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Re: Docket No. AR 632
Renewable Natural Gas Program Rulemaking 2019 SB 98

Electrochaea appreciates the opportunity to submit the following comments to the Oregon Public Utility Commission (PUC) on the Renewable Natural Gas Program Rulemaking for SB 98 (2019). Electrochaea strongly supports Oregon's efforts and incentives to increase the percentage of RNG available for distribution to retail customers, thus supporting State and global climate goals.

A. BACKGROUND ON ELECTROCHAEA

Electrochaea has developed an industrial-scale solution for the production of grid-quality renewable methane which can replace any use of fossil natural gas. The proprietary power-to-gas process converts renewable energy and biogenic carbon dioxide into grid-quality renewable methane (RNG). This technology, called biomethanation, takes hydrogen produced using renewable power and combines it with carbon dioxide (CO_2) to produce methane, effectively storing the renewable electrical energy in the chemical bonds of the methane. Operating plants have been injecting renewable methane into commercial gas grids in Switzerland and Denmark. Electrochaea is actively exploring potential projects to serve the Oregon and Pacific Northwest markets and we believe that our biomethanation technology can play a substantial role in meeting the climate goals of the State of Oregon.

Electrochaea's biomethanation technology makes it possible to store renewable energy and recycle CO_2 in a cost-effective way. 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 methanation technology to operate at lower capital and operating costs and with greater flexibility than conventional thermochemical methanation processes. 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 otherwise-curtailed electricity into methane for immediate use or for storage and use at a later time.

This technology eliminates the temporal link between energy supply and demand, allowing efficient energy and CO_2 storage as renewable methane. When renewable electrical power is available but not immediately needed, 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. Limitations on realizing the full potential of renewable energy production include (a) intermittency (for solar and wind), (b) natural resource requirements (in the case of protected/endangered species requiring certain water flows (as such, impacting

hydroelectric) and (c) economic curtailment (a risk for all renewables). As such, technologies that enable maximized generation of renewable energy when possible and storage of that energy for future use are an increasingly valuable tool for achievement of climate goals.

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 near Copenhagen, 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. 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.

B. GENERAL COMMENTS IN FAVOR OF INCREASING THE PERCENTAGE OF RNG IN THE GAS GRID

1. Converting the gas grid to renewable gas leverages existing assets and markets to provide economic benefits to the economy while enabling the energy transition to renewable power.

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 low-carbon status, and continue to use our largest and most reliable energy distribution and storage system, the gas grid to meet our climate goals. Using existing infrastructure further reduces capital investment and land use concerns. We applaud the Oregon Legislature and the Oregon Public Utility Commission's efforts in recognizing the benefits of RNG.

2. Embracing renewable natural gas as a means of renewable energy storage and distribution is well aligned with climate goals.

Critically, a major advantage of power-to-gas is storage of renewable energy. Electrochaea's model benefits from utilization of intermittent or otherwise-curtailed 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 the largest available 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. 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" of gas assets already in place, it is unlikely we would ever find the gas grid empty. After all, the existing power generation assets and gas storage infrastructure provide ready-made capacity to utilize renewable natural gas instead of fossil gas to generate low-carbon electricity.

At the same time, power-to-gas is 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. Electrochaea's power-to-gas technology can be combined with any biogas source, or any carbon dioxide source.

3. RNG is a cost-effective solution to integrating the renewable energy sectors of our economy

While existing fossil 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. Moreover, there is an additional economic 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.

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, reflective of transmission and distribution costs, reliability and balancing of electricity availability, maintenance and grid hardening, 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 produced by power-to-gas technology in existing baseline resources or firm capacity plants will reduce curtailment of VRE, allow RNG to be used for ramping, and decrease the need for expensive and inadequate battery storage methods.

The RNG produced by power-to-gas and other technologies will initially cost more than fossil 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. Moreover, given the uncertainty in supply chains and other unexpected consequences of the recent pandemic, utilizing existing assets can provide a quicker route to meeting climate goals.

C. SPECIFIC COMMENTS ON THE RULEMAKING DOCUMENT

1. Comment on 860-150-0005

The renewable gas program supports investment in new technologies that provide essential support for Oregon to achieve its portfolio targets outlined in Section 4 of 2019 SB98. The enablement of these incentives combined with the capabilities of utility companies, technology providers and the PUC represent an important achievement for Oregon. Given the many novel aspects of this program, it would be prudent for the PUC to anticipate and welcome requests for exceptions of treatments that may differ from the letter of the rule, though not from the intent.

The program will promote and increase the availability of RNG to retail customers having a significant positive impact on the clean energy future of Oregon. The rules appropriately provide no limits on the value of RNG by sector. While transportation has been the focus of California regulations, the potential impact of RNG in achieving Oregon's climate goals dictates that the rules for SB98 should be inclusive of all sectors.

The role for RNG must be preserved as a solution to serious emissions issues in all economic 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. Moreover, solutions for decarbonization must take a multi-sector approach to meet 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 and the RNG is compatible with any current use of fossil natural gas from residential water heaters, to industrial boilers, and gas-fired peaker plants.

2. Comment on 860-150-0050

While the rulemaking acknowledges alternative approaches for calculation of carbon indices (CI), certain of these methodologies may include unanticipated disincentives. For example, the California Air Resources Board (CARB) calculations dictate the use of year-ago CI levels, rather than incenting and rewarding projects to leverage sourcing relationships that may be dramatically more favorable now than a year previous. The PUC should welcome applications that recognize and seek support for such favorable project designs.

Similarly, the requirement for using M-RETS (with potential for exceptions granted by the PUC) should be relaxed and allow for utilities to use comparable systems or mechanisms that meet the standards of M-RETS.

3. Comment on 860-150-0100

The production of RNG may involve collaboration among utilities, biogas sources (e.g, landfills, waste-water treatment plants, dairy/swine farm), CO_2 sources (e.g, breweries, cement producers), and novel technology/equipment providers. As such, the recovery of a utility's costs should be inclusive of purchased services, licensed technologies, and other considerations outside the traditional scope of utility cost structures.

A utility's Integrated Resource Plan (IRP) may identify strategies and specific tactics for achievement of climate goals and compliance with SB98. With the rapidly emerging range of technologies for RNG, the PUC is encouraged to recognize that utilities may consider investment opportunities that may arise subsequent to the filing of an IRP. Such opportunities may not have been specified in an IRP, though may be squarely consistent with the utility's intentions and the goals of SB98.

4. Comment on 860-150-0500

Substantial Research & Development investments in RNG have enabled a range of new technologies, equipment, and processes that may contribute to the achievement of Oregon's climate goals. In the case of a utility considering the use of proprietary technologies, traditional competitive bidding for commodity or undifferentiated services may be inappropriate. In such cases, utilities should be permitted to consider the totality of costs and benefits associated with alternative providers of technologies, equipment, and processes for RNG production, storage, and delivery.

The above implication for competitive bidding is not intended to relieve utilities from competitive bidding for any elements of a project traditionally suited for such.

Respectfully Submitted,

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