September 19, 2022

California Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: GHC Comments on the Senate Bill (SB) 1075 Joint Agency Kickoff Workshop

I. INTRODUCTION

The Green Hydrogen Coalition (GHC)[1] is an educational 501(c)(3) non-profit organization. GHC was formed in 2019 to recognize the game-changing potential of "Green Hydrogen"[2] to accelerate multi-sector decarbonization and combat climate change. GHC's mission is to facilitate policies and practices that advance Green Hydrogen production and use in all sectors of the economy to accelerate a carbon-free energy future. Our sponsors include foundations, green energy users and developers, utilities, and other supporters of a reliable, affordable Green Hydrogen fuel economy for all.

The GHC would like to express its full support for SB 1075 and its requirement that California state agencies analyze the future role of hydrogen in California's decarbonization strategy. Given the urgency of the climate crisis and the potential for Green Hydrogen to replace fossil fuels in hard-to-electrify applications and create significant air quality and public health improvements, the GHC is appreciative of the Joint Agency's thoughtful and comprehensive approach to implementing SB 1075.

We would also like to express our appreciation to the California Air Resources Board (CARB), California Public Utilities Commission (CPUC), and California Energy Commission (CEC) (together Joint Agencies) for hosting the Senate Bill (SB) 1075 Joint Agency Kickoff Workshop. We also appreciate the contributions of the California Governor's Office of Business and Economic Development (GO-Biz). This workshop was vital in updating the public on the current developments in the Green Hydrogen economy and highlighting the work needed to ensure that it can become a key energy resource in helping to achieve California's climate goals. The coordination between the Joint Agencies will be vital for accelerating progress and helping California develop a common, enduring legal and regulatory framework critical to fostering

[1] https://www.ghcoalition.org/

[2] The GHC's use of "Green Hydrogen" in this document is broadly defined to mean hydrogen that is produced from non-fossil fuel feedstocks and has climate integrity, as measured by well-to-gate carbon intensity. Notably, this definition is broader than the more narrow definition of "Renewable Hydrogen" (referred to in section 4 of our comments), which would be consistent with California Renewable Portfolio Standard law including enabling regulations for eligible feedstocks for the production of renewable energy.

continued innovation and investment. Overall, we commend the Joint Agencies on this successful workshop.

II. COMMENTS

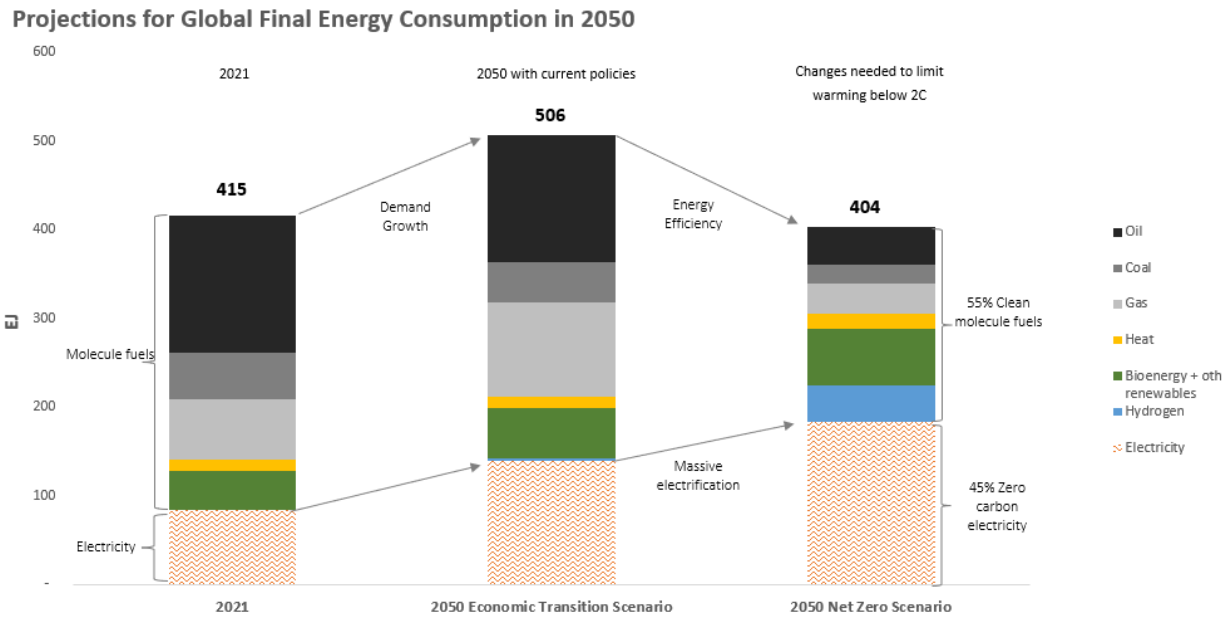
In the following sections, the GHC will present its comments and corresponding recommendations to help ensure the SB 1075 analysis is as robust as possible.

1. SB 1075 analysis is timely and urgently needed to ensure appropriate near-term planning for economy-wide decarbonization.

The SB 1075 analysis discussed in this workshop is timely and needed for helping California achieve economy-wide decarbonization across sectors. While electrification is an important strategy for reducing our reliance on fossil fuels, research highlights that electrification alone will not be sufficient. As illustrated in the graph below from BloombergNEF, even with significant amounts of electrification, 55% of our energy demand by 2045 will still be in molecule form.[3] Therefore, ensuring that those molecules will not be derived from fossil fuels requires coordinated action and planning now, particularly on needed infrastructure.

The goals and objectives of SB 1075 will help identify the needed infrastructure that must be planned for and invested in today to realize affordable green alternatives for the 55% of future energy demand that cannot be electrified. Green Hydrogen is necessary to achieve a fully green portfolio for the 55% forecasted molecule demand, either directly, as shown in the blue bar in the chart below or via its essential role as a renewable energy carrier for the production of synthetic green liquid fuel alternatives for any variety of fossil fuels used today. In this way, electrification with renewable electricity and decarbonized molecules with renewable hydrogen can be used in tandem to reach the ambitious scale and scope needed to decarbonize California economy-wide. Therefore, urgent action is needed to advance Green Hydrogen at scale, with a particular focus on the local, regional, and state-wide renewable hydrogen transport and storage infrastructure needed to allow mass-scale, affordable Green Hydrogen to fill this important role in our energy transition away from fossil fuels.

[3] BNEF New Energy Outlook 2022. Nov. 30, 2022.



Source: BNEF New Energy Outlook 2022, Nov. 30, 2022

Economic Transition Scenario (ETS) - the global energy transition is primarily driven by the economic competitiveness of key technologies, without concerted policy actions to accelerate the transition beyond those policies in place today.

Net Zero Scenario (NZS) - an energy transition pathway consistent with the headline Paris Agreement goal of keeping global warming well below 2C and achieving net-zero emissions worldwide by 2050.

2. SB 1075 analysis should prioritize a systems-level planning approach for intrastate transport and storage infrastructure of Green Hydrogen, which is a key enabler to achieving a mass-scale Green Hydrogen economy.

As GHC's work architecting Green Hydrogen hubs at scale has found, it is possible to achieve less than $1/kg delivered mass-scale Green Hydrogen in Los Angeles with shared 100% Green Hydrogen pipeline transport connected to out of state geologic salt cavern storage.[4] Pipeline transport is the most cost-effective pathway to transport needed quantities (millions of metric tons) of Green Hydrogen from locations of low-cost production to locations of high volume consumption, such as the Port of Los Angeles. To balance seasonal demand for the resulting Green Hydrogen, the pipeline system must also be connected to large-scale underground storage, similar to how natural gas is stored in underground caverns today. Hydrogen is already commercially stored in purpose-built salt caverns in the U.S. today and is commercially sold and transported in 100% hydrogen pipelines, including 17 miles of pipeline in Los Angeles[5] (connecting oil refineries) and more than 1,600 miles of pipeline in the Gulf of Mexico.[6] In short, an expanded new Green Hydrogen pipeline system connected to out of state geologic storage in salt domes[7] is the key enabler of a mass-scale Green Hydrogen economy for California.

[4] Hybuild LA Phase 2 Report and HyBuild LA Phase 2 Report-Out: Advancing the California Hydrogen Hub Vision.
[5] https://www.osti.gov/biblio/1068156
[6] https://www.energy.gov/eere/fuelcells/hydrogen-pipelines
[7] California has no known salt domes today. The closest commercially proven salt dome is ACES Delta, located in central Utah.

GHC's research indicates that the way to get started is by aggregating sufficient demand across sectors in targeted locations so that the needed mass-scale transport and storage solutions can be developed along with lowest cost at-scale production solutions. Therefore, the GHC recommends that the SB 1075 analysis prioritize the needed shared transport and storage infrastructure to achieve mass-scale, low delivered cost and it should be prioritized at both the state and sub-state regional level.

Recommendation: A systems-level approach is needed to accelerate adoption of Green Hydrogen, as indicated in HyBuild™ findings.

As was found in the GHC's Hybuild™ LA analysis, infrastructure[8] is critical to achieving assured year-round supply and low delivered cost of Green Hydrogen to meet the scale and scope of fossil displacement needed to fight climate change. HyBuild LA established a long-term vision (2030) at scale and demonstrated that a scaled Green Hydrogen economy for Los Angles was commercially feasible and cost-competitive with fossil fuels. The analysis also found that aggregated demand in Northern California (Stockton area) could be cost-effectively served by a North/South Green Hydrogen transmission pipeline backbone. As noted above, to achieve the lowest cost for Green Hydrogen year-round, California's Green Hydrogen pipeline infrastructure will need to be interconnected to an out of state salt dome. HyBuild LA findings indicate that the Sierra Nevada mountain range is a challenging geologic barrier for interstate pipeline connection with northern California; therefore, to access out of state salt domes, northern California's Green Hydrogen pipeline system would ideally run through southern California.

The analysis conducted under SB 1075 can similarly establish the needed long-term vision at a statewide level – focusing on what is possible with scaled Green Hydrogen hubs throughout California and at the local level – to quickly achieve this goal. This work can mirror the approach undertaken through the European Hydrogen Backbone Initiative, which aims to accelerate Europe's decarbonization journey across 28 European countries by defining the critical role of hydrogen infrastructure – based on existing and new pipelines.[9]

While long-term visions are extremely helpful for aligning all stakeholders toward a common goal, a bottom-up approach is also necessary to inform how to get started. As part of California's application seeking funding to establish a federal hydrogen hub from the U.S. Department of Energy through the Infrastructure Investment and Jobs Act, the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) has already conducted extensive analysis and has identified a wide variety of near-term projects throughout the Green Hydrogen value chain and across sectors that are suitable for federal funding throughout the state. These projects are important 'beach head starting points' from which progress can be accelerated and scale can be achieved faster. GHC strongly recommends that SB 1075 analysis consider the potential for these early projects to help accelerate the market and, importantly, to inform what locations within the state should start prioritizing needed transport and storage infrastructure. By focusing on a long-term vision based

[8] Infrastructure includes pipeline transport connected to out of state geologic salt cavern storage.
[9] https://ehb.eu/

on systems approach and leveraging near-term projects identified by ARCHES, California can determine the best pathway forward that optimizes for accelerating progress.

3. Achieving scale can be accelerated by considering applications beyond the transportation and power sectors.

Scale is key to achieving the lowest delivered cost for Green Hydrogen and rapid displacement of fossil fuels. While the focus of SB 1075 is specific to the power and transportation sectors, the GHC would like to highlight that any resulting hydrogen infrastructure from these two sectors can also be used effectively to help deeply decarbonize other sectors, particularly for uses in sectors that are geographically close to planned infrastructure and projects for power and transportation sectors. For example, once pipeline transport infrastructure is deployed and the mass-scale low-cost delivery of Green Hydrogen becomes possible, California can potentially begin producing green ammonia at scale for our agricultural, industrial, and refrigeration sectors that is cost-competitive with the fossil-based ammonia that California already imports.

The energy transition will require mass-scale use of Green Hydrogen across various sectors and significant investments in shared transport and storage infrastructure. That infrastructure will be most affordable if it can be shared by users in all sectors, not just the transportation and power sectors. Indeed, for many sectors, Green Hydrogen and its fuel derivatives may be the only way to decarbonize and move away from fossil fuel use. Therefore, we believe it is important to consider the potential for a Green Hydrogen economy to address deep decarbonization across all sectors.

Recommendation: The Joint Agencies should factor in the findings of the CARB 2022 Scoping Plan, which addresses emissions across various sectors.

Given hydrogen's potential, we recommend that the Joint Agencies factor in the findings of the CARB 2022 Scoping Plan, which analyzed all key sectors in which hydrogen can play an important role.[10] This analysis concluded that the scale of California's energy transition will require "1,700 times the amount of current hydrogen supply" and proceeded to set up a Scoping Plan Scenario in which clean hydrogen is used in various sectors, including aviation, ocean-going vessels, and low carbon fuels for buildings and industry. Without incorporating this existing research, the GHC worries this will be a lost opportunity to better understand the infrastructure, production requirements, and end uses that could be rapidly decarbonized with Green Hydrogen. While the Scoping Plan explains "SB 1075 would inform the production of hydrogen at the scale called for in this Scoping Plan," we also encourage the 2022 Scoping Plan analysis to help inform SB 1075.

4. SB-1075 analysis creates an opportunity for the Joint Agencies to establish a common, enduring legal and regulatory framework for Green Hydrogen in California, starting with a technology neutral definition that is consistent with California's extensive statutory history regarding renewable energy.

While California has a diverse abundant array renewable resources to produce Green Hydrogen for our decarbonized energy future, the state currently has not established a common framework or strategy for defining green or renewable hydrogen to help take advantage of these many

[10] https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents

abundant resources. As a result, the definition of Green Hydrogen and its role in the state's energy transition can vary by agency and program. Without a consistent and well-defined framework for Green Hydrogen, the GHC worries that collaboration across all stakeholders may become more challenging and thereby inhibit innovation, investment, and a coordinated approach. Lack of a coordinated approach will ultimately slow progress.

Given the urgency of the climate crisis, the GHC believes it is pivotal that the Joint Agencies work together to establish a common framework for clean and renewable hydrogen that is consistent with the framework established for eligibility for federal tax incentives. Ultimately, the GHC believes that by establishing a framework that supports and encourages renewable resources and allows for innovation, competition, and ease of interpretation with existing federal tax incentives, California can be a 'North Star' that helps align policies and agencies toward common goals and thereby serve as a model for other states and countries. To achieve this, the GHC puts forth the following recommendations: (1) develop a carbon-intensity based definition for Green Hydrogen and Renewable Hydrogen, (2) ensure Renewable Hydrogen definition consistency with prior California renewable energy statute and regulations, and (3) include hydrogen projects in CEQA streamlining under SB 149.

Recommendation #1: Develop a technology neutral, carbon-intensity based definition for Green Hydrogen and Renewable Hydrogen.

Since California needs a broad portfolio of alternative energy sources to reduce our reliance on fossil fuels, it is important that the Joint Agencies adopt a common framework and eligibility criteria for Green Hydrogen based on the use of non-fossil fuel feedstocks and its carbon impacts. While SB 1075 refers specifically to "green electrolytic hydrogen," the GHC would like to highlight that Green Hydrogen can also be produced from other non-fossil fuel pathways, including RPS-eligible feedstocks as well as SB 100-eligible feedstocks (e.g., large hydro). The GHC therefore recommends that the Joint Agencies adopt a technology neutral definition that employs a carbon-intensity framework using a well-to-gate lifecycle analysis (well-to-gate LCA) to capture all Green Hydrogen production pathways. For the purposes of this discussion, a "carbon intensity framework" (CI framework) is the quantitative methodology that calculates the amount of CO2 emissions emitted per unit of hydrogen produced. The GHC defines a "well-togate LCA" based on the International Partnership for Hydrogen and Fuel Cells in the Economy's methodology for determining the greenhouse gas (GHG) emissions associated with the production of hydrogen.[11] There are two key benefits of employing a carbon intensity framework using a well-to-gate lifecycle analysis:

- Appropriate accounting for the environmental impacts of Green Hydrogen. The precise measurements of Green Hydrogen's carbon intensity can more accurately reflect the well-to-gate environmental impacts of a given kilogram of hydrogen produced and overcome the limitations of the "color coding" model (*green, blue, grey, brown, etc*.). This helps reduce market misrepresentations by accurately capturing the true GHG emissions of any type of hydrogen production, including technology-neutral Green Hydrogen, thereby

[11] https://www.iphe.net/iphe-wp-methodology-doc-jul-2023

facilitating the development of a credible clean hydrogen market nationally and ensuring California remains a robust leader in Green Hydrogen development not only for California's use, but ultimately, also for export.

- Approach is technology neutral, which will spur innovation and investment. By focusing on carbon emissions (rather than technology types) to prioritize hydrogen solutions, this approach is inclusive of all non-fossil fuel feedstock hydrogen pathways, including the state's abundant biogenic feedstocks. This not only creates incentives to reduce emissions – and thereby generate progress towards the state's emissions reduction goals – but also helps spur the innovation and investment for cleaner technologies. The GHC supports taking this perspective since it opens other pathways for competition on the basis that Green Hydrogen, regardless of how it is produced, can flourish if it meets the desired emissions reduction threshold. Competition will drive down costs of clean technology, which will benefit consumers and accelerate our clean energy transition.

Given the above benefits, the GHC would like to express its support for ARCHES technology neutral approach and the CPUC's CI framework. The GHC commends ARCHES for its inclusive approach to Green Hydrogen production, which includes biogenic pathways. This approach sets a standard we believe that all state agencies should adopt. Embracing ARCHES' technology neutral approach to Green Hydrogen production will establish a unified statewide approach, enable efficient access to federal tax incentives, and facilitate California's Green Hydrogen market leadership nationally.

Furthermore, we strongly support the CPUC and its CI approach to hydrogen eligibility. This aligns seamlessly with federal guidance and sustainability goals as it makes carbon intensity a critical metric for assessing hydrogen's environmental impact. We recommend other agencies follow the CPUC's lead by implementing technology neutral requirements based on a well-to-gate carbon intensity framework. Such alignment enhances eligibility for federal funding and contributes significantly to reducing greenhouse gas emissions, thereby advancing California's clean energy transition. We also endorse the CPUC's interim hydrogen standard, limiting well-to-gate lifecycle GHG emissions to no more than 4 kilograms (kg) of carbon dioxide equivalent (CO_2e) per kilogram of hydrogen, consistent with the Inflation Reduction Act (IRA) eligibility criteria for the hydrogen production tax credit. This aligns state and federal goals, laying the groundwork for hydrogen to help achieve national and state GHG reduction targets. The proposed definition, focusing on well-to-gate carbon intensity, enables the Commission to evaluate various feedstocks, process energy, and station power inputs for hydrogen production.

However, we urge the Commission to remain consistent with the federal 4kg CO_2e/kg H_2 requirement and avoid imposing prohibitions on secondary inputs (such as station power) since such strict requirements may hinder progress toward state environmental goals. While we support the Commission's non-fossil fuel feedstock requirement, we believe an outright prohibition of minor energy inputs to the lifecycle process is unnecessary, as long as the project's well-to-gate lifecycle carbon intensity does not exceed 4kg CO_2e/kg H_2. Banning the use of any fossil fuels sources – even for secondary inputs – will make many projects infeasible, unnecessarily increase costs, and hinder progress, which will prolong our continued use of fossil fuels. Therefore, we recommend following the federal carbon intensity framework be utilized for eligibility.

It is crucial to acknowledge that multiple pathways exist for producing hydrogen from non-fossil fuel feedstocks, all requiring some form of secondary energy and station power inputs. Allowing projects to use non-renewable inputs, as long as the cumulative amount does not exceed the required 4kg CO2e/kg H2 produced, encourages innovation and system-level benefits. Hence, we encourage the Commission to remain consistent with the federal 4kgCO2e/kg h2 requirement for secondary inputs.

Recommendation #2: Ensure consistency with California's Renewable Portfolio Standard Statutory history and regulations regarding "Renewable Hydrogen"[12]

California has a robust and world-leading regulatory framework for renewable energy. The GHC recommends establishing a definition for Renewable Hydrogen consistent with California's expansive preexisting policy and regulatory history, including eligibility for Renewable Hydrogen produced from all RPS-eligible feedstocks and utilized in all RPS-eligible equipment for converting the resulting renewable hydrogen into electricity, including fuel cells as well as gas turbines that are able to achieve California's world-leading current NOx emissions standards.

Today, under California's RPS program, various clean and green resources are deemed eligible to help meet RPS goals. Renewable hydrogen is considered eligible to the extent it used in fuel cells so long as "the hydrogen was derived from a non-fossil-based fuel or feedstock through a process powered using an eligible green energy resource."[13] However, that same Renewable Hydrogen, as defined, is not allowed in combustion turbines, despite the fact that this technology is already in use around the world and it is an affordable pathway to reduce our reliance on fossil fuels since it can repurpose existing infrastructure to achieve clean firm dispatchable renewable power.

The GHC would like to recognize both CARB and CEC's recognition of the potential use of Renewable Hydrogen for power generation as a means to achieve 100% renewables in the power sector and system-wide reliability at the CEC's recent IEPR workshop.[14] Going forward, greater progress and market certainty will possible if consistency is achieved by allowing the combustion of Renewable Hydrogen in gas turbines is explicitly allowed under the RPS.

Recommendation #3: Include hydrogen projects in CEQA streamlining under SB 149.

Currently, California's Environmental Quality Act (CEQA) streamlining process under SB 149 (2022) is limited to wind and solar. Given Green and Renewable Hydrogen's potential to help the state achieve its GHG emissions goals, we believe that Green and Renewable Hydrogen projects should be eligible for expedited judicial review under CEQA. Expanding CEQA streamlining to include "Green and Renewable Hydrogen" (consistent with §45V of the Inflation Reduction Act) would help achieve a key goal of this bill: to make California more competitive for funding from the federal Inflation Reduction Act and the Infrastructure Investment and Jobs Act of 2021. We believe including Green Hydrogen and Renewable Hydrogen in SB 149 would help incentivize its use and thereby jumpstart progress towards GHG emissions reductions. By taking this action,

[12] "Renewable Hydrogen" is defined according to Assembly Bill 209.
[13] https://efiling.energy.ca.gov/getdocument.aspx?tn=217317
[14] https://www.energy.ca.gov/event/workshop/2023-09/iepr-commissioner-workshop-potential-growth-hydrogen

California could highlight its support for hydrogen fuel production (and pipelines for transport) as part of our zero-energy future.

5. **Green Hydrogen represents an opportunity to reimagine and cocreate California's energy economy in partnership with communities. For the state to scale its Green Hydrogen economy, equal attention must be paid to ensuring that progress happens with environmental integrity.**

As California fosters innovation, competition, and investment in a Green Hydrogen economy, the Joint Agencies should clarify and enforce the existing environmental standards that must be adhered to in order to ensure that all hydrogen-related infrastructure development is completed safely and with environmental integrity.

Recommendation: California has always been a leader in environmental integrity and should continue to do so by ensuring adherence to California's world-leading environmental standards and working with communities of concern as we find a pathway for hydrogen in our economy.

In the analysis of SB 1075, we encourage the Joint Agencies to clarify and reaffirm enforcement of the environmental impact requirements (air quality improvements, water quality improvements, etc.). Transparency and enforcement of environmental requirements is critical to building trust and ensuring corporate responsibility.

A key element of environmental integrity also includes working with communities across the state. Therefore, we urge the Joint Agencies to factor in the needs, concerns, and risks facing all communities *and, importantly, include communities of concern in the investigative and research work planned under SB 1075 – particularly those communities most impacted by climate change throughout the state.* Green Hydrogen has the potential to not only improve air quality for those near urban ports but also decrease fire risk for rural mountain communities, where biomass can be used to help produce Green Hydrogen via gasification. When it comes to successfully decarbonizing the state, the path of fastest and most sustainable progress requires working with local communities to cocreate the path forward.

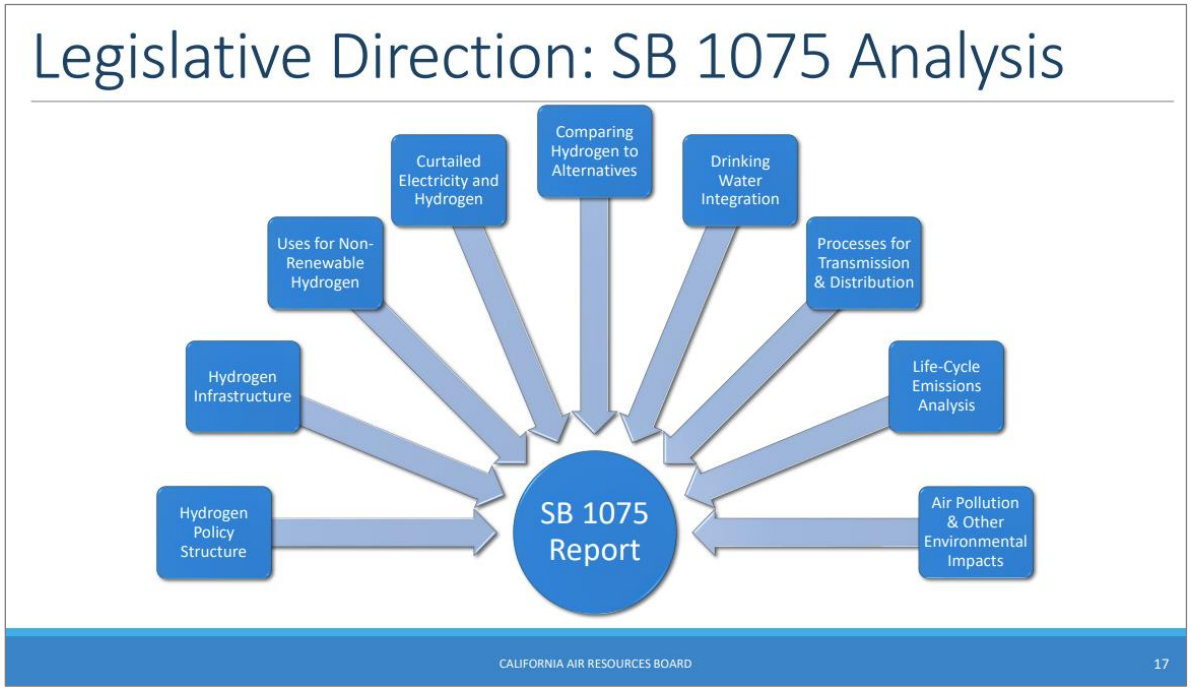
6. **The SB 1075 analysis should be conducted in a transparent manner that captures the reliability and resiliency benefits of Green Hydrogen.**

The GHC appreciates CARB's SB 1075 staff presentation, which included the SB 1075 analysis topics and outlined necessary work for the future: alignment between state and local government, permitting and infrastructure support, expansion of low-carbon hydrogen supply, and further policy and technical evaluations under SB 1075. Each of these outlined elements are critical to developing a robust Green Hydrogen market capable of helping California decarbonize in a sustainable manner. To make the SB 1075 analysis as strong as possible, the GHC has the following two recommendations:

Recommendation #1: Implement transparency in the analysis process

We support the analysis outlined in the CARB presentation to be completed by the Joint Agencies (see image below) and recommend that the Joint Agencies issue periodic public updates – either

through webinars or briefings – to allow stakeholders to comment on assumptions, inputs, and preliminary results. Further, we recommend that CARB amend their process timeline to include a mid-report update between quarters one and two of 2024 to provide stakeholders with a status update and outline the initial findings.



Recommendation #2: Include analysis of reliability and resiliency benefits of mass-scale Green Hydrogen availability.

California, which is home to 40 million residents,[15] needs energy reliability to keep the lights on and ensure success for its long term, world-leading decarbonization goals. As noted previously, Green Hydrogen has the potential to provide clean energy to sectors that are otherwise difficult to electrify. It also can offer backup power and long duration energy storage in the form of clean, firm dispatchable power utilizing existing natural gas generation assets. Both applications will be critical to achieving both a reliable and affordable clean energy transition. Finally, because California is blessed with so many abundant resources from which to produce mass-scale Green Hydrogen, its development will enable greater economic independence from the fossil fuel price volatility affecting California industry and all consumers. Accordingly, we urge the Joint Agencies to include the reliability and resiliency benefits of having mass-scale Green Hydrogen in their analysis.

III. CONCLUSION

[15] U.S. Census Bureau. n.d. "Quickfacts: California." Accessed May 11, 2023. https://www.census.gov/quickfacts/fact/table/CA/PST045221

The GHC appreciates the opportunity to submit comments on the SB 100 Kickoff Workshop. We would like to thank the Joint Agencies for their leadership and look forward to continuing to collaborate with all other stakeholders.

Respectfully submitted,

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