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Comments by H2B2 USA LLC to hydrogen as renewable gas

Additional submitted attachment is included below.

RE: Comments by the California Hydrogen Business Council to Panel 5: Emerging Technologies and Market Opportunities

The following are comments by H2B2 USA LLC to the questions put forth by the Energy Commission to Panel 5: Emerging Technologies and Market Opportunities at the June 27 Joint Agency Workshop on Renewable Gas. At H2B2 USA LLC we appreciate the opportunity to include hydrogen in the discussion on recommendations on renewable gas. We strongly urge the Commission to consider the broad spectrum of renewable gases, including hydrogen, to keep the intent and language of Senate Bill 1383, which CHBC helped craft last year, and which specifically tasks the "energy commission, in consultation with the state board and the commission, (to) develop recommendations for the development and use of renewable gas." [Sec. 5, Section 39730.8 (b)].

How would you characterize the promise of your fuel/technology and what steps are required to achieve commercial availability?

Renewable hydrogen can very well be produced via electrolysis using the energy from renewable sources as wind, solar, geothermal, etc. Each of those available renewable sources of energy have different characteristics and therefore, to efficiently combine them to produce hydrogen, there can be different technical configurations. In any case, all those solutions are fully commercially functioning technologies readily available.

The hydrogen produced in the aforementioned way is 100% renewable, with no carbon footprint whatsoever. This hydrogen can be stored either at high or low pressures depending on its intended use. The technologies to compress and store hydrogen are all well-known technologies commercially available.

Additionally, hydrogen can be mixed in certain percentages with NG in existing pipelines for other storage and transport options. The % of hydrogen admitted in currently existing NG pipelines depends on the characteristics of those pipelines, normally being between 5% and 20%. Many countries are progressively upgrading their existing NG pipelines in order to withstand higher percentages of hydrogen. On top of that, thousands of miles of dedicated hydrogen pipelines are already in place in California and in the rest of the world. The technology is well known and poses minor technical challenges.

Finally, the stored hydrogen can be used in multiple ways. In order to use it to produce energy, the most typical solutions are either burn it in turbines/engines or mix it with oxygen to produce water and electricity in fuel cells.

- Standard engines/turbines can burn a mix of hydrogen and natural gas in different proportions and the process involves little or no technological challenges. The efficiency of those units fits within nowadays' standards.
- Turbines and engines to burn only hydrogen exist in different sizes and although their total hours of operation don't add up to the same numbers as those for burning just NG, still are well established solutions for cases below a few MW of power. Larger units are in development.
- Fuel cells can produce electricity from hydrogen, currently with efficiencies between 50% and 70%, roughly double of heat-based systems to produce energy can provide. The technology is commercially available for units of up to a few hundreds of kW and larger solutions are under development.

The only mayor requirement to make those technologies widely available, to produce energy from renewable hydrogen, is a market growth that can help scaling up manufacturing processes and therefore reduce prices. Additionally, to widen the range of applications of those solutions the following is desirable:

- **Policy Support -** As specified in response to Question 3 below.
- **Appropriate electricity pricing** - Access to wholesale markets and more aggressive retail rate structures would allow utilities and system operators to fully utilize electrolysis flexibility.
- **Support to enter new markets and maximize revenue opportunities -** e.g. Providing ancillary services, transportation fuels, electricity generation, building end uses, demand response.
- **Support for research and development –** As with any energy technology, R&D helps to improve efficiencies, build understanding of best applications and practices, and test new markets.
- **High penetrations of renewable electricity generation –** This will necessitate bulk seasonal storage, for which P2G is favorable because of its flexibility and scalability.

1. What challenges might interrupt development and commercialization of your fuel/technology for any of the following areas:

    a. Technology development

There are no mayor technological challenges for the deployment of the technology; however, some of the described applications like injecting hydrogen into the pipeline will require further data to assess the maximum percentages that different existing pipelines can accept.

b. Project location

Hydrogen production via electrolysis can be located at the source of the renewable energy source, thus saving grid transportation and distribution costs. Injection of this hydrogen into existing pipelines could be done at the production site if the pipeline is available. Electricity production via fuel cell can be done at the site and the electricity put into the grid.

A distinctive advantage of those systems is its flexibility not only in terms of location but also in terms of its smaller footprint and its capability to offer flexible solution to different energy power requirements. On top of that, the solution is easily scalable.

c. Pipeline injection

Pipeline injection is only one of many possible applications for hydrogen and one the possible solutions for storing and producing energy with hydrogen.

As detailed above, injection of hydrogen into existing NG pipelines is possible and safe in different proportions depending of each particular pipeline. The protocols nowadays establish ranges approximately between 5% and 20% (in volume). It is worth considering that even a very conservative 2% of hydrogen into a standard 24" pipeline represents over 500kg/h of hydrogen, that is equivalent to approx. 12MWh of energy (if used at a fuel cell).

d. Business models and project financing

Successful business models for hydrogen and power-to-gas technology, very much rely on the cost parameters, especially the cost of electricity. Therefore, despite the foreseeable success of future improvements on energy pricing tariffs to use electricity from the grid for P2G applications, nowadays the best alternative to proceed is by connecting the hydrogen production equipment (electrolyzers) to the renewable sources of energy in a "behind the meter" configuration.

e. Institutional/regulatory

The CPUC currently does not recognize P2G as an eligible storage resource, and it is unclear how P2G can competitively bid into this market if it is not recognized by the State.

Neither CAISO nor a DER market has the rate structure in place for P2G systems to take advantage of low cost or negative electricity rates or to receive compensation for providing grid services.

California's Energy Storage Roadmap, developed by the CEC, CPUC and CAISO, does not include renewable hydrogen based solutions, and all involved agencies have been slow to seriously

examine these solutions as a low-cost option for greater renewables integration and grid resiliency, despite the clear benefits to the electricity grid as well as to the emerging zero and near emission transportation setting with hydrogen fuel cells and other renewable hydrogen-based transportation fuels.

f. Demand and vehicle availability

N/A

g. Related infrastructure

As explained above.

2. What type of government action is required to support development and use of emerging fuels and technologies?

We believe that:

a. It is essential that state agencies ensure that hydrogen-based products remains part of the implementation of SB 1383, in which the legislature explicitly directed the Energy Commission to look at “renewable gas” - that both houses of the legislature and the Governor's office understood at the time of the bill’s passage to include agency consideration of electrolyzer-produced renewable hydrogen.
b. The CPUC ought to ensure that P2G facilities are eligible for appropriate (wholesale or at least more aggressive retail rate structures) electricity rates, as well as low T&D rates for fuel production and industrial process applications.
c. California ought to implement a renewable gas standard, requiring state investor owned utilities to procure at least 5% renewable gas by 2030.
d. California ought to consider mechanisms to allow for renewable attributes of hydrogen to be tracked and verified, especially in the context of P2G.

3. Can cost data be provided to the Energy Commission to support the cost-effectiveness and economic viability of your fuel/technology?

Yes.