of economic growth in California.
- Provide ***monetary incentives to support first-mover projects for organics recycling and green electrolytic hydrogen***, accelerate project development, and maximize benefits.
- ***Adopt financial mechanisms*** that can support new zero-carbon gas policies and infrastructure by re-imagining existing programs to attract private investment and reduce consumer costs.
- ***Support a series of pilot projects*** as launching pads for the green hydrogen and electrolysis market.
- Provide ***non-monetary support for shovel-ready projects, incentives to attract private capital and cost-effective project financing to enable new infrastructure***.

It is becoming increasingly clear that zero-carbon gases, including green electrolytic hydrogen, will be a necessary component in California's effort to decarbonize the power sector and achieve climate neutrality. The sooner we deploy this technology and these resources, the sooner we will achieve our climate and clean energy goals.

We would appreciate the opportunity to work with your agencies to immediately incorporate green electrolytic hydrogen into the SB 100 and other modeling and planning efforts. Additionally, we urge you to implement key policies, like those outlined in this letter, that will catalyze growth in this sector and unlock its full potential. Doing so will not only offer a major step toward achieving the state's SB 100 and climate objectives, but will also propel an infrastructure construction boom, akin to that seen as a result of the Renewable Portfolio Standard, which will aid in the state's recovery from the COVID-induced recession.

About Our Companies: Leading Efforts to Decarbonize Power, Industry, and Other Sectors

For decades, True North Renewable Energy, LLC and True North Venture Partners (True North) have invested in disruptive technologies that can reduce climate change and improve fundamental societal practices to be more sustainable – including renewable electricity production, water treatment, organic waste recycling, and renewable and electrolytic gas and

fuel production. We also contribute research and analysis in major international markets to help shape policies that enable green economic expansion and advance climate change policies. The companies' individual and collective work ranges from thin film solar technology development and deployment (First Solar), to organics recycling-to-biogas (True North Renewable Energy, LLC), to electrolysis for hydrogen production (Aquahydrex).

Mitsubishi Power leads the industry in power generation and energy storage solutions and is at the forefront of deploying green hydrogen and battery energy storage systems. Mitsubishi Power's mission is to provide power generation and storage solutions that enable our customers to combat climate change and advance human prosperity. Mitsubishi Power was recently awarded a contract by the Intermountain Power Agency for turbines to support transitioning the Intermountain Power Plant from coal today to a blend of 70 percent natural gas and 30 percent green hydrogen by 2025, and then 100 percent green hydrogen by no later than 2045. The project, which is operated by the Los Angeles Department of Water and Power, will immediately reduce emissions from the plant by 75 percent in 2025, and is a critical element to the utility's climate goals and SB 100 compliance plans.

Mitsubishi Power, in partnership with Magnum Development, is also developing the Advanced Clean Energy Storage project in Delta, Utah. This facility is the world's largest renewable energy storage project and it demonstrates a path to a decarbonized power grid for the Western United States. It leverages salt dome technology to develop storage caverns, each capable of storing enough green hydrogen to provide 150 GWh of clean energy. The project will have the capacity to store months of power generated by excess renewable resources, fundamentally changing the way we store energy.

Ørsted is a leading global renewable energy developer with $60 billion market capitalization and over 10 TWh of generation worldwide consisting of offshore wind, onshore wind, solar and bioenergy facilities. In 2020, Ørsted was recognized as the world's most sustainable company by Global 100 Index. The company is looking to continue its renewable investments in the U.S. market with a capital spending program planned at $35 billion by 2025. Ørsted has direct experience in successfully transitioning away from fossil fuel energy toward renewable energy generation and sees California as an exciting potential market for green electrolytic hydrogen and supporting wind and solar facilities.

Our companies are global leaders facilitating change in the energy sector, developing and commercializing technologies that produce and utilize non-fossil, zero-carbon energy resources – including renewable power, green electrolytic hydrogen and biogas. We look forward to helping the state meet its SB 100 and climate neutrality goals as soon and as effectively as possible.

Climate Neutrality Requires Reducing Electric Sector Emissions to Zero

We have commented previously that SB 100 specifically references transitioning to a "zero carbon electric system," and should be considered one-and-the same as climate neutrality. 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 carbon emissions on at least a similar timeline as it plans to achieve climate neutrality.

We have also previously commented and advocated for accelerating both targets, which is readily achievable with focused efforts on decarbonizing the last of the power sector and reaching other hard-to-abate sectors like existing buildings, industry, heavy-duty and off-road transportation, maritime shipping, agriculture, data centers and others. The solutions for these sectors include zero-carbon gases like green electrolytic hydrogen and hydrogen derived fuels such as e-Methanol and e-Ammonia.

We Need More than Solar, Wind and Batteries

We appreciate that the joint agencies explored a range of scenarios, including scenarios that begin to illustrate the value of diverse and dispatchable zero-carbon resources. Those scenarios deserve to be further explored.

Many of the scenarios presented focus on primarily adding solar, wind and batteries to power 100 percent of retail sales with zero-carbon resources. However, the electricity system is bigger and more complicated than that, and almost all of the scenarios continue to rely on fossil natural gas to balance the grid. The modeling should take a deep dive into scenarios and technologies that can efficiently decarbonize all grid operations.

Additionally, the scenarios highlight that a bifurcated system that relies on renewable power to supply 100 percent of retail sales and fossil fuels to balance the grid is inefficient. Indeed, many of the scenarios indicate an overbuild and under-utilization of grid assets, to the extent that marginal solar resources only have an effective load carrying capacity (ELCC) of 2 percent.

It is impractical to assume that projects would continue to be built that are so poorly utilized, or that such low capacity credit and utilization would not significantly impact the levelized costs of these resources. Already, curtailment levels today are making the case for building new utility-scale solar projects more difficult. Assets offering so little value to the grid would invariably need to find other sectors and markets to participate in – such as generating electrolytic hydrogen to displace fossil natural gas use in buildings or industry – when they aren't powering the electricity sector. And if we're going to need new loads like green electrolytic hydrogen production to make these projects work anyway, the modeling should specifically include this and include green electrolytic hydrogen in the electricity sector, as well.

Scenarios Do Not Minimize Greenhouse Gas Emissions

Intermittent resources and short-duration storage are incapable of completely replacing the role existing gas plants play in balancing the grid. The joint agencies should revisit the modeling with a specific focus on minimizing greenhouse gas emissions cumulatively and achieving zero or near-zero greenhouse gas emissions in the power sector as soon as possible.

Every scenario but one implies we will continue to rely on fossil fuels in power plants perpetually into the future. For example, the Core scenarios include ongoing greenhouse gas emissions of 24 $MMTCO_2$ per year in 2045 and beyond. This implies SB 100 could deliver as little as a 20 percent reduction in greenhouse gas emissions, compared to the utility planning target range of 30-46 $MMTCO_2$ in 2030 that existed before SB 100 was passed.

The Issue to Focus on is Decarbonizing Gas Plants

Actually reducing greenhouse gas emissions requires addressing those plants that continue to provide needed reliability to the grid through the 2045 modeling timeframe, and presumably well beyond. This is a very tangible problem that the joint agencies should prioritize addressing in new modeling scenarios and the SB 100 Report. There are a fixed number of plants, a limited number of options to decarbonize them – including replacing fossil natural gas with green electrolytic hydrogen – and a clearly identified need for them on an ongoing basis. **Figuring out how quickly and how best we can decarbonize these plants would be the most promising and beneficial modeling and policymaking task for the joint agencies to focus on in the SB 100 implementation process.**

The scenarios do, helpfully, begin to demonstrate the opportunity here. We appreciate that the Zero Carbon Firm Resources scenario illustrates the tremendous value that resources like green electrolytic hydrogen offer. Although it doesn't specify green electrolytic hydrogen as a resource, it shows that zero-carbon firm and dispatchable power plants can replace fossil natural gas and avoid overbuilding other resources. *The results are clear – this scenario reduces capacity requirements by 70 GW, or about 40 percent, and reduces greenhouse gas emissions.* However, this scenario only incrementally replaces fossil fuels on the grid, to meet the retail sales specification in SB 100. We urge the joint agencies to further explore how zero-carbon firm and dispatchable resources can be deployed to fully decarbonize the power sector as quickly as possible – which, as stated in previous comments, we believe to align with the intent of SB 100 – and focus specifically on technologies like green electrolytic hydrogen that can do so.

Green Electrolytic Hydrogen Supports Environmental Justice

We do acknowledge that the scenarios offer the No Combustion scenario, which does achieve zero emissions by 2045. Even this scenario, however, does not minimize cumulative greenhouse gas emissions before 2045, and it has the highest costs, lowest utilization of assets, and requires more than twice the capacity as the Zero Carbon Firm Resources scenario.

We appreciate the need to prioritize and focus on delivering beneficial outcomes for environmental justice communities. However, we do not feel that this scenario, or an objective of eliminating combustion in the power sector, is the best way to achieve those outcomes. For one, transitioning power plants away from fossil fuels to use green electrolytic hydrogen would

significantly reduce emissions. Additionally, achieving beneficial environmental justice outcomes entails engaging at a local level and addressing specific sources of pollution.

We think the best way to achieve environmental justice outcomes is to engage at the community-level on specific sources of concern – which in some cases may include power plants, and in others, may not – while committing to and focusing on most quickly and cost effectively decarbonizing the power sector and economy on whole.

Green Electrolytic Hydrogen Part of the Solution

We strongly support the rapid deployment of solar, wind, and batteries to decarbonize our grid. However, the analytical task associated with achieving 100 percent clean energy and a zero-carbon power sector requires a deep look at other solutions, including green electrolytic hydrogen.

Studies that do look to fully decarbonize the power sector inevitably include green hydrogen. For example, while a recent and commonly-cited paper highlighted how wind, solar and batteries could reduce greenhouse gas emissions in the U.S. electricity sector by 90 percent,[7] a follow up study highlights green electrolytic hydrogen as one of a set of additional strategies that could achieve 100 percent zero carbon energy in the U.S. by 2035 without increasing customer costs.[8] Every scenario that LADWP has developed for complying with SB 100 and maintaining grid reliability includes green hydrogen, including an "LA Leads" scenario that uses green electrolytic hydrogen to displace all fossil natural gas and achieve a 100 percent zero-carbon electricity system for Los Angeles by 2035.[9] Another study shows how utilizing green electrolytic hydrogen in existing power plants can significantly reduce costs, emissions, and land use associated with SB 100.[10] And even E3, despite excluding green electrolytic hydrogen from the SB 100 scenarios, includes it to achieve zero-carbon electricity in climate neutrality scenarios recently developed for CARB,[11] and as referenced above, has developed a report specific to hydrogen that highlights its tremendous potential to help economically decarbonize California's power grid – not just in 2045, but well beforehand, too.[12]

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[7] https://www.2035report.com

[8] https://energyinnovation.org/wp-content/uploads/2020/09/Pathways-to-100-Zero-Carbon-Power-by-2035-Without-Increasing-Customer-Costs.pdf

[9] For example, see: https://www.ladwp.com/cs/idcplg?IdcService=GET_FILE&dDocName=OPLADWPCCB726105&RevisionSelectionMethod=LatestReleased

[10] https://www.pathto100.org/wp-content/uploads/2020/03/path-to-100-renewables-for-california.pdf

[11] E3 (2020) Achieving Carbon Neutrality in California: PATHWAYS Scenarios Developed for the California Air Resources Board, Energy+Environmental Economics, Inc., August. https://ww2.arb.ca.gov/sites/default/files/2020-08/e3_cn_draft_report_aug2020.pdf

[12] E3 (2020) Hydrogen Opportunities in a Low-Carbon Future: An Assessment of Long-Term Market Potential in the Western United States, Energy+Environmental Economics, Inc., June. https://www.ethree.com/wp-content/uploads/2020/07/E3_MHPS_Hydrogen-in-the-West-Report_Final_June2020.pdf

Sufficient Cost and Supply Data to Model Green Electrolytic Hydrogen

Contrary to the assertion in the scenarios and supporting documentation that there is insufficient data to model green electrolytic hydrogen as a drop-in fuel, electrolysis has a significant global market today, and we have clear line of sight on industry trends and expected cost reductions over time.

For their part, and as referenced elsewhere in this letter, E3 has specifically modeled green electrolytic hydrogen in the California electricity market and includes green electrolytic hydrogen costs in several other scenarios developed for the joint agencies. Similar to E3's findings, a study by the Hydrogen Council with McKinsey finds that hydrogen in the power sector could be cost-effective in the 2025-2030 timeframe.[13] Additionally, 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."[14]

When considering the development of green electrolytic hydrogen, we recognize many similar cost patterns that emerged in the wind and solar markets. Innovation and large-scale deployment of renewable technologies contributed to bringing down the cost of wind and solar plants, which today are cheaper than fossil-fueled generation in most parts of the United States. Over the course of a single decade, these markets disproved a long-held conventional wisdom that renewable power would always be more expensive than fossil fuels. Green electrolytic hydrogen is on a similar innovation and large-scale deployment journey. Electrolyzer costs are expected to fall rapidly over the next five years and continue beyond that. There are now credible projections that suggest that green electrolytic hydrogen will outcompete fossil hydrogen production by 2030.

Modeling should also consider utilizing pipeline infrastructure to transmit zero-carbon gases. Transportation of energy will be key to accessing multiple California markets and providing a path toward decarbonization for the hard to abate industries. Gas pipeline infrastructure can be a less expensive means of expanding renewable energy transportation than siting and constructing new electric transmission facilities. Gas pipelines also provide the additional benefit of allowing secondary storage of zero-carbon gas inside the pipe.

Our companies are in the market and some are developing commercial scale green electrolytic hydrogen projects today. We see and expect costs in-line with these projections and are thinking about how you create a large-scale market for green electrolytic hydrogen to helkp quickly achieve climate neutrality. We are excited about near- and mid-term opportunities for green electrolytic hydrogen in the electricity sector and other markets, in California and beyond.

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

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

Revisit Modeling, Incorporate Green Electrolytic Hydrogen to Achieve Zero Carbon Emissions

The state can no longer ignore green electrolytic hydrogen or other strategies that are needed to quickly and deeply decarbonize our economy. Projects are moving forward today,[15,16] and your agencies should not wait until the next SB 100 Report in 2025 to recognize and explore these solutions.

These scenarios offer a start, and identify a need for additional technologies, like green electrolytic hydrogen, to provide grid reliability with zero carbon emissions. In light of the Governor's comments last week and the rolling blackouts experienced this summer, we urge you to go back and develop scenarios that look deeper and more purposefully at completely decarbonizing the power sector. This must include green electrolytic hydrogen and any other technology that might help us move quickly and effectively to zero carbon emissions while enhancing system reliability, protecting resource diversity, and expanding our capacity for resiliency.

[15] https://amer.mhps.com/intermountain-power-agency-orders-mhps-jac-gas-turbine-technology-for-renewable-hydrogen-energy-hub.html

[16] https://www.greentechmedia.com/articles/read/nextera-energy-to-build-its-first-green-hydrogen-plant-in-florida