CALIFORNIA HYDROGEN BUSINESS COUNCIL

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California Hydrogen Business Council Comments on California ISO Electricity 2030 Trends and Tasks for the Coming Years

Comments prepared and submitted on November 20, 2017

The California Hydrogen Business Council (CHBC) appreciates the opportunity to comment on the California Independent System Operator *"Electricity 2030" Discussion Paper.* The CHBC is a California industry trade association with a mission to advance the commercialization of hydrogen in transportation and stationary sources to reduce greenhouse gas, criteria pollutant emissions and dependence on fossil fuels. Our more than 100 members include fuel cell and electrolyzer companies, auto manufacturers, industrial gas companies, and natural gas companies with an interest in hydrogen and hydrogen infrastructure in California[1].

We believe the California ISO's Discussion Paper has identified key trends affecting the electricity sector. The paper would be strengthened by incorporating renewable hydrogen and fuel cell technology, which are important tools to help *decarbonize*, *decentralize* and *regionalize* California's electrical system and energy

[1] 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. LLC., Airthium, Alameda-Contra Costa Transit District (AC Transit), American Honda Motor Company, Anaerobe Systems, Arriba Energy, Ballard Power Systems, Inc., Bay Area Air Quality Management District, Beijing SinoHytec, Black & Veatch, BMW of North America LLC, Boutin Jones, Cambridge LCF Group, Center for Transportation and the Environment (CTE), CNG Cylinders International, Community Environmental Services, CP Industries, DasH2energy, Eco Energy International, LLC, ElDorado National – California, Energy Independence Now (EIN), EPC - Engineering, Procurement & Construction, Ergostech Renewal Energy Solution, EWII Fuel Cells LLC, First Element Fuel Inc, FuelCell Energy, Inc., GenCell, General Motors, Geoffrey Budd G&SB Consulting Ltd, Giner ELX, Gladstein, Neandross & Associates, Greenlight Innovation, GTA, H2B2, H2Safe, LLC, H2SG Energy Pte Ltd, Hitachi Zosen Inova ETOGAS GmbH, HODPros, Horizon Fuel Cells Americas, Inc., Hydrogenics, Hydrogenious Technologies, Hydrogen Law, HydrogenXT, HyET - Hydrogen Efficiency Technologies, Hyundai Motor Company, ITM Power Inc, Ivys Inc., Johnson Matthey Fuel Cells, Kontak, LLC, KORE Infrastructure, LLC, Life Cycle Associates, Linde North America Inc, Longitude 122 West, Inc., Loop Energy, Luxfer/GTM Technologies, LLC, McPhy Energy, Montreux Energy, MPL Consulting, Inc., National Renewable Energy Laboratory (NREL), Natural Gas Fueling Solutions – NGFS, Natural Hydrogen Energy Ltd., Nel Hydrogen, New Flyer of America Inc, Next Hydrogen, Noyes Law Corporation, Nuvera Fuel Cells, Pacific Gas and Electric Company - PG&E, PDC Machines, Planet Hydrogen Inc, Plug Power, Port of Long Beach, PowerHouse Energy, Powertech Labs, Inc., Primidea Building Solutions, Proton OnSite, RG Associates, Rio Hondo College, Rix Industries, Sacramento Municipal Utility District (SMUD), SAFCell Inc, Schatz Energy Research Center (SERC), Sheldon Research and Consulting, Solar Wind Storage LLC, South Coast Air Quality Management District, Southern California Gas Company, Sumitomo Corporation of Americas, Sunline Transit Agency, T2M Global, Tatsuno North America Inc., The Leighty Foundation, TLM Petro Labor Force, Toyota Motor Sales, United Hydrogen Group Inc, US Hybrid, Verde LLC, Volute, Inc., WireTough Cylinders, LLC, Zero Carbon Energy Solutions.

transition. The document currently omits renewable hydrogen and fuel cells entirely, although these technologies are integral to state energy policy and have many relevant and versatile applications, including:

- Microgrids
- Integrating renewable electricity generation
- Energy storage
- Zero emissions transportation
- Decarbonizing gas power generation
- Providing large scale, controllable demand
- Zero greenhouse gas industrial uses
- Ancillary grid services at any time scale

Note that renewable hydrogen can be produced from biogas, syngas made from bio-waste, or using renewable electricity via electrolysis that splits water into hydrogen and oxygen - a process called power-to-hydrogen or power-to-gas (P2G). While all these pathways have value, P2G holds the largest volume potential, due to the limited amount of available organic waste. Therefore, these comments focus mostly on the P2G pathway.

Summary

The following is a summary of the multiple applications for renewable hydrogen, followed by specific proposed edits to the Electricity 2030 Discussion Paper. The major themes in the suggested changes are:

- **To be consistent with state policy, we request that deployment of fuel cell electric vehicles and hydrogen stations be considered on equal footing as plug-in and battery electric vehicles and charging stations as the California ISO explores opportunities for a more secure, sustainable, and affordable electric service.**
  More specifically:
  1) While the term “electric vehicle” encompasses both fuel cell and battery technologies, “zero emissions vehicle (ZEV)” is a more appropriate term used by other state agencies, as it leaves less room to interpretation. When discussing a vehicle’s energy storage, we request you use the term “storage” instead of “batteries” in order to avoid any potential technology bias but remain technology neutral.
  2) In several places, the report should also include hydrogen production to meet ZEV fueling requirements with efficient dispatching of grid resources.
  3) Moreover, smart-charging and time-of-use incentives can apply to hydrogen stations, with either on-site production via electrolysis or by controlling compression equipment. In fact, these incentives can have a larger impact when used at a hydrogen station that supplies fuel for hundreds of vehicles rather than charging of an individual vehicle.
  4) Lastly, deployment of hydrogen stations is as essential as deploying charging infrastructure, particularly in dense urban areas that lack private parking, in rural areas where people drive long distances, and for medium- and heavy-duty vehicles.

- **To be technology neutral, where biogas and biofuels are considered, such as for decarbonizing gas generation or heavy duty vehicles, so too should a broader range of renewable gases, including bio-based and electrolytic hydrogen, that are able to provide comparable services.**

- **When discussing system storage needs, clearly articulate the opportunity for hydrogen and other storage mechanisms to find their opportunities alongside battery storage, further supporting diurnal and seasonal fluctuations.**

- **When reviewing policies, rates structures and plans, be open and inclusive of hydrogen and FCEV related services for the system, to enable and support all market opportunities.**

Overview of Multiple Applications of Renewable Electrolytic Hydrogen

Application 1: Zero Emissions Transportation

Hydrogen fuel cell vehicles (FCEVs) emits zero tailpipe air pollution or greenhouse gas, including in difficult use cases like medium and heavy duty trucks, and the more the electricity grid transitions to renewable sources, the more hydrogen produced with electrolysis will also help eliminate greenhouse gas and criteria pollution over the entire lifecycle of transportation fueling.

Hydrogen fuel cell technology is a cornerstone of California's clean transportation policy. Governor Brown's Executive Order B-16-2012 set a target of 1.5 million Zero Emissions Vehicles (ZEVs) on California roads by 2025, which includes vehicles powered by not only batteries but also fuel cells. Other state policies that support FCEVs include the Clean Vehicle Rebate Project, AB 8, and the Energy Commission's Alternative and Renewable Fuel and Technology Program. As a result of these efforts, California is on its way to achieving its initial goal of 100 hydrogen fueling stations, and there are thousands of hydrogen fuel cell electric vehicles (FCEVs) on the state's roads. There are three models of FCEVs on California's roads today with more expected in coming years,[2] there have been several recent OEM announcements on medium and heavy-duty vehicles,[3] and adoption of hydrogen fuel cell options for non-vehicular industrial equipment like forklifts is also starting to boom.[4]

By 2030, the California Fuel Cell Partnership expects that up to 500,000 FCEVs will be in California fueling at hundreds of stations. They also expect to see up to 50% of hydrogen produced from renewables, much of that via electrolysis. Currently, hydrogen dispensed in California is already 44% renewable.

In that respect, EVs will not be the "bulk of new car sales" as suggested in this document without a suite of supportive policies in California and nationwide.

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[2] http://www.businessinsider.com/12-hydrogen-car-projects-2017-5/ - the-epa-recently-gave-the-car-an-estimated-range-of-366-miles-the-longest-range-of-any-zero-emissions-vehicle-honda-says-the-clarity-has-a-refuel-time-of-just-three-to-five-minutes-2

[3] https://www.trucks.com/2017/05/08/hydrogen-fuel-cell-trucks-holy-grail/

[4] https://www.hygen.com/hydrogen-forklifts-new-home-amazon/

Application 2: Decarbonizing Gas Power Plants

Hydrogen could replace a large majority of the natural gas going into power plants, which are the biggest end users of natural gas in California.[5] Replacing fossil fuel natural gas with renewable hydrogen could help reduce greenhouse gas emissions from a major source of electricity that helps stabilize the grid, lower air pollution from power plants that presents a health hazard to communities, and avoid electric generation stranded assets funded previously by California ratepayers.

Application 3: Energy Storage

As the state advances toward ever-higher renewable electricity targets, curtailment is increasing.[6] As the state progresses to 50% and higher penetrations of mostly variable renewable generation, like solar and wind power, over the coming years, there will be an increasing need for energy storage, including large scale, seasonal storage. The geographic limitations of pumped hydro and compressed air storage will require additional large scale storage solutions. Electrolytic hydrogen production is uniquely scalable from small amounts to the terawatt-hour-scale, making it a potentially critical resource in providing geographically flexible seasonal storage. Compared to lithium-ion batteries, it can store far more massive amounts of energy and can shift such energy over far longer periods of time (e.g. seasonally, annually), it can provide more capacity in less space, and modeling shows it can also be cost-competitive. [7]

Application 4: Integration of Renewable Electricity and Other New Clean Energy Loads

As the CAISO clearly knows, over the coming years, electricity grids increasingly must accommodate new intermittent generation resources and loads, like solar, wind and electric vehicles, which must be to maintain reliable, cost-effective service. Electrolyzers can be deployed as a flexible tool that are able to absorb surplus generation from short to continuous periods, using the electricity to make hydrogen via electrolysis for multiple possible applications – and conversely, supplying the grid with power as needed via fuel cells or power plants.

Application 5: Decarbonizing Industrial Processes

Renewable hydrogen can replace conventional hydrogen production and help decarbonize refineries, which emit 31% of greenhouse gases from California's industrial sector.[8] For large emitters that use hydrogen, like refineries and fertilizer producers, options are limited for meeting greenhouse gas reduction requirements. Renewable hydrogen provides an important, greenhouse gas free, drop-in alternative.

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[5] https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_sca_a.htm

[6] http://www.utilitydive.com/news/prognosis-negative-how-california-is-dealing-with-below-zero-power-market/442130

[7] See *Economics of P2G*, CHBC, June 27, 2017 http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-10/TN219923_20170626T180524_Emanuel_Wagner_Comments_Economics_of_Power_to_Gas.pdf

[8] Source: CARB; *https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2014/ghg_inventory_trends_00-14_20160617.pdf*

Specific Edits to the *Electricity 2030* plan

Proposed edits are in red line.

Page 4

Transportation, buildings, electricity, the opportunities of a clean energy economy depend on addressing energy use holistically.

- Change "Batteries in electric vehicles," to "Electrolyzers producing hydrogen and batteries in zero emission vehicles,".

About this document:

- Change "accelerate EV deployment" to "accelerate ZEV deployment".

Page 10

Biofuels play a larger role in the thermal generation fleet:

- Change "Biofuels play a larger role…" in the heading to "Renewable gas plays a larger role…"
- Change "An increasing number of fast-start conventional resources are converted to use biofuels instead of fossil fuels" to "An increasing number of fast-start conventional resources are converted to use renewable gas, such as biofuels and electrofuels, instead of fossil fuels."

Page 11

Guiding Questions:

- Add #5: "What are the constraints and opportunities for use of electrofuels like electrolytic hydrogen and synthetic methane in electricity generation? What infrastructure upgrades would be required to access and biofuels for electricity generation?"

Page 14

***Electric* vehicles comprise the bulk of new car sales and represent a significant share of cars on the road in California.**

- Change "Electric Vehicles" to "Zero-emission vehicles" and "EVs" to "ZEVs"
- Change "Smart-charging and time of use incentives enable electric vehicles to provide thousands of megawatts of controllable demand" to "Smart-charging and time-of-use incentives for charging plug-in vehicles and producing hydrogen for fuel cell electric vehicles to provide thousands of megawatts of controllable demand.
- Change "individually owned EVs" to "individually owned ZEVs".

Customers become "prosumers":

- Change "Microgrids incorporating battery storage" to "Microgrids incorporating energy storage".

Page 16

Falling *battery* costs and IT technologies encourage formation of local microgrids.

- Change to "falling storage costs" to encompass opportunities with fuel cells and power-to-gas in microgrids. Several microgrid pilots are already using electrolytic hydrogen and fuel cells[9] and cost of electrolyzers has dropped by 80% since 2002.[10]

***Electric vehicles* and sophisticated building energy management technologies…**

- Change "Electric vehicles" to "Zero emission vehicles" OR "Plug-in and fuel cell electric vehicles"

Page 20

Electric vehicles (EVs) rapidly replace internal combustion engine vehicles. EVs represent…

- Change "Electric vehicles (EVs)" to "Zero emissions vehicles (ZEVS) rapidly replace internal combustion engine vehicles. ZEVs represent…"

Public transportation is increasingly electric-driven.

- In the paragraph under this bullet heading, change "Electric buses" to "Zero emission electric buses" and "EVs" to "ZEVs".

Electric vehicles provide a large volume of widely dispersed and dispatchable storage capacity.

- This section is very specific to charging battery cars and is written differently than the other sections. We recommend the following objective wording that encompasses both types of electric vehicles:

  "Plug-in and fuel cell electric vehicles provide widely dispersed and dispatchable storage capacity.

  Controlled battery charging and electrolytic hydrogen production provides multiple paths to absorbing excess renewable generation, reducing peak demand, and optimizing electrical system assets. Combined with time-of-using pricing for charging and using hydrogen fueling station equipment, plug-in vehicles and hydrogen equipment enables flexibility for load balancing by using excess renewables to fuel cars, and using the geographically-dispersed energy stored in batteries and hydrogen to provide power to the grid."

Page 21

Task: Develop policies and programs to integrate transportation and building energy use with electrical service

- Bullet 4: Add—accelerated, widespread deployment of vehicle charging "and hydrogen fueling" infrastructure; Change "Electric Vehicles" and "EVs" to "Zero emissions Vehicles (or Battery electric and fuel cell electric vehicles)" and "ZEVs".

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[9] See, e.g., https://www.energymanagertoday.com/uc-irvine-power-gas-storage-performs-lithium-ion-batteries-0168751/; https://microgridknowledge.com/fuel-cell-microgrids-fuelcell-energy/

[10] https://energy.gov/sites/prod/files/2017/10/f37/fcto-progress-fact-sheet-august-2017.pdf

- Bullet 5: Change “behind-the-meter resources such as EVs and buildings” to “behind-the-meter resources such as ZEVs, hydrogen production, and buildings.”
- Add bullet: “Establish sustainable pathways to integrate power-to gas into the energy system, including for transportation, gas end uses for buildings, and industrial applications.”

Guiding questions

- #3: Change to - What programs and incentives are required to expand daytime BEV charging and hydrogen production and/or compression?
- Remove the question about EV owners that do not have access to home charging. This is a role that fuel cell electric vehicles and hydrogen stations fill.
- #4: Change “allow fleets of EVs and…” to “allow fleets of ZEVs and…”