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GHC Comments on the 2022 Integrated Energy Policy Report Update

Additional submitted attachment is included below.

December 7, 2022

Email to: docket@energy.ca.gov

Docket Number: 22-IEPR-01

Re: GHC Comments on the "2022 Integrated Energy Policy Report Update"

To Whom it May Concern:

The Green Hydrogen Coalition (GHC) appreciates the opportunity to submit comments on the 2022 Integrated Energy Policy Report Update ("IEPR").[1] GHC appreciates both the California Energy Commission's ("CEC") recognition that California will need clean hydrogen for reliability and other purposes, as well as its progressive, forward-thinking leadership for California's clean energy transition.

I. INTRODUCTION

The Green Hydrogen Coalition ("GHC")[2] is a California educational 501(c)(3) non-profit organization. GHC was formed in 2019 to recognize the game-changing potential of "green hydrogen" 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, renewable energy users and developers, utilities, and other supporters of a reliable, affordable green hydrogen fuel economy for all.

The GHC applauds the CEC on its comprehensive approach to the IEPR, and respectfully offers the comments below. We look forward to working more closely with the CEC going forward.

II. COMMENTS

[1] See https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2022-integrated-energy-policy-report-update

[2] See https://www.ghcoalition.org/

a) The GHC Appreciates the CEC's Reference to the GHC's Proposed Definition of 'Green Hydrogen' and Proposes a Modified "Clean Hydrogen" Definition that is Consistent with the Federal Carbon Intensity Standard in the Inflation Reduction Act.

The GHC sincerely appreciates the CEC's reference to our proposed definition of "green hydrogen"[3] in the IEPR.

The GHC proposed a definition for "green hydrogen" in 2020[4] and *sincerely* appreciates the CEC's reference to our proposed definition in the IEPR.[5] Since 2020, however, we recognize that the discussion around hydrogen has since evolved. Most notably, the Biden Administration has advanced both the Infrastructure Investment and Jobs Act ("IIJA") and the Inflation Reduction Act ("IRA"), which focus on a carbon intensity ("CI") framework. The GHC supports the CI-specific approach - instead of one focused on "colors" – since it will reduce the subjectivity inherent in the conversation about what constitutes "green hydrogen."[6] Moreover, the GHC appreciates that the IRA makes the CI framework more robust by employing a lifecycle-based approach (e.g., well-to-gate).[7] We believe this better supports sustainable reductions in greenhouse gas ("GHG") emissions, as compared to a "point of production" definition in the IIJA.[8] We support the fact that this approach is inclusive of all production types – so long as they have a low CI – and thereby is inherently technology-agnostic. The GHC commends this perspective since it opens other pathways for competition on the basis that hydrogen, regardless of how it is produced, can flourish if it meets the desired life cycle emissions threshold.

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[3] "Hydrogen produced from non-fossil-fuel feedstocks and emits zero or de minimis GHG emissions on a lifecycle basis."

[4] See https://www.ghcoalition.org/green-hydrogen

[5] "Hydrogen produced from non-fossil-fuel feedstocks and emits zero or de minimis GHG emissions on a lifecycle basis."

[6] See https://static1.squarespace.com/static/5e8961cdcbb9c05d73b3f9c4/t/636e8ada74bfee38e83092df/1668188890529/2022-11-14+GHC+Response+to+DOE+CHPS+Draft+Guidance_FINAL.pdf

[7] The Inflation Reduction determines hydrogen production incentive eligibility based on hydrogen that does not exceed four kilograms of carbon dioxide-equivalent produced on a lifecycle basis per kilogram of hydrogen produced.

[8] "Clean hydrogen" as provided in section 16166(b)(1)(B) means hydrogen produced with a carbon intensity equal to or less than 2 kilograms of carbon dioxide-equivalent produced at the site of production

In addition, the CPUC recently filed two decisions with interim renewable and clean hydrogen definitions.[9] We support many elements of the CPUC's proposed interim definitions since they also align with the recent federal legislation while also emphasizing the exclusion of fossil fuel feedstock and production. We support this additional requirement and believe the exclusion of fossil fuels is appropriate for California's decarbonization goals; however, we argue that while fossil fuels should be excluded from feedstock, the associated secondary energy sources should be tied to a CI framework since there is an unlimited number of combinations and pathways to produce hydrogen. For example, an electrolytic hydrogen production project could be co-located with solar generation for production during the day and utilize some grid power at night to improve its capacity factor or provide ancillary services to the grid as a highly modifiable load. Under this scenario, the electrolytic hydrogen project's resulting hydrogen production should only be classified as "clean hydrogen" if it meets the well-to-gate lifecycle carbon intensity threshold.

It is important to remember that there are many pathways to produce hydrogen from non-fossil fuel feedstocks, and all these pathways will all require secondary energy sources and station power. Allowing projects to use some non-renewable inputs – so long as the cumulative amount still falls below the required CI threshold produced – would enable project innovation and the realization of system-level benefits.

Thus, in recognition of the fact that a well-to-gate CI framework is a more rigorous methodology for assessing the CI of hydrogen production and aligns with both the federal requirement and recent activities at the CPUC, we propose that the CEC adopts the following interim definition (*see below*) for "clean hydrogen." This proposed definition encompasses critical components the GHC supports: (1) inclusion of a CI threshold, (2) adoption of a well-to-gate lifecycle assessment, and (3) the enforceability of non-fossil fuel feedstock and secondary energy based on achieving less than 4kgCO2e/kg renewable hydrogen produced.

> *"Clean Hydrogen is hydrogen which is produced from non-fossil fuel feedstocks and secondary energy sources that result in a lifecycle (i.e., well-to-gate) GHG emissions rate of not greater than 4 kilograms of CO2e per kilogram of hydrogen produced."*

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[9] See Decision Approving the Angeles Link Memorandum Account To Record Phase One Costs and Decision Directing Biomethane Reporting And Directing Pilot Projects To Further Evaluate And Establish Pipeline Injection Standards For Renewable Hydrogen.

We encourage the CEC to recommend the adoption of this clean hydrogen definition in the IEPR since it is consistent with federal guidelines and CA state agency activities, and it encompasses critical components the GHC supports. With the CEC's adoption of this proposed definition, the GHC believes the CEC can help set California up for integration with the federal clean hydrogen strategy, interstate connectivity, and regional market development.

b) The IEPR Should Include a Recommendation for Long-Term Assessment and Planning Associated with the Potential Conversion of California's Existing Natural Gas Utility Infrastructure into a 100% Clean Hydrogen Pipeline Backbone and Network.

The GHC maintains that the CEC, through IEPR, should provide both a recommendation and a strategic vision regarding how the gas pipeline network will evolve in line with the State's climate goals. This will help the CEC and other state agencies address the many decisions about gas investments that will build toward a zero-carbon energy system. For example, the IEPR could begin by setting an overarching goal with clear targets to guide gas pipeline planning in the context of California's climate ambitions and set clear criteria to ensure a robust assessment of alternative solutions to traditional infrastructure needs. The GHC believes that this must include addressing the potential to transition some existing natural gas utility infrastructure to support the development of a hydrogen pipeline backbone and network. Ultimately, this will support those hard-to-abate sectors that require an alternative to electrification.

In future years, a hydrogen pipeline network will be needed to serve power generation, long-haul trucking corridors, air- and seaports, and connect industrial hydrogen demand with supply. This network – or backbone – will require substantial hydrogen volumes. To achieve this need, natural gas pipelines will either need to be retrofitted for 100% hydrogen transport or new hydrogen-dedicated pipelines will need to be constructed. Implementing a hydrogen pipeline network will enable more rapid scaling for hydrogen producers since they are more likely to build systems where the capability exists to transport hydrogen at scale to the broadest set of end-users. Without the ability to transport hydrogen at scale, hydrogen producers will be more prone to develop under-sized projects that serve a more localized need. Accordingly, early investments in hydrogen delivery infrastructure will play a critical role in catalyzing zero-carbon fuel development.

The GHC has extensively modeled the critical drivers of mass-scale, low-cost clean hydrogen hubs. We found that access to 100% hydrogen pipeline infrastructure is a decisive driver in achieving the development of such hubs.[10] Further, the ability to have open access to shared hydrogen pipeline infrastructure and the resulting low-cost scaled clean hydrogen deliveries will be pivotal to unlocking massive conversion from economy-wide fossil fuel use to clean hydrogen.

GHC's extensive modeling work to date indicates that the ability to transport large-scale, low-cost clean hydrogen via shared pipeline infrastructure is the decisive factor in achieving low delivered cost. GHC recommends that the CEC assume a leadership role in planning for and helping to guide, in close collaboration with the CPUC's gas system planning efforts, a long-term vision for converting existing gas infrastructure to 100% clean hydrogen infrastructure over time. An illustrative example of such a vision is what is being done in Europe via the European Hydrogen Backbone initiative.[11]

c) ***<u>The IEPR Should Include a Recommendation to Modify the RPS Guidebook Eligibility for Hydrogen Fueled Turbines</u>***

The GHC appreciates the IEPR identifying the use of hydrogen-fueled turbines and their purpose in filling the need for dispatchable zero-carbon resources. For background, the GHC, in conjunction with the Los Angeles Department of Water and Power (LADWP) and other key partners, launched HyBuild LA. This initiative seeks to create North America's first competitive, high-volume multi-sectoral renewable hydrogen hub. The effort builds on the LADWP's leadership in transforming the Intermountain Power Project, an 1800 MW coal-fueled generator, to an 840 MW combined cycle gas turbine scheduled to go online in the summer of 2025 with a 30% green H2 blend, increasing to 100% by 2045. LADWP is currently developing a system plan for converting four in-basin generating facilities from natural gas-fueled to 100% renewable hydrogen-fueled turbines by 2035.

These generating facilities will serve reliability needs by utilizing electrolytically produced renewable hydrogen for long-duration energy storage needs. The cost-effectiveness of renewable hydrogen for gas turbine use is best evaluated under a storage framework compared to other

[10] See https://www.ghcoalition.org/hybuild-la
[11] See https://ehb.eu/

storage alternatives. In this regard, the production and use of renewable electrolytic hydrogen as energy storage will serve other potential benefits, including capacity and ancillary services. Furthermore, renewable hydrogen storage is the only commercially viable pathway to achieve seasonal balancing and matching renewable energy supply with demand from a longer-duration perspective. However, this cannot happen overnight. The only reasonable path forward to achieving seasonal renewable energy storage is by increasing the amount of renewable hydrogen used by the power sector over time. As a result, this requires multiple pathways for the power sector to produce renewable hydrogen and use the hydrogen to produce electricity.

For this reason, we are requesting that the IEPR provides a recommendation to seek clarification that a gas turbine facility that uses renewable hydrogen can be certified as an eligible renewable energy resource under the CEC's RPS Guidebook. For the purposes of this requested clarification, the renewable hydrogen used by the facility would be created by an electrolysis process, as defined in Ca. Pub. Util. Code § 400.2, certified by the CEC as an "eligible renewable energy resource." While we believe that certification of the renewable hydrogen gas turbine should be permitted when the electrolysis process is powered by any "eligible renewable energy resource," we are asking that the IEPR include a recommendation to seek guidance and clarification to amend the CEC RPS Guidebook appropriately.

d) The IEPR Should Include a Recommendation for Exploring how to Decarbonize California's Agricultural Economy via Clean Hydrogen.

Today, California only focuses on the GHG impacts of agricultural energy use within the State's borders. It does not consider the carbon emissions embedded in the ammonia used to produce the fertilizer for California crops. Ammonia is a globally traded commodity; approximately 80% of global production is used for fertilizer production. It is produced from gray hydrogen (hydrogen produced from fossil fuels) and atmospheric nitrogen. California does not produce ammonia in-state; it imports ammonia made from fossil fuels and transports them by rail or ship into the Port of Stockton.

Ammonia production in North America generates 2.129 tons of carbon dioxide per ton of ammonia produced.[12] For perspective, California's import of 0.75 billion kg of ammonia in 2018 was responsible for approximately 1.6 billion kg of CO_2 emissions, which is underestimated because it does not take into account the shipping or rail transport emissions created by importing this large quantity of ammonia into California.[13] As a result of the omission of the embedded emissions in ammonia imports, California considers the agricultural sector as one of the lowest GHG emitting sectors, when clearly, it is a significant contributor. If these emissions were considered, the agricultural sector would be seen as a high GHG contributor.

As noted above, the most significant driver of decarbonizing agriculture will be driven by moving from fossil fuel-derived ammonia to green ammonia. Other energy uses in the agricultural sector may be well served through electrification, and as is the case in other sectors; however, some end uses may not be easily electrified and, for those uses, renewable fuels – including clean hydrogen and its derivative fuels – should explicitly be explored in California.

With the increasing scale of clean hydrogen production, the prospect of cost-competitive green ammonia is now in sight. The war in Ukraine has driven up fossil fuel costs to extraordinary levels in Europe and here in North America. Natural gas prices have risen quite substantially and so have ammonia prices, which are closely tied to natural gas prices, given that hydrogen produced from natural gas is a significant component of ammonia production cost. Anhydrous ammonia pricing has since risen to all-time highs – it is now approximately $1,400/ton in Europe and $900/ton in California, whereas it normally trades at below $500/ton.[14]

Producing green ammonia from clean hydrogen is now being developed at scale all over the world. As an example, below is an overview of announced clean hydrogen to green ammonia production projects funded by Copenhagen Infrastructure Partners, a global fund management company specializing in energy infrastructure investment.[15]

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[12] Brown, Trevor, et al. "Ammonia Production Causes 1% of Total Global GHG Emissions." Ammonia Industry, 31 Jan. 2019, ammoniaindustry.com/ammonia-production-causes-1-percent-of-total-global-ghg-emissions/

[13] See https://www.cdfa.ca.gov/is/ffldrs/Fertilizer_Tonnage.html

[14] See https://californiaagtoday.com/the-story-of-rising-fertilizer-prices/

[15] Copenhagen Infrastructure Partners interviews and website

Project Name/Location	GH2 capacity and source	Green Ammonia production & offtake	Construction Complete
Host (Denmark)	1GW electrolysis Offshore wind, solar, Grid	200-300 kilo tons/yr - fertilizer	2026
Iverson (Norway)	240 MW electrolysis Wind and solar	600 metric tons/day – ammonia as a global commodity	2024
Murchison Renewable Hydrogen Project (Australia)	3 GW electrolysis Wind and solar	1.7 million tons/year – export to Asia for power production	2030
HNH Energy (Chile)	5 GW electrolysis Wind energy	TBD – fertilizer and shipping fuel supply	2029
Madoqua Project (Portugal)	400 MW Grid-connected, onshore wind, and PV	TBD – chemicals and fertilizer, potential shipping fuels	2026

Given these recent global trends, the timing for developing locally produced renewable alternatives to fossil-based ammonia production has never been better. This will enable California's farmers to decarbonize their crops, enhance yield, and decouple fertilizer cost and availability from the volatility associated with fossil fuels. This will help California to:

- Increase energy and food security;
- Diversify California's Central Valley economy by reducing outflows of capital from California to Texas and gray ammonia producers in the Gulf of Mexico;
- Repurpose some portion of agricultural land for less water-intensive, high-value renewable energy & clean hydrogen production;
- Leverage future demand for clean hydrogen and green ammonia production to justify new municipal water infrastructure projects, increasing water security for consumers (e.g., Municipal water recycling and storage projects);
- Position California to supply green ammonia as a carbon-free alternative to diesel and bunker fuel for maritime shipping;
- Position California as a national leader for clean hydrogen and green ammonia production, with large domestic uses (green ammonia, shipping fuel) and position California for unlimited export potential. For example, in early 2022, JERA, Japan's largest Independent Power Producer, in an effort to achieve zero CO2 emissions from its domestic and international businesses by 2050, launched a project to demonstrate the use of ammonia as a fuel for power generation and concurrently issued a global RFP to import 500,000 tons of decarbonized ammonia to Japan;[16]

[16] See https://www.jera.co.jp/english/information/20220218_853

- Rapidly scale clean hydrogen production to support immediate demand for green fertilizer, a concentrated and high-volume application of clean hydrogen; and
- Create many highly skilled, high-paying jobs in some of the most disadvantaged areas of the State. The fertilizer industry contributes about $8.6 billion to the California economy and $632 million in state taxes. The California fertilizer industry already employs a significant workforce. This includes about 3,451 jobs in retail and 933 in distributors.[17]

Based on this opportunity, the GHC encourages the CEC, through the IEPR, to provide the leadership needed to realize this opportunity and thereby deeply decarbonize California's agricultural economy. To start this process, appropriate tracking of all emissions resulting from our agricultural sector, including embedded emissions in the fertilizer we import, is required. Additionally, through research and development, the CEC can provide leadership and guidance to stakeholders to help drive demand for decarbonized alternatives. With clean hydrogen's potential as the next commodity to revolutionize the energy market, it is essential to employ the IEPR to plan for the significant benefits to California that could come from the deep decarbonization of the agricultural industry.

e) *GHC Supports the IEPR Addressing Potential Impacts of Fugitive Hydrogen and Believes That the CEC Can Play an Important Role in Working with All Stakeholders to Design a Responsible Clean Hydrogen Vision for California.*

The GHC appreciates the CEC's leadership in identifying the potential indirect global warming impact of fugitive hydrogen, which is a topic that is relevant for both renewable hydrogen and all hydrogen use. The GHC has been collaborating closely with EDF, RMI, and others on this topic, and we believe it warrants further investigation, specifically regarding quantifying actual leak rates and formulating recommendations for their mitigation. Recent findings from EDF conclude that attention to this issue is *not* a reason to halt clean hydrogen progress; rather, it is a reason to move forward in a collaborative and science-based approach to ensure that we are indeed achieving the desired beneficial climate impacts.[18] RMI findings also conclude that the climate benefit from a well-regulated clean hydrogen economy outweighs the impact of any emissions that hydrogen

[17] The Fertilizer Institute. 2020. "Fertilizer Grows Jobs Feeding Crops While Growing The U.S. Economy".[online].
[18] Ocko, I. B. and Hamburg, S. P.: Climate consequences of hydrogen emissions, Atmos. Chem. Phys., 22, 9349–9368, https://doi.org/10.5194/acp-22-9349-2022, 2022

would add to our energy system, especially if we prioritize hydrogen produced from renewable-powered electricity.[19]

Below are findings from EDF, presented at the CatalystH2 event in Long Beach on November 16, 2022. This analysis compares the climate impact of blue versus green hydrogen under different leak rates as compared to the fossil fuel it is replacing. It is of utmost importance to acknowledge that green hydrogen, when available and used at scale to displace fossil fuel products, will still have a net climate benefit even under drastic fugitive hydrogen scenarios (e.g., as much as 10% leakage).

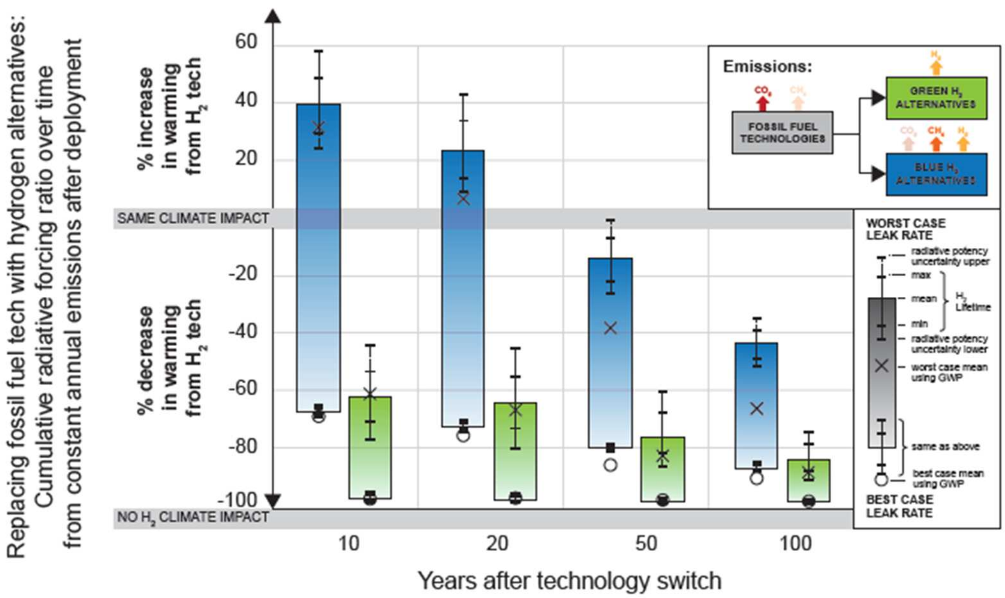


Figure: Relative warming impact over time from replacing fossil fuel technologies with green or blue hydrogen alternatives for a generic case.[20] Ratio of cumulative radiative forcing of a constant emissions rate from deploying 1 kg of H2 continuously is used as a proxy of relative warming impacts. Emissions from hydrogen alternatives are hydrogen for green hydrogen and hydrogen and methane from blue hydrogen. Emissions from fossil fuel technologies are carbon dioxide, estimated at 11 kg CO2 avoided per 1 kg H2 deployed based on estimates from Hydrogen Council (2017). Emissions of hydrogen and methane include a range of plausible leak rates from 1% (best-case) to 10% (worst-case) per unit H2 deployed for hydrogen and from 1% (best-case) to 3% (worst-case) for methane. The height of each bar corresponds to the range from leakage. See Table 2 for emissions inputs for hydrogen and methane, and Table 1 and Eqns (1) – (8) for equations used in the calculation and input parameters. more details on emissions assumptions and Table 3 for radiative properties and decay functions used. Error bars represent uncertainties in both hydrogen's soil sink and therefore lifetime (solid lines) as well as uncertainties in hydrogen and carbon dioxide's radiative effects (~±20%; dashed lines). Corresponding GWP results (only difference is pulse emissions rather than constant emissions rate) are shown using the "x" and "o" markers.

[19] See RMI's Hydrogen Reality Check #1: Hydrogen Is Not a Significant Warming Risk
[20] Ocko, I. B. and Hamburg, S. P.: Climate consequences of hydrogen emissions, Atmos. Chem. Phys., 22, 9349–9368, https://doi.org/10.5194/acp-22-9349-2022, 2022

To make progress in advancing clean hydrogen market development, the GHC maintains that the work led by EDF and RMI should occur alongside safe engineering research. Since hydrogen is a commodity that is already produced, transported, and stored, there is already a vast amount of knowledge that can be applied to the safe engineering of the related clean hydrogen infrastructure. To advance needed shared infrastructure to achieve low delivered cost, such research can include mitigation of fugitive hydrogen leaks – **from a climate perspective, as well as for safety** – while together we (the GHC, EDF, RMI, and others) further research appropriate measurement, monitoring, and mitigation solutions.

f) The IEPR Underestimates the Potential Demand for Hydrogen and Should Be Revised.

The GHC believes that the forecast included in the IEPR significantly underestimates the potential demand for hydrogen. Furthermore, we contend it fails to incorporate the use of clean hydrogen use in the power sector to achieve 100% renewable electricity, including 100% clean, firm, dispatchable renewable power that can leverage some portion of the existing thermal electric generation fleet. We believe the forecast is an underestimate since GHC's forecast[21] identified 1.4 MMT aggregated, multi-sectoral demand in the Los Angeles Basin by 2030 and 2.2 MT of aggregated demand by 2040.

g) The IEPR Should Provide a Recommendation to Assess the Possible Transition from Fossil Fuel Backup Generation to Clean Hydrogen Backup Generation.

There is a proliferation of diesel backup generators accelerating throughout California as we experience longer and more intense wildfire and drought seasons. In the South Coast Air Quality Management District alone, the number of backup diesel generators jumped by 22 percent from 2020 to 2021, while the proliferation of backup diesel generators in the Bay Area Air Quality Management District soared by 34 percent in less than three years.[22]

[21] Conducted as a part of the GHC's HyBuild Los Angeles Initiative

[22] Steven Moss and Andy Bilich, M.Cubed, "Diesel Back-Up Generator Population Grows Rapidly in the Bay Area and Southern California" (2020). https://bit.ly/34qOr0b. BUGs have reached 7,360 MW of capacity in the South Coast AQMD and 4,840 MW of capacity in the Bay Area AQMD based on information for BAAQMD and SCAQMD. The report estimates an average capacity of 0.543 MW for units in SCAQMD and 0.628-0.642 MW for units in BAAQMD

Diesel generators are a significant source of GHG and air pollution since they release particulate matter, volatile organic compounds, and nitrous oxides – the combination of which creates smog, thus exacerbating respiratory illness and accelerating climate change. Since many backup diesel generators are sited in low-income and disadvantaged areas, these communities face a disproportionately higher threat to public health. Recent analysis indicates that diesel-related pollution may trigger upwards of $136 million in health costs per year, due to increased mortality, heart attacks, hospital visits, and other adverse consequences.[23] The South Coast Air Quality Management District has estimated that excess emissions from diesel engines during public safety power shutoffs ("PSPS") events exceeded the total emissions from basin refineries.

Fortunately, clean hydrogen technologies can help replace fossil fuel-based backup generators. There is now a fleet of innovative, commercially available solutions that can be sited in critical locations to provide long-duration emergency backup service without the need for any fossil fuels, such as:

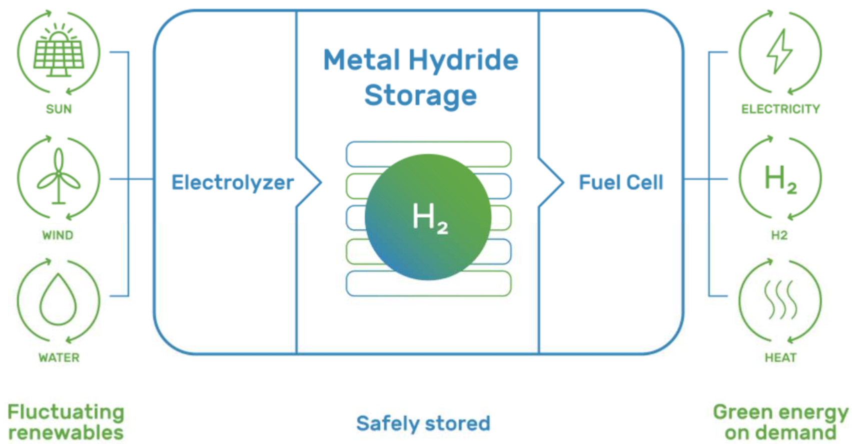
- ***Linear generators.*** Clean hydrogen-fueled linear generators are fully dispatchable and fuel-flexible, with the ability to deliver clean, firm power at a low cost. Modular and scalable linear generators can be deployed where the demand exists, either at a local level or at utility scale. Since they are fast-ramping with 24/7 load-following capability, linear generator technology can instantaneously respond to load fluctuations as well as grid outages caused by wildfires, extreme weather events, or other unforeseen disruptions.

- ***Fuel cell systems.*** Fuel cell systems are non-combustion distributed energy resources operating both behind-the-meter and in-front-of-the-meter that can address requirements for resilient, firm capacity, baseload, permanent load reduction, peak shaving, and backup power.

- ***Metal hydride storage***. The storage technology generates clean hydrogen from fluctuating renewable energy sources, storing it compactly and safely in metal hydride over long periods of time.[24] As depicted in the image below, this storage solution allows

[23] Ibid.
[24] See https://www.gknhydrogen.com/

renewables, like solar and wind, to provide green energy when needed. As the State works to deeply decarbonize its various industries, metal hydride storage has the potential to provide reliable energy on demand.



GKN infographic depicting its metal hydride storage technology.[25]

As these above-mentioned examples demonstrate, clean hydrogen can offer innovative solutions that are uniquely positioned to provide zero-carbon firm dispatchable generation while accelerating cross-sectoral decarbonization. Thus, we recommend that the CEC include a recommendation in the IEPR to support the assess the transition from fossil fuel backup generation to clean hydrogen backup generation.

h) The GHC Supports the Proliferation of Both Battery Electric Vehicles (BEVs) And Fuel Cell Electric Vehicles (FCEVs).

The GHC recognizes that BEVs and FCEVs each have their own strengths and have different functions in the market. To achieve a sustainable and clean energy transition, the GHC is therefore confident we will need both platforms to effectively decarbonize the transportation industry due to their complementary functions.

BEVs are particularly well-suited for use in light-duty transportation and are therefore a critical tool for decarbonizing passenger vehicle transportation. Momentum is building for zero-emission

[25] See https://www.gknhydrogen.com/

vehicle (ZEV) deployment, including BEVs, and infrastructure growth at both the federal[26] and state[27] levels. While the number of charging stations as well as the sales of zero-emission vehicles (ZEVs) – including BEVs – are increasing in California,[28] the reality is that more growth is required. For example, the State currently has just below 80,000 electric vehicle charging stations.[29] However, AB 2127 (2018), which requires the CEC to evaluate the EV charging infrastructure needed to meet the State's 2030 goals, estimates that 1.2 million chargers will be needed by 2030, which includes BEV stations.[30] Noting this need for growth, as well as the integral role BEVs can play in the decarbonization light-duty travel, the GHC supports BEV development.

FCEVs, like BEVs, can be used for the same light-duty applications; however, they have the added benefit of being well-suited for medium- and heavy-duty applications (e.g., trucks and buses; any high utilization application that has a heavy payload). The most extreme case where FCEVs will be important is for long-haul aviation and long-distance maritime shipping since these applications are unlikely ever to be powered with a battery-electric solution.[31] Furthermore, clean hydrogen fueling infrastructure can be used by all types of vehicles, including passenger and heavy-duty vehicles, and importantly provides **consumer choice.** The element of choice is important for consumers who do not have a single-family home and readily accessible BEV charging infrastructure access or who simply prefer to own an FCEV. In these ways, the role of FCEVs – and hydrogen refueling infrastructure – complement the role of BEVs since they can help with light-duty decarbonization while also reaching segments of the transportation sector where BEVs may not be the most reliable or practical option.

[26] See https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/05/fact-sheet-president-biden-announces-steps-to-drive-american-leadership-forward-on-clean-cars-and-trucks/
[27] See https://www.gov.ca.gov/2022/08/25/california-enacts-world-leading-plan-to-achieve-100-percent-zero-emission-vehicles-by-2035-cut-pollution/
[28] See https://www.gov.ca.gov/2022/02/25/california-leads-the-nations-zev-market-surpassing-1-million-electric-vehicles-sold/
[29] See https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/electric-vehicle
[30] See https://www.energy.ca.gov/programs-and-topics/programs/electric-vehicle-charging-infrastructure-assessment-ab-2127
[31] Clean hydrogen or a carbon-free derivative liquid fuel made from clean hydrogen is the likely solution for these applications.

Thus, GHC supports the proliferation of both BEVs and FCEVs, as stated in the IEPR. Given the reality that the transportation sector accounts for 50% of the State's GHG emissions,[32] we believe the growth of both pathways is integral to decarbonizing the sector.

i) The IEPR Should Move Away from the Least-Cost Paradigm to a Stacked Benefits Paradigm when Evaluating Clean Hydrogen.

Historically, power and gas sector planning has relied on least-cost models to evaluate and prioritize infrastructure investment decisions. For decades, this system worked well as demand was relatively easy to forecast and fossil-fueled capacity easy to procure. However, this system limits innovation since it focuses heavily on cost and no longer serves the interests of consumers or our clean energy policy goals.

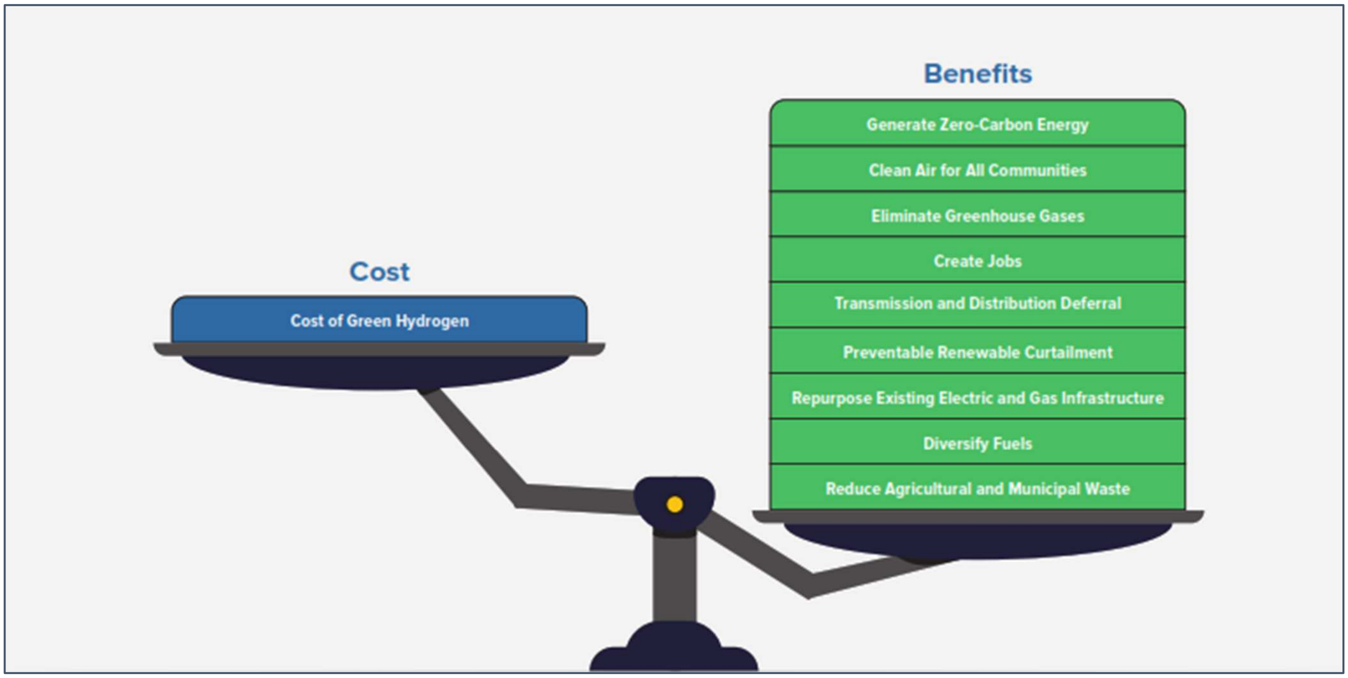
The way we generate and use energy is changing rapidly. Many trends are challenging the least-cost paradigm, such as the emergence of low-cost renewable energy, moving from centralized to decentralized energy systems, smart digital controls, bidirectional energy storage, and the urgent need to decarbonize energy systems. When making integrated energy policy decisions, a more prudent approach for our energy systems would be to evaluate policy recommendations based on a comparison of stacked benefits instead of the traditional least-cost approach.

Bidirectional energy storage was the first significant technology addition to grid planning that challenged the traditional least-cost procurement approach. The CEC has recognized the benefit-stacking potential of bidirectional energy storage assets, including recognizing the benefits that a single asset can provide (i.e., energy arbitrage, capacity, ancillary services, and distribution deferral). The CEC is now researching new ways energy storage can achieve more flexible, resilient, stable, and affordable grid operations. Realizing the benefits of bidirectional energy storage for the power system was a direct result of regulatory innovation – such as the weight the IEPR provides – that enabled stacked benefits to be recognized.

Similarly, the IEPR should focus on a stacked benefits paradigm when assessing clean hydrogen. Like energy storage, clean hydrogen can deliver many stacked benefits (*see image*

[32] See https://www.energy.ca.gov/about/core-responsibility-fact-sheets/transforming-transportation

below). To attract investment, the benefits provided by these projects must be recognized and compensated.



Enabling compensation pathways for all the benefits provided by a clean hydrogen project is exceptionally challenging because the benefits not only span the silos inherent in the power sector[33] but can also span multiple sectors.[34] Further, these sectors and their related jurisdictional governing bodies were organized many decades ago when it was not envisioned that the use of a flexible resource, like clean hydrogen, has many pathways for production and use.

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), scalability, and recognition and compensation for all the benefits provided. This will create a virtuous cycle that ensures ongoing investment and sustainability.

III. CONCLUSION

[33] Transmission, distribution, generation, and load.
[34] Power, gas, transportation, water, and waste management.

The GHC appreciates the opportunity to submit comments on the 2022 Integrated Energy Policy Report Update. We look forward to collaborating with the CEC and all other stakeholders.

Respectfully submitted,

____________/s/
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