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California Hydrogen Business Council Comments on the May 12 IEPR Workshop

Additional submitted attachment is included below.

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Comments of the California Hydrogen Business Council in response to the California Energy Commission's (CEC) 2017 Integrated Energy Policy Report (IEPR) Joint Agency Workshop on the Increasing Need for Flexibility in the Electricity System held on May 12, 2017

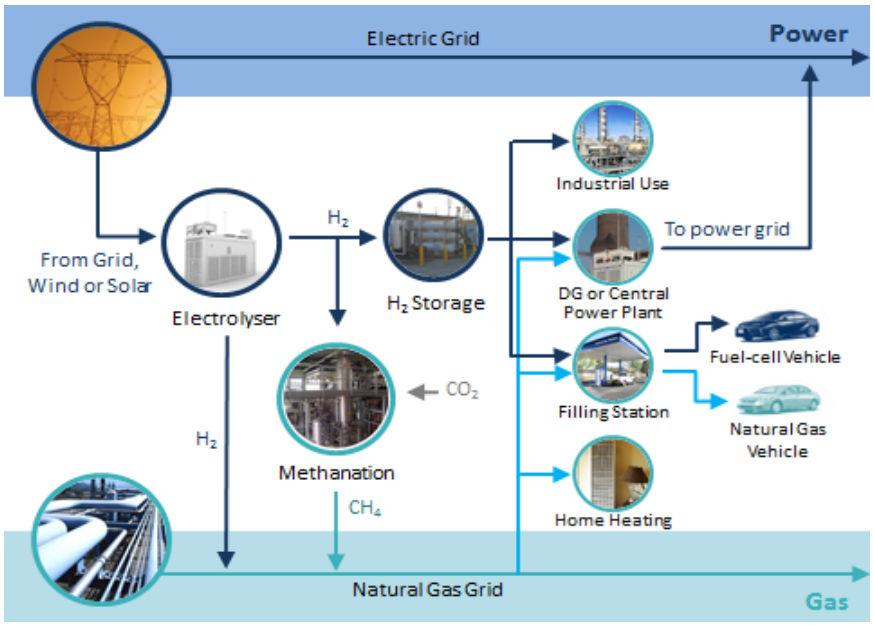
The CHBC [i] would like to thank the California Energy Commission, the Public Utilities Commission and the Independent System Operator and the staff of each organization for the opportunity to provide comments on the May 12, 2017 Joint Agency Workshop on the "Increasing Need for Flexibility in the Electricity System regarding the 2017 IEPR".

The CHBC would like to highlight the opportunity for **hydrogen energy storage** to provide key grid services that can provide for greater flexibility of the grid, especially related to the integration of vast amount of renewable energy long term for low cost. As outlined in CHBC's White Paper "Power-to-Gas: The Case for Hydrogen"[ii], hydrogen in combination with electrolyzers, fuel cells and the natural gas grid can play vital role in addressing key grid services and needs related to the increase of intermittent renewable energy as part of the grid portfolio.

For example, as part of the system, hydrogen from electrolyzers in combination with fuel cells can provide the following services:

- Energy time shifting (arbitrage)
- Voltage and frequency regulation
- Ramping
- System Capacity
- Rapid Demand and Supply Response
- T&D investment deferral

The biggest opportunity in the near term however, is when excess renewable energy is used to produce hydrogen for storage in the existing natural gas storage system. Hydrogen produced from renewables can be directly injected into the pipeline or converted to renewable methane, in both cases replacing fossil natural gas and increasing the share of renewable gas available to the customers or gas or fuel cell power plants, in both cases leading to reduction in GHG emissions.



Power-to-Gas Concept

The CHBC asks for the following considerations to be made in the development of the 2017 IEPR:

1. **Hydrogen and Power-to-Gas are as safe as any other energy technology**
2. **Power-to-Gas shall be made an eligible storage technology in California**
3. **Power-to-Gas projects should be implemented to develop a clear understanding of cost and benefit for the technology in the California environment**
4. **Creation of a framework for establishing the renewable content and carbon intensity of hydrogen**

1. Hydrogen and Power-to-Gas are as safe as any other energy technology

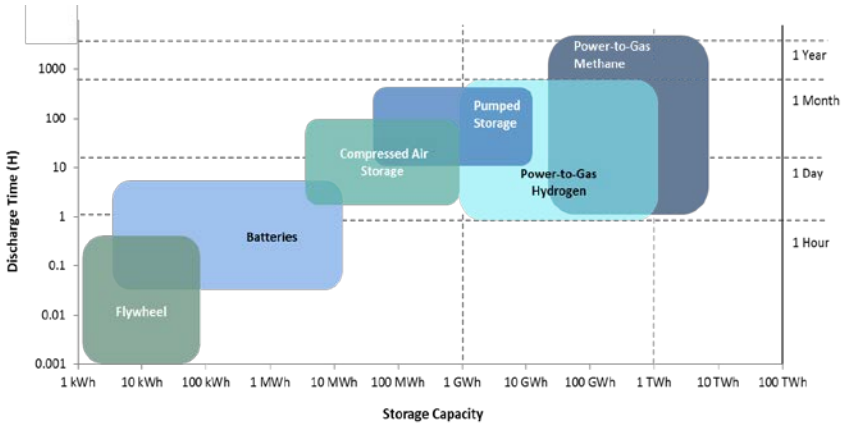
A common misperception relates to the safety aspects of hydrogen and fuel cell technology.

In the U.S., over 11 million metric tons of hydrogen are produced annually[iii], over 1,600 miles of hydrogen pipelines exist today, and according to the U.S. Department of Energy, "*one possibility for rapidly expanding the hydrogen delivery infrastructure is to adapt part of the natural gas delivery infrastructure to accommodate hydrogen. Converting natural gas pipelines to carry a blend of natural gas and hydrogen (up to about 15% hydrogen) may require only modest modifications to the pipeline. Converting existing natural gas pipelines to deliver pure hydrogen may require more substantial modifications. Current research and analyses are examining both approaches*."[iv]

Regarding pipeline safety, according to the U.S. Department of Transportation, "*pipelines enable the safe movement of extraordinary quantities of energy products to industry and consumers*", and "*pipeline systems are the safest means to move products*".[v]

While no energy system is perfectly safe, it is unreasonable to associate an increased sense of danger or unsafety for hydrogen as an energy carrier over other fuels, as long as the systems using hydrogen adhere to the developed hydrogen safety codes and standards.

2. **Power-to-Gas shall be made an eligible storage technology in California.**



Storage Technologies and Power / Energy Characteristics (After Fraunhofer ISE, 2015)

Currently, the Public Utilities Commission is assessing advanced storage technologies, but has decided that Power-to-Gas technology effectively does not qualify as a storage resource in the CPUC procurement program when used in combination with the natural gas pipeline system. The CHBC as party to the proceedings questions that decision, especially as the reasoning behind the exclusion stems from a misunderstanding of the functionality of the technology.

The CHBC asserts that there needs to be a place for alternative storage technologies, e.g. mixed mode storage (electrical energy stored as chemical energy) in future CPUC proceedings. In that respect, CHBC would like to reference the energy storage definition used by the EU Commission: "*energy storage means, in the electricity system, deferring an amount of the electricity that was generated to the moment of use, either as final energy or converted into another energy carrier*."[vi]

Furthermore, the EU and many of its member countries feature several dozen power-to-gas demonstration and commercial projects[vii]. It would be unfortunate if California would prevent a promising technology to participate in energy storage procurements when countries with a similar goal of drastically increasing their share of renewable energy, like Germany, embrace the technology.

3. **Power-To-Gas projects should be implemented to develop a clear understanding of cost and benefit for the technology in the California environment**

The CHBC urges for the consideration of the deployment of commercial MW scale Power-to-Gas pilot-projects in the State in order to establish a clear understanding of the cost and potential revenue streams for the technology. While analysis from CHBC and NREL show great promise for low-cost energy storage, especially for large-scale long-term duration storage scenarios, real-world data needs to be collected to enable reliable cost analysis. Power-to-gas technology uses neither a novel nor an untested technology. Electrolyzers have existed for a very long time, and with recent increase in demand are becoming cheaper and more efficient, a trend that follows the price reduction seen for battery systems. Since a storage system, e.g. the natural gas grid, already exists, almost no new infrastructure needs to be deployed. Hydrogen can be stored in salt cavern, hydrogen tanks and the natural gas grid in very large quantities, allowing longer term to very long-term storage (seasonal storage), without a corresponding increase of the cost of the system.

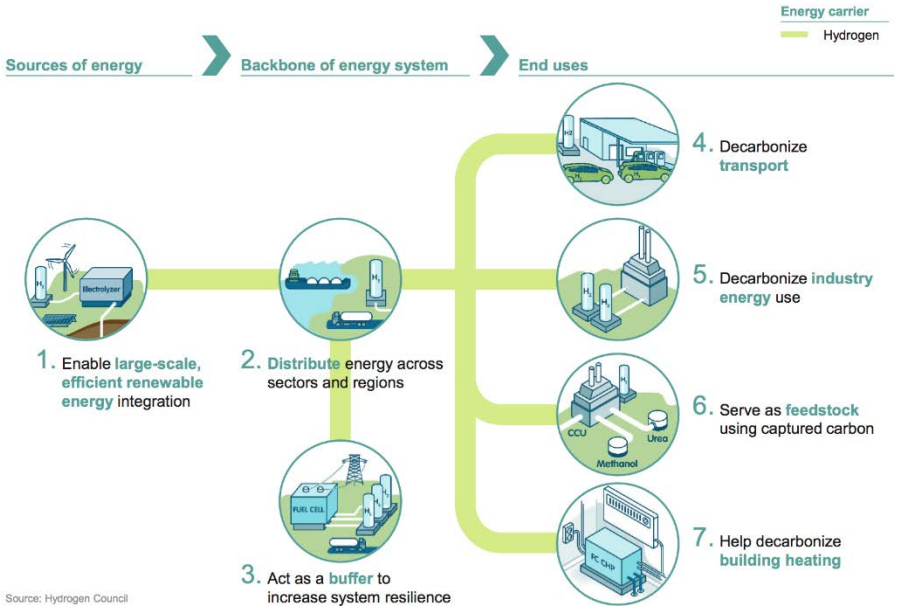
Deploying Power-to-Gas projects would also enable the agencies to receive information on how to price additional grid and ancillary services, which the technology can provide. In addition, there is need for supportive policies, such as those called for in SB 1383, Short-lived Climate Pollutants, to develop a stable market price for renewable hydrogen in all uses.

4. Creation of a renewable hydrogen framework to allow for renewable hydrogen to be tracked

The CHBC recommends an effort to develop an accounting framework for renewable hydrogen, similar to the RINs or REC system for fuels and electricity. Since renewable hydrogen has beneficial attributes, which should be rewarded and monetized in order to overcome the typical early market challenges, producers and consumers need a verifiable framework that tracks and accounts for the renewable component of hydrogen. The CHBC has been communicating with the CertifHy[viii] efforts in the EU, which has recently undergone just such a framework development and would be a perfect resource to draw from.

Additional benefits

Hydrogen from renewable energy sources can furthermore provide for the deep decarbonization not only of the electricity sector, but the transportation sector as well. Renewable hydrogen can replace diesel and gasoline combustion in passenger vehicles, medium and heavy duty long haul trucks, trains, and eventually shipping and aerospace as well, all with zero tailpipe emissions.



Schematic of the Role of Hydrogen to Achieve Deep Decarbonization - Hydrogen Council

More recently, Germany has started to endorse the concept of Power-to-Liquids, in which renewable electricity can be used to produce hydrogen to create synthetic fuels and chemicals currently relying on fossil fuels.

All of these benefits should be considered when discussing flexibility in California's grid.

Conclusion

The CHBC respectfully asks the involved agencies to look at hydrogen energy storage and power-to-gas as a key component for the development of a resilient, high-penetration renewable electric grid in California, while also realizing a number of additional benefits for the environment and the economy for comparatively low cost. Implementing several projects in the near term of a proven energy technology that is equally safe as other energy technologies will help in achieving the goals the Governor, the legislature and the agencies have called for. The CHBC stands ready to lend a hand and be a part of that transition to a zero-carbon economy.

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[i] 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 oil. 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 Air Liquide Advanced Technologies U.S. LLC., Alameda-Contra Costa Transt District (AC Transit), American Honda Motor Co., Inc., Bay Area Air Quality Management District (BAAQMD), Ballard Power Systems Inc., Beijing SinoHytec, BMW of North America LLC, California FuelCell Partnership, California Air Resources Board, CALSTART, Cambridge LCF Group, Center for

Transportation and the Environment, China Hydrogen Fuel Cell Corporation, Coalition for Clean Air, Community Environmental Services, E4 Strategic Solutions, ElDorado National – California, Energy Independence Now, Ergostech Renewal Energy Solution, First Element Fuel Inc, FuelCell Energy, Inc., General Motors Corporation, Giner, Inc., GNA, Golden State EPC, Greenlight Innovation, GTA, Inc., GTM Technologies Inc., H2B2, H2Safe, LLC, H2SG Energy Pte Ltd, H2Tech Systems, Horizon Fuel Cells Americas, Inc., Hydrogenics Corporation, Hydrogenious Technologies, HydrogenXT, Hyundai Motor Company & Kia Motors Corp, i-2-m, ICS, Idaho National Laboratory, Intelligent Energy, IRD Fuel Cells LLC, ITM Power Inc, Ivys Inc., Johnson Matthey Fuel Cells, Lilium Energy Inc, Linde North America, Inc., Longitude 122 West, Inc., Loop Energy, McPhy Energy, MPL Consulting, Inc., National Renewable Energy Laboratory – NREL, Nel Hydrogen, New Flyer of America Inc, Next Hydrogen Corporation, Noyes Law Corporation, Nuvera Fuel Cells, Pacific Gas and Electric Company - PG&E, Paramount Energy West LLC, PDC Machines, Inc., Plug Power, Port of Long Beach, Power Planet, PowerHouse Energy, Powertech Labs, Inc., Proton OnSite, Ramco Consulting Company Inc, Rio Hondo College, Sacramento Municipal Utility District (SMUD), SAFCell Inc, Schatz Energy Research Center, Solar Hydrogen System, South Coast Air Quality Management District, Sumitomo Corporation of Americas, SunLine Transit Agency, Tatsuno North America Inc., Terrella Energy Systems Ltd, Toyota Motor North America Inc., Advanced Power and Energy Program - UC Irvine, United Hydrogen Group Inc, US Hybrid Corporation, WireTough Cylinders, LLC, Zero Carbon Energy Solutions, Ztek Corporation.

[ii] https://californiahydrogen.org/sites/default/files/CHBC%20Hydrogen%20Energy%20Storage%20White%20Paper%20FINAL.pdf

[iii] https://www.hydrogen.energy.gov/pdfs/12014_current_us_hydrogen_production.pdf

[iv] https://energy.gov/eere/fuelcells/hydrogen-pipelines

[v] https://phmsa.dot.gov/portal/site/PHMSA/menuitem.6f23687cf7b00b0f22e4c6962d9c8789/?vgnextoid=a62924cc45ea4110VgnVCM1000009ed07898RCRD&vgnextchannel=daa52186536b8210VgnVCM1000001ecb7898RCRD&vgnextfmt=print#QA_5

[vi] 47. at page 56 in: European Commission: Directive on common rules for the internal market in electricity, 2016. Updated 02.23.17. http://ec.europa.eu/energy/sites/ener/files/documents/1_en_act_part1_v7_864.pdf

[vii] Details on projects available here: http://www.powertogas.info/english/

[viii] http://www.certifhy.eu/