Date: September 29, 2023

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RE: GHC's Response to the IEPR Commissioner Workshop on the Potential Growth of Hydrogen

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's approach is focused on scaling Green Hydrogen as a viable and cost-competitive alternative to fossil fuels.

The GHC would like to express its support for the Integrated Energy Policy Report (IEPR) Commissioner Workshop on the Potential Growth of Hydrogen hosted by the California Energy Commission (CEC).[3] The GHC appreciates the CEC's ongoing commitment to understanding and advancing the role of Green Hydrogen in decarbonizing California's energy systems and accelerating deep economy-wide decarbonization. We commend the CEC for their previous work on hydrogen, including their recognition of the potential benefits of Green Hydrogen in the 2021 and 2022 IEPR and for providing a forum for stakeholders to contribute to the development of comprehensive energy policies.

II. RESPONSE OF THE GHC

In the following sections, the GHC will present its comments and corresponding recommendations on the IEPR Workshop on the Potential Growth of Hydrogen hosted by the California Energy Commission to help ensure the IEPR analysis is as robust as possible.

1. IEPR's analysis on the potential adoption of hydrogen is timely and urgently needed to ensure appropriate near-term planning necessary to achieve economy-wide decarbonization.

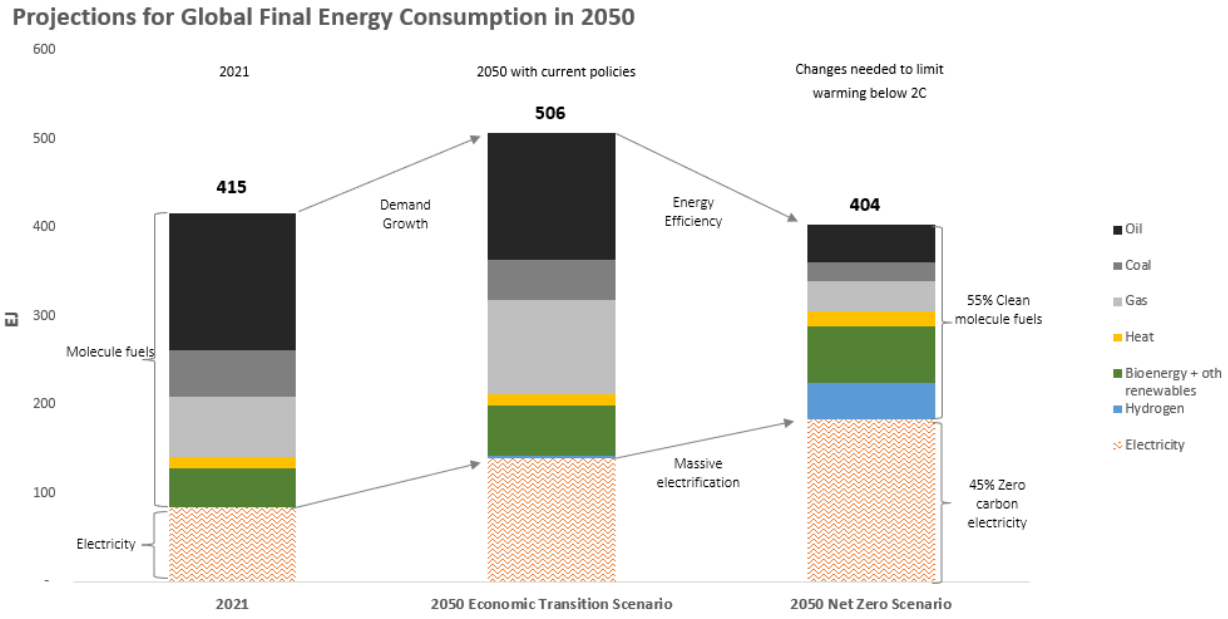
[1] https://www.ghcoalition.org/

[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 narrower definition of "Renewable Hydrogen" (referred to later 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.

[3] https://www.energy.ca.gov/event/workshop/2023-a44`09/iepr-commissioner-workshop-potential-growth-hydrogen

The IEPR analysis on the potential adoption of hydrogen 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.[4] Therefore, ensuring that those molecules will not be derived from fossil fuels requires coordinated action and planning now.

The IEPR process 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 particular focus paid to the policy actions as well as the local, regional, and state-wide renewable hydrogen transport and storage infrastructure needed. In turn, this will allow mass-scale, affordable Green Hydrogen to fill this important role in our energy transition away from fossil fuels.



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.

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

2. **The GHC recommends prioritizing a systems-level planning approach that considers repurposing existing natural gas infrastructure for California's needed Green Hydrogen transport and storage infrastructure, 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 storage of hydrogen in salt caverns (California does not have any in state geologic salt formations).[5] 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 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[6] (connecting oil refineries) and more than 1,600 miles of pipeline in the Gulf of Mexico.[7] In short, an expanded new Green Hydrogen pipeline system connected to out of state geologic storage in salt domes[8] is the key enabler of a mass-scale Green Hydrogen economy for California because it is necessary to achieve supply availability and low delivered cost, two essential criteria to encourage fuel switching from fossil fuels to Green Hydrogen.

GHC's research indicates that accelerating the development of this needed infrastructure requires 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. This is the essential concept of a Green Hydrogen hub. Ultimately, regional hubs can be interconnected state-wide via a Green Hydrogen 'backbone' transmission pipeline to form a comprehensive state-wide Green Hydrogen network, potentially repurposing much of our existing natural gas pipeline infrastructure.

Therefore, the GHC recommends that the IEPR analysis prioritizes the needed shared transport and storage infrastructure to achieve mass-scale, low delivered cost at both the state and sub-state regional level. Further, to ensure lowest cost for this expanded new infrastructure, the GHC recommends that the IEPR examine if and how existing natural gas infrastructure can be repurposed for this goal, particularly given the anticipated decrease in demand for natural gas as demand for Green Hydrogen is expected to grow.

[5] Hybuild LA Phase 2 Report and HyBuild LA Phase 2 Report-Out: Advancing the California Hydrogen Hub Vision.
[6] https://www.osti.gov/biblio/1068156
[7] https://www.energy.gov/eere/fuelcells/hydrogen-pipelines
[8] The closest commercially proven salt dome is ACES Delta, located in central Utah.

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[9] is critical to achieving assured year-round supply and low delivered cost of Green Hydrogen to meet the scale and scope of fossil displacement to fight climate change. HyBuild LA established a long-term vision (2030) at scale and demonstrated that a scaled Green Hydrogen economy for Los Angeles 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, as California does not have any known geologic salt formations. HyBuild LA findings indicate that the Sierra Nevada Mountain range is a challenging geologic barrier for interstate pipeline connection with Green Hydrogen demand in northern California; therefore, to access out of state salt domes, northern California's Green Hydrogen pipeline system would ideally be interconnected through southern California.

The analysis conducted under IEPR 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 by 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 repurposing existing infrastructure and establishing needed hydrogen pipelines.[10]

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.[11] These projects can be important 'beach head starting points' from which progress can be accelerated and scale can be achieved faster. GHC strongly recommends that IEPR 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 on a systems approach and by leveraging near-term projects identified by ARCHES, California can determine the best pathway forward that optimizes for accelerating progress.

[9] Infrastructure includes pipeline transport connected to out of state geologic salt cavern storage.
[10] https://ehb.eu/
[11] https://archesh2.org/

3. **Achieving scale can be accelerated by considering demand for Green Hydrogen in 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 this IEPR workshop was "the potential adoption of hydrogen to help decarbonize the electric generation and transportation sectors, as required by Senate Bill (SB) 1075 (Skinner, Chapter 363, Statutes of 2022),"[12] 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 those geographically close to planned infrastructure and projects for the electric generation 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 in a manner that is cost-competitive with the fossil-based ammonia that California already imports and uses today.

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 electric generation 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 CEC 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 CEC factor in the findings of the CARB 2022 Scoping Plan, which analyzed all key sectors in which hydrogen can play an important role.[13] 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.

4. **Green Hydrogen represents an opportunity to reimagine and co-create 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.**

[12] https://efiling.energy.ca.gov/GetDocument.aspx?tn=251864
[13] https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents

As California fosters innovation, competition, and investment in a Green Hydrogen economy, the CEC 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 IEPR analysis, we encourage the CEC to clarify and reaffirm enforcement of the environmental impact requirements (air quality improvements, water quality improvements, etc.) and to enforce the safety and technical engineering standards that are already in place for hydrogen production, transport, storage, and use as a mature, industrial commodity. Transparency and enforcement of environmental requirements is critical to building trust and ensuring corporate responsibility.

Given the potential scale and scope of displacing fossil fuel use with Green Hydrogen, establishing a vision for Green Hydrogen to achieve multisectoral decarbonization is also an opportunity to re-imagine our fossil-based energy economy by prioritizing those communities most affected. There are numerous communities throughout the state that have suffered from the effects of our legacy fossil fuel economy, including direct impacts from air pollution as well as devastating wildfire and flood impacts from the effects of climate change. A mass-scale, Green Hydrogen economy for California represents an opportunity to foundationally address the impacts of fossil fuel use for all of these communities, albeit in different ways. For example, for inner city communities close to ports, Green Hydrogen can be used to displace diesel use for cargo handling and heavy-duty trucking, the most significant contributor to smog and air pollution related health impacts. For communities located near forested areas, the production of Green Hydrogen from forest waste is an excellent alternative to open burning and can thereby help to mitigate wildfire risk. For communities located near agriculture, the production of Green Hydrogen from organic solid waste is an excellent alternative to open burning. Each of these communities has suffered in different ways from fossil fuels; consequently, each of these communities has the potential to benefit from transitioning towards the use of carbon free Green Hydrogen and its fuel derivatives.

Therefore, we urge the CEC to factor in the needs, concerns, and risks facing all communities *and, importantly, include communities of concern in the IEPR – 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. When it comes to successfully decarbonizing the state, the path of fastest and most sustainable progress requires working closely with local communities.

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

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

California, which is home to 40 million residents,[14] 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 abundant resources from which to produce mass-scale Green Hydrogen, the development of this nascent market will enable greater economic independence from the fossil fuel price volatility affecting California industry and all consumers. Accordingly, we urge the CEC to include and quantify the reliability and resiliency benefits of having mass-scale Green Hydrogen in their analysis.

6. The IEPR creates an opportunity for the CEC 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.

In the development of any new market, definitions are a critical component of the foundational legal and regulatory framework, particularly for clean energy. Only after clear definitions are established can eligibility, recognition, tracking, and monitoring solutions be implemented. Transparency, clarity, and consistency across regions are critical to encouraging investment and tradable markets for Green Hydrogen, which will soon become one of the world's most traded commodities. For the GHC's comments below, there are three relevant and distinct definitions that need to be clarified by California:

- "Green Electrolytic Hydrogen," as defined in SB 1369 (Skinner. Energy: Green Electrolytic Hydrogen)

- "Green Hydrogen," which is broadly defined by the GHC to mean hydrogen that is produced from non-fossil fuel feedstocks and has climate integrity, as measured by well-to-gate carbon intensity. Under this broad definition, SB 100 resources such as large hydro would be an eligible resource for the production of Green Hydrogen.

- "Renewable Hydrogen," consistent with existing statute in support of California's Renewable Portfolio Standard (RPS). Renewable Hydrogen is a subset of "Green Hydrogen" as eligible feedstocks would be limited to only water and RPS eligible feedstocks as defined by PU code 399.12.

[14] https://www.census.gov/quickfacts/fact/table/CA/PST045221

While California has a diverse and abundant array of 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 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 CEC establish a common framework for Green 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 that California's Renewable Hydrogen definition is consistent 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.

As noted by both the Environmental Defense Fund (EDF) and the Natural Resources Defense Council (NRDC) during the workshop, it is important to use hydrogen strategically to help decarbonize the state's hard-to-electrify sectors. We agree with the broad point made throughout the workshop that there are applications where Green Hydrogen or its fuel derivatives may be one of the only ways to achieve decarbonization (i.e., maritime shipping, aviation, etc.). These high-value applications tend to be those where Green Hydrogen can provide an alternative to fossil fuels, and importantly, scale near-term. Applications that can scale near-term will help catalyze a Green Hydrogen ecosystem, driving down delivered cost. Achieving both mass-scale supply availability and competitive costs will create a virtuous cycle that will accelerate fuel switching, especially in hard-to-abate sectors, which often require substantial capital expenditures by end users to be able to utilize hydrogen or its derivative fuels. In this way, electrification and Green Hydrogen can work in tandem to decarbonize the state's economy. The common energy carrier for decarbonizing these hard-to-abate sectors is Green Hydrogen. As indicated by the Commissioners and the various panelists, it is therefore important to identify these sectors and invest accordingly.

Accelerating progress for Green Hydrogen and Renewable Hydrogen should allow for innovation, which should not preclude any renewable resource/production pathway or end-use of that resulting Renewable/Green Hydrogen. At this early stage of market development, it is too soon to predict

which production pathway will offer the best value proposition for the myriad of potential possible end uses. Each region in the country and indeed, each sub region within California state will have different resources to produce Green Hydrogen and a collection of different potential scalable end uses. A technology neutral definition will allow Green and Renewable hydrogen to flourish in all corners of the state.

California has always served as an innovation hub for technology and solutions of all types; therefore, it can and should apply this same spirit of innovation to Renewable and Green Hydrogen, as defined below.

Recommendation: The GHC therefore recommends that the CEC adopt a technology neutral definition for Green Hydrogen that employs a carbon-intensity framework using non-fossil fuel feedstocks and 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 recommends adopting the "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,[15] has been adopted by the U.S. Department of Education.[16] 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 feedstock or technology solution to producing Green Hydrogen, thereby facilitating the development of a credible clean and Green Hydrogen market nationally. This will help ensure that California remains a robust leader in Green Hydrogen development, not only for California's use, but ultimately, also for export out of state and internationally.

- Ensures innovation to help leverage California's vast renewable resources and spur investment. By focusing on carbon emissions (rather than feedstocks or 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 innovation and investment in cleaner technologies. The GHC supports taking this perspective since it opens other pathways for

[15] https://www.iphe.net/iphe-wp-methodology-doc-jul-2023
[16] https://www.hydrogen.energy.gov/docs/hydrogenprogramlibraries/pdfs/chps/clean-hydrogen-production-standard-guidance.pdf

competition on the basis that Green Hydrogen, regardless of the renewable resource/feedstock used, can flourish if it meets the desired emissions reduction threshold and other local permitting requirements. Competition will drive down costs of clean technology, which will benefit consumers and accelerate our clean energy transition. Given the urgency of fighting climate change, fostering as diverse a portfolio as possible to produce scaled, carbon free alternatives to fossil fuels is a risk mitigating strategy that will help ensure progress.

Given the above benefits, the GHC would like to express its support for ARCHES' technology neutral approach and the CPUC's CI framework employed at the recent SB 1075 workshop. The GHC commends ARCHES for its inclusive approach to Green Hydrogen production, which includes biogenic organic waste 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. We also fully support ARCHES' point that the state's hydrogen strategy can serve as a 'North Star' to help accelerate clean energy deployment and decarbonize many sectors.[17]

Furthermore, we strongly support the CPUC and its CI approach to hydrogen eligibility in the recent SB 1075 workshop.[18] This aligns seamlessly with federal guidance and sustainability goals as it makes well to gate 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 (CO2e) 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 CO2e/kg H2 requirement and avoid imposing unnecessary additional 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 fossil fuels for 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 CO2e/kg H2. Banning the use of any fossil fuels sources – even for secondary inputs – will make many projects

[17] https://efiling.energy.ca.gov/GetDocument.aspx?tn=252171&DocumentContentId=87170
[18] https://ww2.arb.ca.gov/sites/default/files/2023-09/sb-1075-workshop-090523-presentation-cpuc.pdf

infeasible, unnecessarily increase costs, and hinder progress, which will prolong our continued use of fossil fuels.

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 hydrogen requirement for Green Hydrogen.

Recommendation #2: Ensure consistency with California's Renewable Portfolio Standard Statutory history and regulations regarding "Renewable Hydrogen"[19]

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. This should include 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 linear generators, gas turbines, and other clean energy generation technologies that are able to achieve California's world-leading current NOx emissions standards.

Today, under California's RPS program, various renewable resources are deemed eligible to help meet RPS goals. Renewable Hydrogen, as defined, 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."[20] 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 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 commend both CARB and the CEC's appropriate recognition of the potential use of Green and Renewable Hydrogen for power generation as a means to achieve a 100% carbon-free power sector and system-wide reliability at the CEC's recent IEPR workshop.[21] Going forward, greater progress and market certainty will be possible by allowing the combustion of Renewable Hydrogen in gas turbines and linear generators 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.[22] Given Green and Renewable Hydrogen's potential to help

[19] "Renewable Hydrogen" is defined according to Assembly Bill 209.
[20] https://efiling.energy.ca.gov/getdocument.aspx?tn=217317
[21] https://www.energy.ca.gov/event/workshop/2023-09/iepr-commissioner-workshop-potential-growth-hydrogen
[22] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240SB149

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 make California more competitive for funding from the federal Inflation Reduction Act and the Infrastructure Investment and Jobs Act. We believe that removing the hydrogen exclusion in SB 149 would send an important market signal that California is serious about economy-wide decarbonization and recognizes the important role of Green and Renewable Hydrogen toward achieving this goal.

7. **The GHC supports Green Electrolytic Hydrogen, as defined in SB 1369. Capturing the true potential of Green Hydrogen for California will require a more inclusive approach that also includes biogenic organic waste feedstocks and a phased-in implementation of the "three pillars" in a manner that is relevant for California and consistent with similar requirements for other energy loads.**

As discussed in the IEPR workshop, electrolysis will be a key pathway for the production of Green Electrolytic Hydrogen. We fully support Green Electrolytic Hydrogen and believe it will be an integral part of the Green Hydrogen economy. As discussed in the previous section, however, the GHC would also like to highlight that it is important to do the following: consider (1) biogenic organic waste feedstock pathways for producing Green and Renewable Hydrogen and (2) a modified, thoughtful phased-in implementation of the three pillars that respects both California's leading position with clean energy and establishes equal treatment with other electricity consuming clean energy demand, such as EV charging.

Recommendation #1: Support the inclusion of biogenic organic waste pathways.

As discussed in the previous section, it is important to employ a technology agnostic approach that is inclusive of all non-fossil fuel feedstock hydrogen production pathways for Green Hydrogen. This is particularly important since California has abundant and diverse organic waste feedstocks, affording it a national and international competitive advantage for the production of Green Hydrogen from these resources. As CARB highlighted in the recent SB 1075 workshop, Green Hydrogen produced from organic waste will provide the majority of clean hydrogen in 2030 and more than one-third in 2045.[23]

California's organic waste resources are not only a valuable feedstock for the production of Green Hydrogen but are also a financial and risk burden to California taxpayers since they require both treatment and removal. Unless remediated, these organic waste resources can have significant environmental consequences. Given the massive quantities and persistent environmental impacts of California's organic waste production, it is important to encourage innovation and allow these feedstocks to be utilized to help produce Green Hydrogen, which is an important zero carbon fuel for the production of clean, firm power and to displace fossil fuels statewide.[24]

[23] https://ww2.arb.ca.gov/sites/default/files/2023-09/sb-1075-workshop-090523-presentation-carb.pdf
[24] For greater detail on this topic, please see the Bioenergy Association of California's (BAC) comments on Hydrogen for the 2023 IEPR and SB 1075 Report.

Recommendation #2: If the Commission gives consideration to the "three pillars," we recommend a gradual approach with due reflection of California's unique market context.

The GHC acknowledges and endorses the fundamental principles encapsulated in the "three pillars:" additionality, deliverability, and time matching. These pillars undoubtedly play a pivotal role in ensuring the efficacy of Green Hydrogen in reducing carbon emissions and advancing our collective efforts against climate change. However, the implementation of these principles must be carried out thoughtfully, which will require taking into account the distinctive dynamics of the California market.

Green Hydrogen is a nascent industry with immense potential to significantly decarbonize various sectors. It is of paramount importance that California – as a leader in energy and environmental policy – does not impose an undue burden on its development by subjecting it to standards more rigorous than those applied to other electricity-consuming applications, such as battery electric vehicles or energy storage.

In light of the GHC's extensive engagement with stakeholders, including academics, non-governmental organizations, and policymakers, we recommend that – if the CEC recommends the three pillars framework – they do so by using a phased-in strategy, characterized by a reasonable timeline and ensure that the same framework be consistently applied to all energy transition load. This approach will allow the industry to scale up gradually and align its progress with the broader energy landscape. It is essential to maintain a level playing field and not place Green Hydrogen production at a higher standard than other electricity-consuming applications such as commercial buildings and EV charging, for example.

Furthermore, we emphasize that the U.S. Green Hydrogen market is not monolithic; it will exhibit regional variations as it evolves through the hub-and-spoke model. Each region may necessitate distinct criteria to guarantee the climate integrity of hydrogen production. For instance, the additionality requirement will hold particular significance in states and regions where fossil fuels dominate the grid and no Renewable Portfolio Standards are in place. This is vital to prevent the diversion of clean resources away from grid decarbonization efforts, as highlighted in the EDF presentation.

However, in the context of California, where ambitious RPS and zero-carbon goals are in place, the application of the additionality requirement becomes more nuanced. California is currently a leader in electricity generation from solar and geothermal sources[25] and is on track to achieve a substantial percentage of clean energy by 2030.[26] Notably, California's grid briefly operated on 100% renewable electricity in May 2023, showcasing the rapid progress being made toward becoming zero-carbon.[27] Requiring California to adhere strictly to the additionality requirement

[25] https://www.eia.gov/state/analysis.php?sid=CA#:~:text=The%20state%20is%20the%20nation's,%2C%20Oregon%2C%20and%20New%20York.

[26] https://energyinnovation.org/publication/85-percent-clean-electricity-by-2030-in-california/

[27] http://www.caiso.com/Documents/MonthlyRenewablesPerformanceReport-May2023.html

could inadvertently hinder Green Hydrogen production, given the state's trajectory toward an increasingly cleaner grid.

It is also crucial to consider the definition of "new" renewable power. The GHC advocates for an inclusive definition that encompasses curtailed renewables, repowered assets, and re-contracted existing assets, in addition to new resources. This approach allows for the effective management of renewable resources and the optimal utilization of existing assets.

Ultimately, we must be cautious not to impede the scalability of green technologies like Green Hydrogen. Should the CEC recommend the three pillars, the GHC recommends they employ a phased-in strategy. California's ability to guarantee electrification across all sectors is not absolute, making zero-carbon fuels like Green Hydrogen a necessary component of our future climate change mitigation strategies. The successful implementation of the "three pillars" should align with the unique characteristics of the California market, employing a phased approach that considers the state's impressive progress toward decarbonization. By doing so, we can ensure that Green Hydrogen contributes meaningfully to our shared climate goals without unnecessarily stifling its growth or unnecessarily prolonging fossil fuel use.

The GHC has dedicated significant effort and research to the implementation of the pillars. We are enthusiastic about the prospect of further collaboration and information sharing with the CEC to ensure that our collective objectives are met. We kindly request the opportunity to schedule a call or meeting with the CEC to discuss this recommendation in more detail and explore how we can work together to advance the responsible development of Green Hydrogen within California's unique market context.

8. **The importance of Green Hydrogen in California's power sector highlights the need for hydrogen combustion in gas turbines**.

In California's drive to electrify large segments of our economy, the power sector has become more important than ever. For the state to achieve its ambitious goal of attaining 100% clean electricity by 2045,[28] California must implement alternative energy sources to fossil fuels that can provide reliable and clean power to its approximately 40 million residents.[29] As California's electricity consumption exceeds that of every other state but Texas and Florida,[30] the solution must be able to operate at a scale sufficient to meet the state's demand. The issue remains that California relies on natural gas-fueled power plants to achieve grid reliability — and will continue to until at least 2045.[31]

Studies find that to reduce this reliance on fossil fuels, California must embrace on-demand, clean resources to bolster grid resilience. To fully replace fossil fuels, EDF estimates that California will

[28] https://www.energy.ca.gov/sb100
[29] https://www.census.gov/quickfacts/fact/table/CA/PST045221
[30] https://www.eia.gov/state/analysis.php?sid=CA#24
[31] https://www.energy.ca.gov/news/2021-03/california-releases-report-charting-path-100-percent-clean-electricity

require between 25 to 40 gigawatts of clean and dependable power.[32] In addition, the state will require robust energy storage solutions to manage the fluctuations of multi-day and seasonal energy demand, which cannot be achieved with current battery technology.

Green hydrogen offers a solution, since it can fulfill the state's need for clean, firm power and long-duration renewable/zero carbon energy storage. Without access to such a resource, the state will continue to rely on natural gas plants. Green hydrogen can be a key element in mitigating power sector emissions and supporting the state's emission reduction objectives.

Recommendation: The IEPR should be inclusive of hydrogen combustion in natural gas turbines and re-confirm that any combustion of hydrogen MUST meet California's world-class existing nitrogen oxide (NOx) emission standards.

During the IEPR workshop, hydrogen combustion was a topic of concern. We support CARB's presentation in which staff recognized the importance of both combustion and non-combustion hydrogen. We also appreciate the attention NRDC staff paid to the topic of NOx and agree more research is needed on this topic. However, the GHC would like to flag that technology exists today to limit NOx and, therefore, hydrogen combustion in turbines may have an important role to play in California's power sector.

The unique challenge that California faces, unlike other segments of the U.S., is that it does not have access to the end-uses often touted as ideal for near-term use and creating scale, such as high-heat industrial applications or ammonia production. Therefore, California must look to other end uses to scale quickly to create a developed hydrogen economy.

The use of Green Hydrogen in existing gas turbines is a strategic near-term pathway for helping to achieve scale for Green Hydrogen since it allows the repurposing of valuable infrastructure at existing power plants – land, water infrastructure, and electric interconnection – and enables an affordable transition to 100% renewable electricity. In this way, combustion of hydrogen in gas turbines offers a cost-effective means to scale its use while also achieving long duration storage for the state. We also wish to note that the use of hydrogen combustion in gas turbines is not going to be a large application in the future; rather, it is important now to jumpstart the ecosystem in California today to help other sectors scale.

In this discussion of combustion, we fully recognize that the issue of NOx is an incredibly valid concern. The GHC would like to highlight, however, that NOx emissions can be contained with the use of Selective Catalytic Reduction (SCRs). As a result, hydrogen combustion can be cleaner than natural gas combustion because it does not produce CO, CO2, SOx, or particulates.[33] We fully

[32] https://www.edf.org/sites/default/files/documents/SB100%20clean%20firm%20power%20report%20plus%20SI.pdf

[33] See Chapter 10: https://www.nrel.gov/docs/fy21osti/79444-10.pdf

support the need for greater research and innovation on this topic, but believe current technology is sufficient to keep NOx at or below current standards.

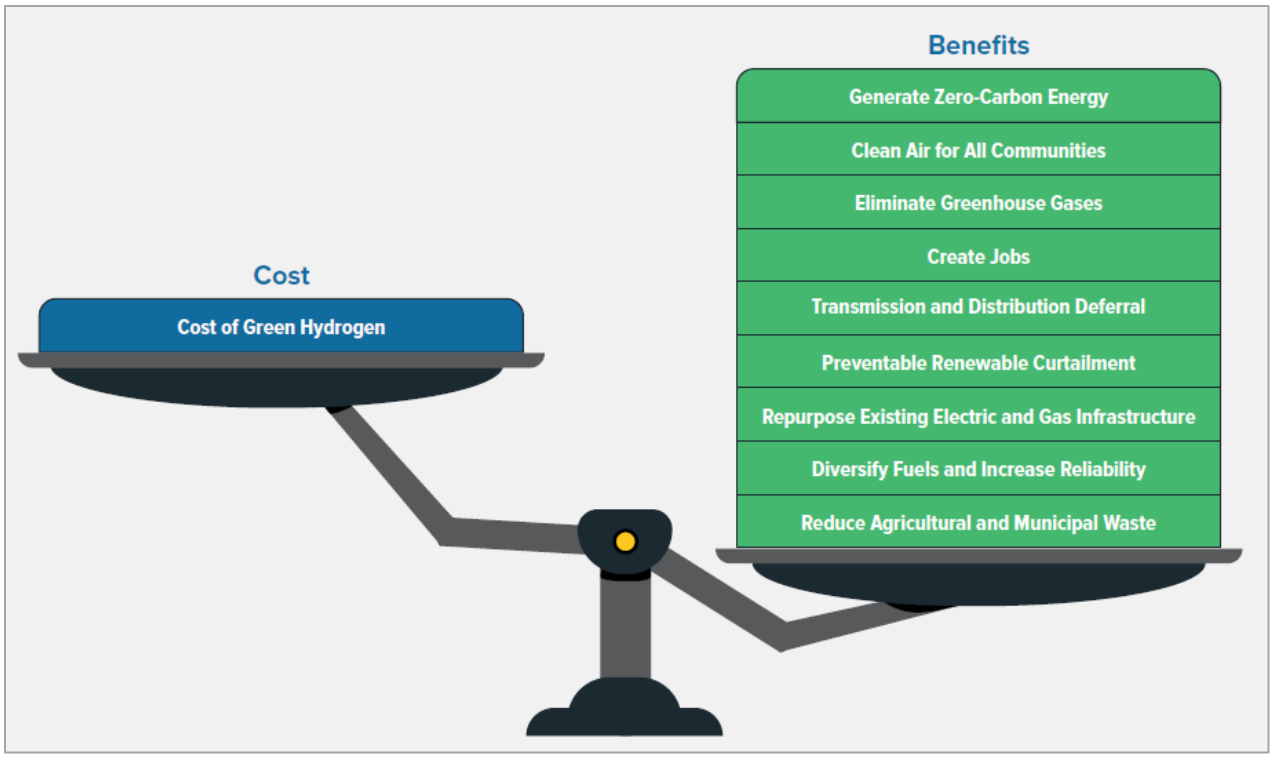
9. The GHC would like to highlight that efficiency should not be the only metric considered, and that the metric that is most important is the comparison of benefits vs. cost.

One theme of the workshop involved concerns of the efficiency of combusting hydrogen. The GHC recognizes that this is an important metric worth paying attention to but maintains that this is not the *only* metric worth considering.

It is important to remember that Green Hydrogen's use in the power sector is not just a value proposition about energy, it is also a value proposition about capacity. A key function of Green Hydrogen in the power sector is that it provides resource adequacy, reliability, and clean, firm power. Currently, there are not many low-carbon options to provide this to the grid today that can scale. In the case of storage, Green Hydrogen is the only commercially available low or zero-carbon solution that can provide the needed long duration energy storage across seasons to support California's grid reliability.[34] This will become increasingly important as electrification drives higher electricity demand and may stress the grid. These benefits, however, often get overlooked by its cost in the marketplace since Green Hydrogen is more expensive than fossil fuels. The GHC worries this simplistic view does not properly account for the plethora of benefits that are possible.

Therefore, the GHC urges the CEC to evaluate policy recommendations based on a comparison of these system-wide stacked benefits to the cost of the Green Hydrogen. The IEPR should focus on the many stacked benefits that Green Hydrogen can deliver (*see below*). Since clean hydrogen solutions are commercially available today, the best pathway to accelerate progress is for the IEPR to recognize and promote policy recommendations that focus on the aggregation of clean hydrogen applications (demand) and scalability. This will not only create a virtuous cycle that ensures ongoing investment and sustainability but also provides a more holistic view about the value proposition of Green Hydrogen.

[34] Neither current battery technology nor pumped hydro can provide this.



III. CONCLUSION

The GHC appreciates the opportunity to submit comments on the IEPR Commissioner Workshop on the Potential Growth of Hydrogen. We would like to thank the CEC for their leadership and look forward to continuing to collaborate with all other stakeholders.

Respectfully submitted,

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