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Power-to-Gas Enables a Green Gas Grid for California's Future

Additional submitted attachment is included below.

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March 9, 2020

California Energy Commission
1516 9th Street
Sacramento, CA 95814-5512

Docket: 19-SB-100

Re: SB 100 Joint Agency Report: Charting a Path to a 100% Clean Energy Future

Electrochaea GmbH (Electrochaea) appreciates the opportunity to submit the following comments to the California Energy Commission (CEC), California Public Utilities Commission (CPUC), and the California Air Resources Board (CARB), (collectively, the Joint Agencies) on the February 24, 2020 Senate Bill 100 Modeling Inputs and Assumptions Workshop.

Background on Electrochaea

Electrochaea has developed a grid-scale energy storage solution. The proprietary power-to-gas process converts renewable energy and biogenic carbon dioxide into grid-quality renewable methane for storage and distribution. Operating plants have been injecting renewable methane into commercial gas grids in Switzerland and Denmark. Over the last year, Electrochaea has been actively exploring potential projects to serve the California market and we believe that our biomethanation technology can play a substantial role in meeting the Renewable Portfolio Standard (RPS) targets and related climate goals of the State of California.

Electrochaea's technology based on biological methanation makes it possible to store renewable energy and recycle CO_2 in a cost-effective way. This technology eliminates the temporal link between energy supply and demand, allowing efficient energy and CO_2 storage as renewable methane. When renewable power is available but not immediately used (such as through routinely experienced curtailments across the State), renewable methane can be generated "on demand" and stored in the gas grid. This enables the growing market for renewable electric power, providing an expanding source of renewable gas. The more intermittent renewable energy generated, the more valuable this technology becomes.

The core of our power-to-gas system is a selectively evolved microorganism – a methanogenic archaea – that excels through unprecedented catalytic ability and industrial robustness. The technical advantages of this biocatalyst enable our BioCat methanation technology to operate at lower capital and operating costs and with greater flexibility than conventional thermochemical methanation processes.

Electrochaea is a dynamic growth-stage company with headquarters, engineering and development teams in Munich, Germany, and commercial scale demonstration facilities in Denmark

and Switzerland, and a research reactor in Golden, CO at NREL (the NREL reactor was supported by a grant from SoCalGas). The Electrochaea story started in the year 2006 with basic research and four years of proof-of-concept work in Prof. Laurens Mets' laboratory at the University of Chicago. De-risking of the process for commercialization began in 2011, using raw biogas to produce methane at a brewery digester in St. Louis, MO, and continued with field trials in Foulum, Denmark. In 2016, an industrial scale plant was commissioned in Avedore, Denmark at a wastewater treatment plant. The methanation plant has been in intermittent operation for 3.5 years, with 4,500 total operating hours. Grid quality methane (>97% methane) is produced by the self-sustaining biocatalyst, and has been injected onto the Danish gas grid. This gas meets Rule 30 specifications for injection into the gas grid in Southern California. A second-generation plant, with automated remote operation, was commissioned in 2019 in Switzerland, and was injecting high quality methane onto the gas grid within 96 hours of startup. The plant has produced methane for more than 1,300 hours since July 2019.

Both plants have demonstrated flexible operation with immediate recovery after different periods of shutdown. This flexibility is important to accept intermittent renewable power, when it is available. Load factor tests have shown that the Electrochaea power-to-gas system can be operated at 0-100% capacity. The Electrochaea power-to-gas technology captures would-be curtailed electricity into methane for immediate use or for storage and use at a later time.

Electrochaea is expanding its network of partners throughout the West Coast of the United States, holding informational meetings with various regulators and actively engaging with new business partners in California and Oregon.

Comments

Three main points:

1. **The gas grid is essential to maintain the stability and reliability of the power grid now and during the transition to an integrated energy system that meets 2045 climate goals – but the gas composition needs to change.**
2. **Converting the gas grid to renewable gas leverages existing assets and markets to provide economic benefits to our economy while enabling the energy transition to renewable power.**
3. **Embracing renewable natural gas as a means of renewable energy storage and distribution is well aligned with existing State goals and initiatives.**

Electrochaea is concerned by the proposed prohibition on any combustion as part of the path forward to meeting SB 100's directives. Such a wide-sweeping ban excludes many new, innovative and demonstrated technologies that may provide creative and necessary solutions to reliability issues posed by intermittent resources, while maintaining zero-carbon status.

We think it is important to remember that, not so long ago, the power grid was more carbon intensive than the gas grid, and the gas grid was a major contributor to reducing the carbon index of our power grid by displacing coal as a power generation fuel. The power grid is only as green as the power we put into it. The gas grid is exactly the same. We can deliberately lower the carbon intensity of the gas grid by displacing fossil gas with renewable gas with zero-carbon status, and continue to use our largest and most reliable energy distribution and storage system to meet our climate goals.

As other commenters at the Workshop noted, it is critical to be inclusive at this stage of SB 100 policy development to ensure the future portfolio of resources can be optimized for reliability issues. None of the agency presenters discussed a role for renewable natural gas (RNG) and Electrochaea believes this is a major oversight for the future of California.

RNG and, more specifically, power-to-gas technologies provide reliability benefits to the grid. As the CAISO presented, maintaining the gas transmission system for ramping needs is critical. The recently projected load ramps, in excess of 25,000 MW by 2030, are unlikely to be met by renewables alone. Increasing the intermittent renewable resources on the grid will exacerbate not only the ramping needs in the afternoon, but also the intermittency and curtailment issues we see throughout the day. The loss of renewable production for even short periods of time, due to weather conditions alone, could jeopardize the California power grid in the absence of reliable, proven generations assets.

While existing natural gas resources are coming offline due to economic concerns, RNG may provide a cost-effective solution to meeting these reliability needs utilizing the existing infrastructure. The gas grid can become a valuable green resource, similar to the way the power grid has become increasingly green. There may actually be a synergy in coupling the renewable power sector with renewable gas. By providing a buyer for economically curtailed power, we would simultaneously enable production of low-cost renewable gas and recover lost revenues for the power sector. This power-to-gas process can provide a perpetually sustainable and renewable fuel for the gas grid and stabilize economic returns for the developers of renewable power generation.

Critically, power-to-gas adds an additional advantage of providing seasonal storage of renewable energy. Electrochaea's model is premised on utilizing intermittent renewable generation at times of peak production, often when this generation is curtailed for market reasons, in order to store that clean energy for use at another time. Analogous in many ways to pumped hydro or other forms of gravity-based storage, Electrochaea's technology is able to convert wasted generation from other sources into RNG for much later future use. In this way, the existing gas grid becomes California's largest battery, storing renewable energy for use later in the day, month, or even year.

Unlike traditional battery technologies, the 'state of charge' of the gas grid is effectively insensitive to a charge/discharge cycle. Last year the State surrendered 965 MWh of renewable power to curtailment. California's gas grid could easily accommodate the renewable gas produced from this power. The gas grid would essentially never be full and would not degrade its state of

charge during storage. Unlike the owner of a lithium ion battery, the gas grid operator would never be compelled to discharge at the first or best time to empty the battery to prepare for its next economic charge cycle. With sufficient "charging" power-to-gas assets in place, it is unlikely we would ever find the gas grid empty. This reliable reservoir of low carbon fuel would provide the power sector with a renewable resource adequacy asset it desperately needs and enable continued use of our fleet of generation assets to produce low carbon electricity.

Using existing infrastructure also further reduces capital investment and land use concerns. Given the intermittency and ramping problems associated with renewable generation, such as solar, a huge amount of geographically diverse land will be needed for these purposes if California is to meet its zero-carbon goals utilizing these resources. While Electrochaea fully supports a rapid increase in the penetration of renewables, our mission is to better utilize the otherwise curtailed power, thus ensuring that the siting of solar and other facilities is responsive to competing land use needs. Co-located power-to-gas and generation facilities are likely to reduce the air pollutants, SO_2, NOx and VOCs, emitted at the landfills, since the power-to-gas process includes gas polishing methods that will serve to improve the air quality in nearby disadvantaged communities.

Although the wholesale cost of VRE (variable renewable energy) is going down, the retail price is increasing. This reflects the larger cost in providing renewable energy to the customer of transmission and distribution, reliability and balancing of electricity availability, maintenance, and taxes. The expansion of RNG use for the generation of firm renewable electricity production can reduce the need for expansion of the transmission infrastructure and can play a significant role in providing reliability using existing infrastructure. The use of renewable gas in firm plants produced by power-to-gas technology will reduce curtailment of VRE, allow RNG to be used for ramping, and decrease the need for expensive and inadequate battery storage methods. The use of biogenic CO_2 in the power-to-gas process may also enable the penetration of 100% zero-carbon electricity by 2045, as expensive carbon capture technologies have not yet been commercialized.

The RNG produced by power-to-gas and other technologies will initially cost more than our current natural gas. Like wind and solar and other nascent technologies, the cost of assets and the gas product will decrease with market growth. In the interim, the higher value of this fuel will provide additional impetus to tighten the gas grid and improve stewardship over the current gas to power infrastructure to meet climate goals and prevent economic losses to rate paying customers.

One remaining challenge for implementation of power-to-gas in California is for the appropriate regulatory and policy bodies to evaluate and model the use of the gas grid as a battery, to be able to effectively track and predict the renewable gas production and storage "charging" cycles, and to combine this with the known "discharge" cycle from the combustion assets that will serve the power grid with renewable gas. Standards of conformity for response times, charging and discharging ramp rates, power capacities and the like would be critical to allow markets to value gas grid battery services, and enable participants to design and provide cost estimates for capital to deploy power-to-gas assets. Financial markets will increasingly price in significant risk for power-

to-gas projects in the absence of clear guidance for performance standards and commensurate value recognition.

Moreover, solutions for decarbonization must take a multi-sector approach if California is to meet our aggressive and necessary goals in a short timeframe and in a cost-effective way that protects ratepayers. The biomethanation process is compatible with any anaerobic digestion gas, from which it can double the production of RNG, including anaerobic digestion gas from projects focused on organic waste diversion from landfills. As such, Electrochaea supports comments made in reference to SB 1383 that reminded the Workshop participants that California also has a mandate to reduce organic waste in landfills. Our technology enables that waste to provide a sustainable renewable energy source for California's power grid and its transportation sector.

The role for RNG must be preserved as a solution to serious emissions issues in other sectors. By partnering with existing sources of emissions, power-to-gas technology can serve to recycle these emissions into a new source of renewable fuel for the gas grid.

We respectfully suggest that evaluating scenarios for enabling a green gas grid will provide a useful comparison to the current model for eliminating the gas grid as we strive to reach our climate goals, preserve our physical environment and grow a sustainable economy.

Electrochaea looks forward to further participation in this proceeding and we thank the Joint Agencies for their consideration of these comments.

Respectfully Submitted,

Mich Hein
Resident, Oceanside, CA, and
CEO, Electrochaea GmbH