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Re: Canada Gazette, Part 1, Volume 154, Number 51. December 19, 2020. Clean Fuel Regulations

Electrochaea appreciates the opportunity to submit the following comments to the Department of the Environment regarding the proposed Clean Fuel Regulations ("Regulations"). Electrochaea strongly supports the implementation of regulations that will significantly decrease Canada's greenhouse gas emissions to achieve the goal of net-zero emissions by 2050. To achieve these goals, a multi-faceted approach must be taken across both liquid and gaseous fuels. This approach should support emerging technologies that have reached commercial readiness but have both low adoption rates and a lack of existing policy incentives, as their potential impact has not been recognized. Similarly, policies that address cross-benefits in multiple sectors will be increasingly critical to decarbonize in a cost effective way. As such, it is important that the Clean Fuel Regulations support emerging technologies with potential contributions to achievement of Canada's goals through implementation of regulations (e.g., fuel definitions and carbon-intensity ("CI") calculation methods) that are agnostic to any particular technology. The credit generation compliance categories are an important step in ensuring this qualification flexibility. In these comments we provide specific recommendations to the definitions included in the Regulations in order to realize additional, critical flexibility.

A. BACKGROUND ON ELECTROCHAEA

Electrochaea has developed an industrial-scale solution for the production of grid-quality renewable natural gas that can replace any use of fossil natural gas. The proprietary power-to-gas process converts renewable energy and carbon dioxide (CO_2) into grid-quality methane. This technology, called biomethanation, takes hydrogen produced using renewable power and combines it with CO_2 to produce methane, effectively storing the renewable electrical energy in the chemical bonds of the methane. Electrochaea biomethanation plants have injected renewable natural gas into commercial gas grids in Switzerland and Denmark. Electrochaea is actively exploring potential projects to serve the Canadian market and we believe that our biomethanation technology can play a substantial role in lowering greenhouse gas emissions and meeting renewable natural gas blending

targets across the country. We are optimistic that regulations and market drivers will continue to evolve in support of renewable natural gas and our biomethanation technology.

Additionally, 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. Our biomethanation 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.

The power-to-gas technology eliminates the temporal link between energy supply and demand, allowing efficient energy and CO_2 storage as renewable natural gas. When renewable electrical power is available, but not immediately needed, renewable natural gas can be generated and stored in the gas grid. This enables the growing market for renewable electric power, providing an expanding source of renewable natural gas. Curtailment is a major lost opportunity for renewable energy production, whether solar, wind, or hydroelectric that can be [captured/mitigated] with power-to-gas technology. The Electrochaea power-to-gas technology captures otherwise-curtailed electricity into renewable natural gas for immediate use or for storage and use at a later time.

Electrochaea is a dynamic growth-stage company with headquarters, engineering and development teams in Munich, Germany, and a subsidiary, Electrochaea Corporation in the USA. 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 biomethanation 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.

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.

Just as the carbon index of the power grid is increasingly reduced, we can deliberately lower the carbon intensity of the gas grid by displacing fossil gas with renewable natural 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.

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

With new technologies and policy drivers that recognize cross-sector benefits, we can utilize an intertwined gas grid, electric grid, and transportation sector to further drive carbon intensity reductions. Critically, a major advantage of power-to-gas is storage of renewable energy. Electrochaea's technology benefits from utilization of intermittent or otherwise-curtailed renewable electricity 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 otherwise wasted power into renewable natural gas for much 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. 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.

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.

C. SPECIFIC COMMENTS ON THE CANADA GAZETTE, PART 1, VOLUME 154, NUMBER 51. DECEMBER 19, 2020. PROPOSED CLEAN FUEL REGULATIONS

1. **The compliance credit-based program has considerable opportunity to incent new technologies to be adopted in Canada.**

By focusing on achievement of policy goals, and not limiting the technology that could be used to achieve the goals, the Clean Fuel Regulations will be the first step towards achieving the 2050 climate goals. The credits-based program is a straightforward way to stimulate investments in renewable natural gas projects. The regulations should focus on achievement of goals, while avoiding overly proscriptive paths to doing so. For example, recognition of hydrogen's potential towards climate goals should not stop with using hydrogen as an end product. Hydrogen can also be used to further support the production of other low carbon intensity fuels, such as renewable natural gas synthesized using power-to-gas technologies.

Electrochaea encourages the Department of the Environment to take advantage of multiple opportunities to incent the development of low carbon intensity fuels. The flexibility in Compliance Category 1, while still limiting the creation of credits, is important to increase the production of new low carbon fuels, allowing for the reduced use of fossil fuels. The creation of advanced renewable fuels under Compliance Class 2 may also promote further end-use switching in transportation covered under Compliance Category 3, such as in the adoption of vehicles powered by renewable natural gas.

2. **Support emerging technologies by developing guidelines and definitions that do not limit the technology.**

Fuels that meet the carbon intensity guidelines (whether anticipated and specified or not) should qualify in the Clean Fuel Regulations. One such example of a low carbon intensity fuel is the gas made during the power-to-gas process. The definitions of substances, such as renewable natural gas, should be dependent upon the renewable nature of the gas rather than the process or feedstock that was used to obtain the gas. The definition of renewable natural gas in the proposed regulations is:

> **Current definition:** *Renewable natural gas (gaz naturel renouvelable) means gas that meets the standard for injection into the closest natural gas pipeline and that is either synthetic natural gas from biomass or derived from processing biogas.*

The definition unnecessarily defines the feedstock of the renewable natural gas that can be used to replace fossil-derived natural gas. Renewable natural gas, produced by Electrochaea's biomethanation technology, can be synthesized from a variety of renewable feedstocks and still meet the standard for injection in the gas grid with a lower CI than the baseline for non-renewable natural gas. We suggest that the definition be replaced by the following, which will allow a wider range of renewable gases to be called renewable natural gas.

Proposed definition: *Renewable natural gas means gas that meets the standard for injection into the closest natural gas pipeline that is synthesized using renewable resources or derived using renewable resources and resulting in a gas which can be classified as a low carbon intensity fuel.*

3. **Support emerging technologies such as power-to-gas and biomethanation by allowing quantification of CI through the generic default mechanism.**

The CI calculation should allow determination of CI for new processes, including known processes that may not have operational data/experience in Canada. Fuels produced using power-to-gas that meet the standards for "renewability" should qualify with their computed CIs. It is unclear in Section 30 (1) if a commercially-ready emerging technology that has low adoption would be allowed to use the generic method outlined in Section 62.

In addition, wording in the Schedule 5 (4) does not clearly describe the CI to be used for hydrogen produced by electrolysis using electricity with a CI between 0 g/MJ and 50 g/MJ.

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Thank you for this opportunity to participate in the process for development of the Clean Fuel Regulations. We look forward to contributing to Canada's achievement of its net-zero emissions goals.

Respectfully Submitted,

Mich Hein
CEO, Electrochaea