CALIFORNIA HYDROGEN BUSINESS COUNCIL

Main Office: 18847 Via Sereno Yorba Linda, CA 92886 **DC Office:** 1211 Connecticut Ave NW, Ste 650 Washington, DC 20036

Phone: (310) 455-6095 | Fax: (202) 223-5537
info@californiahydrogen.org | www.californiahydrogen.org

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Kevin Uy & Laurie ten Hope
California Energy Commission
Energy Research & Development Division
1516 Ninth Street
Sacramento, CA 95814

Regarding: Natural Gas Research and Development Program Expansion

The California Hydrogen Business Council (CHBC)[i] is pleased to comment on the Energy Commission's intent to request the Public Utilities Commission to expand the existing investor-owned utility (IOU) funded Natural Gas Research and Development program. Our comments respond to the information and feedback request as presented in your January 25, 2018 Public Workshop on this subject. We focus primarily on the question posed to stakeholders regarding whether it is worth investigating potential pathways for dramatic GHG emissions reduction, such as hydrogen and synthetic natural gas production technologies.[ii]

The CHBC is a member organization representing a broad mix of stakeholders focused on bringing the environmental and societal benefits of using Hydrogen into the mainstream energy markets over the next decades. The CHBC believes that hydrogen produced with renewable sources and synthetic methane derived from this hydrogen can play a critical role in deeply reducing greenhouse gas emissions from the energy system. Renewable hydrogen is a zero-carbon resource, and when produced with electrolysis powered by renewable sources, renewable hydrogen can be delivered at mass scale. Synthetic methane derived from this electrolytic hydrogen can be used to displace fossil fuels and decarbonize any natural gas application.

Some of the specific ways that hydrogen-based gas can reduce GHG in the energy system are as follows:

- *By increasing grid reliability and integrating increasing levels of renewables onto the regional electric grid*. Rather than waste excess electricity from over-generation of intermittent renewables, the electricity can be used to power electrolysis to produce hydrogen, which can then be used in a variety of ways or stored for later use. Electrolysis can also provide a range of grid services, such as frequency regulation and voltage support, as well as integrate renewables in microgrids that help make communities resilient.

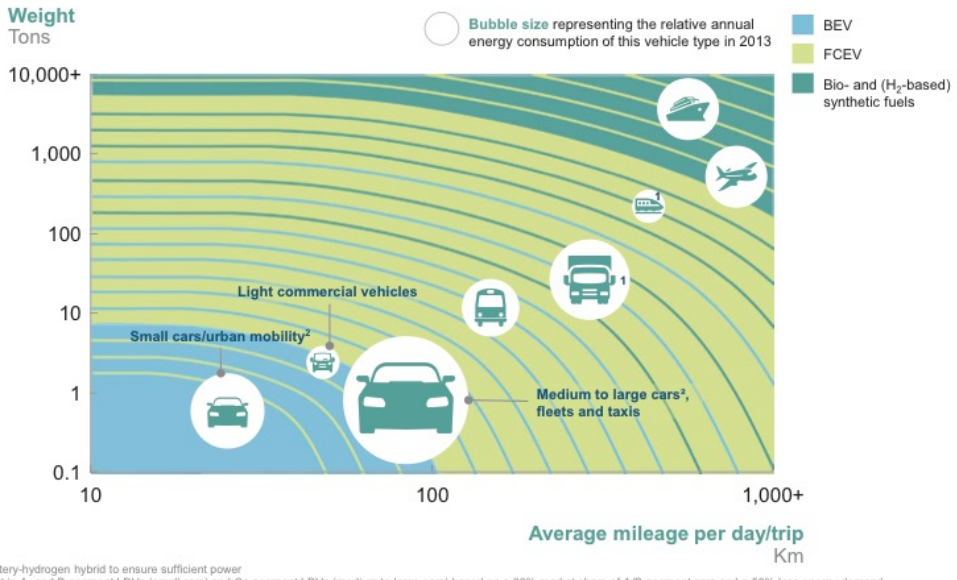
- *By turning the "duck curve" challenge into an opportunity.* Low or no cost renewable electricity produced at times of low demand can inexpensively produce renewable hydrogen and enable more renewable electricity to be integrated economically into the grid. Future costs of fuel production through this pathway are expected to be below $2/kg for hydrogen and below $15/MMBTU for methane including the cost of electricity as the feedstock.

- *By providing highly scalable, cost-effective, geographically flexible energy storage.* It is the only technology capable of providing storage at terawatt-hour scale without location limitations, when the existing gas infrastructure is used. This is particularly important for seasonal storage that will be critical as California reaches high penetrations of variable renewable electricity generation. It is more cost-effective and geographically efficient than Li-ion batteries at high capacity and more geographically flexible than pumped hydro and compressed air.[iii] Underscoring this, Former Energy Secretary and Nobel Laureate Steven Chu, who is a global expert on battery technology, recently acknowledged that hydrogen is more likely an economic solution to seasonal urban energy storage than batteries.[iv]

- *By displacing fossil – based hydrogen in highly polluting industries* such as refining, fertilizer and metals production.

- *By fueling hydrogen stations* for zero-emissions fuel cell electric vehicles.[v]

Figure 5: FCEVs will play an essential role in decarbonizing transport
Projected economic attractiveness



FCEVs will play an essential role in decarbonizing transport – Projected economic attractiveness

- *By providing a climate protective pathway for energy uses that are difficult to decarbonize with battery electrification only, such as medium and heavy-duty vehicles, freight, aviation, and certain industrial equipment.* For instance, hydrogen fuel cell electric vehicle technology is better suited to long haul heavy duty trucks than pure batteries, due to advantages like better performance and quicker fueling times. That said, the two technologies can also complement each other. Fuel cell electric bus equipped

with batteries will travel further, be refueled much quicker at a comparable cost, and the hybrid solution prolongs the lifetime of the batteries by maintaining them in an optimal state-of-charge, thus resulting in less chemical battery waste. Another application better suited to hydrogen fuel cells than batteries is forklifts, due to increased productivity and lower operating costs and ultimately reduced carbon footprint.[vi]

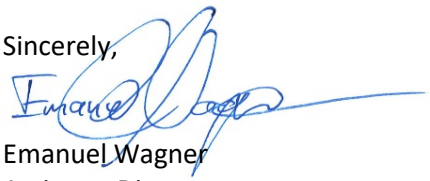
- *By decarbonizing ultra-low NOx ("near zero emissions") gas engine heavy-duty trucks at scale which can help curb criteria pollutants, along with carbon emissions.*

Renewable hydrogen's multiple pathways to "dramatically reduce" greenhouse gas emissions are why it is supported by the US Department of Energy's H2@Scale program.[vii] Electrolytic hydrogen and its derivatives are also supported as a greenhouse gas reduction pathway by the European Union,[viii] and viewed by the German federal government as being essential to reaching deep greenhouse gas reduction (near carbon neutral by 2050) goals.[ix]

In conclusion, CHBC strongly supports expansion of the gas IOU R&D program, and notes that ratepayer value would be well served when developing synergistic hydrogen and natural gas infrastructure and applications. We strongly support moving the program format to a three-year period, as well as increasing the potential upper funding limit to accommodate more substantial projects. Industrial hydrogen knowledge is deep and well documented. However, fully developing applications and altering processes optimized for renewable hydrogen's larger role (and evolution of existing natural gas infrastructure) will need hardware demonstrations. Hardware development and process optimization inevitably require somewhat greater funding than more fundamental research. Moving to the three-year format should not, however, unduly delay R&D efforts, which can move more quickly.

Thank you for your consideration.

Sincerely,



Emanuel Wagner
Assistant Director
California Hydrogen Business Council

[i] The views expressed in these comments are those of the CHBC, and do not necessarily reflect the views of all of the individual CHBC member companies. Members of the CHBC include Advanced Emission Control Solutions, Air Liquide Advanced Technologies U.S., Airthium, Alameda-Contra Costa Transit District (AC Transit), American Honda Motor Company, Anaerobe Systems, Arriba Energy, Ballard Power Systems, Bay Area Air Quality Management District, Beijing SinoHytec, Black & Veatch, BMW of North America, California Performance Engineering, Cambridge LCF Group, Center for Transportation and the Environment (CTE), CNG Cylinders International, Community Environmental Services, CP Industries, DasH2energy, Eco Energy International, ElDorado National – California, Energy Independence Now (EIN), EPC - Engineering, Procurement & Construction, Ergostech Renewal Energy Solution, EWII Fuel Cells, First Element Fuel, FuelCell Energy, GenCell, General Motors, Geoffrey Budd G&SB Consulting Ltd, Giner ELX, Gladstein, Neandross & Associates, Greenlight Innovation, GTA, H2B2, H2Safe, H2SG Energy Pte, H2Tech Systems, Hitachi Zosen Inova ETOGAS GmbH, HODPros, Horizon Fuel Cells Americas, Hydrogenics, Hydrogenious Technologies, Hydrogen Law, HydrogenXT, HyET - Hydrogen Efficiency Technologies, Hyundai Motor Company, ITM Power, Ivys, Johnson Matthey Fuel Cells, Kontak, KORE Infrastructure, Life Cycle Associates, Linde North America, Longitude 122 West, Loop Energy, Luxfer/GTM Technologies, McPhy Energy, Millennium Reign Energy, Montreux Energy, MPL Consulting, National Renewable Energy Laboratory (NREL), Natural Gas Fueling Solutions – NGFS, Natural Hydrogen Energy, Nel Hydrogen, New Flyer of America, Next Hydrogen, Noyes Law Corporation, Nuvera Fuel Cells, Pacific Gas and Electric Company - PG&E, PDC Machines, Planet Hydrogen, Plug Power, Port of Long Beach, PowerHouse Energy, Powertech Labs, Primidea Building Solutions, Proton OnSite, RG Associates, Rio Hondo College, Rix Industries, Sacramento Municipal Utility District (SMUD), SAFCell, Schatz Energy Research Center (SERC), Sheldon Research and Consulting, Solar Wind Storage, South Coast Air Quality Management District, Southern California Gas Company, Sumitomo Corporation of Americas, Sunline Transit Agency, T2M Global, Tatsuno North America, The Leighty

Foundation, TLM Petro Labor Force, Toyota Motor Sales, True Zero, United Hydrogen Group, US Hybrid, Verde, Vinjamuri Innovations, Volute, WireTough Cylinders, Zero Carbon Energy Solutions.

[ii] CHBC acknowledges that the Commission also included carbon sequestration among the potential GHG reduction pathways, but we are not addressing this in this document, since it is out of the scope of our expertise.

[iii] For more information, please refer to CHBC's *Economics of P2G* white sheet submitted to the 2017 IEPR docket: http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-10/TN219923_20170626T180524_Emanuel_Wagner_Comments_Economics_of_Power_to_Gas.pdf

[iv] https://www.theaustralian.com.au/news/health-science/obama-energy-secretary-steven-chu-flat-on-battery-plants/news-story/6fa3216e712fe7261a39a06f9f2056e9

[v] http://hydrogencouncil.com/wp-content/uploads/2017/06/Hydrogen-Council-Vision-Document.pdf

[vi] http://www.plugpower.com/wp-content/uploads/2014/12/PlugPower_7ReasonsH2FC_F102116.pdf

[vii] https://energy.gov/eere/fuelcells/h2-scale

[viii] http://www.fch.europa.eu/sites/default/files/P2H_Full_Study_FCHJU.pdf

[ix] https://www.umweltbundesamt.de/en/press/pressinformation/a-greenhouse-gas-neutral-germany-is-almost-possible