DOCKETED	
Docket Number:	21-IEPR-01
Project Title:	General Scope
TN #:	241324
Document Title:	Electrochaea Corporation Comments - on Draft 2021 Integrated Energy Policy Report, Vol III Decarbonizing the State's Gas System
Description:	N/A
Filer:	System
Organization:	Electrochaea Corporation
Submitter Role:	Public
Submission Date:	1/28/2022 2:45:41 PM
Docketed Date:	1/28/2022

Comment Received From: Electrochaea Corporation
Submitted On: 1/28/2022
Docket Number: 21-IEPR-01

Comments on Draft 2021 Integrated Energy Policy Report, Vol III Decarbonizing the Stateâ€™s Gas System

Additional submitted attachment is included below.

Electrochaea Corporation • 500 Capitol Mall • Suite 1900 • Sacramento, CA 95814

January 28, 2022

The Honorable J. Andrew McAllister, Lead Commissioner
California Energy Commission
715 P Street
Sacramento, CA 95814

Re: Docket No. 21-IEPR-01
Draft 2021 Integrated Energy Policy Report, Vol. III: Decarbonizing the State's Gas System

Dear Commissioner McAllister:

Electrochaea Corporation (Electrochaea) appreciates the opportunity to submit comments on the Draft 2021 Integrated Energy Policy Report, Volume III: Decarbonizing the State's Gas System ("Draft 2021 IERP").

Electrochaea is the provider of an industrial-scale technology for production of grid-quality renewable methane using our power-to-gas biomethanation technology, which is a power-to-methane process. Using a microorganism (an Archaea), CO_2 and green hydrogen are combined to produce a renewable methane, which can replace fossil natural gas in any application and with existing infrastructure. As one of the many solutions with significant potential to achieve California's climate goals, this power-to-gas solution for the production of renewable gas should be recognized in the Draft 2021 IERP. In this comment, Electrochaea requests two corrections; (1) to remove an unsubstantiated comment about the cost of green methane and (2) to indicate that archaea and bacteria produce biogas in landfills. Electrochaea also requests additions to the 2021 IERP to indicate the potential of power-to-methane in the production of renewable gas, the storage of renewable energy, and the elimination of unnecessary GHG emissions.

I. Requested corrections

a. *A correction is requested on page 78 to remove an unsubstantiated remark about the cost of green methane.*

In the section on the Future of Renewable Hydrogen in California (pg. 66-78), a discussion is presented about the benefits of "green" hydrogen and the barriers to its widespread use and adoption as a renewable fuel. On page 78, it is noted that green hydrogen can also be used to produce renewable methane using the power-to-gas biomethanation process that Electrochaea uses, with a footnote about the cost of that process. The footnote references a PowerPoint presentation[1] given by Mike Petouhoff that does not support the assertion about costs of the synthesis of methane from hydrogen and carbon dioxide. Electrochaea requests that the clause, as crossed out below, be removed from the final 2021 IERP, Vol. III document.

> An alternative process can convert green hydrogen and CO_2 to green methane and water, which can be transmitted in fossil gas pipelines and used in the same way as fossil gas. No modifications to fossil gas pipelines or other infrastructure would be necessary; ~~however, the cost of creating the green hydrogen and then reconverting it into green methane could be cost-prohibitive~~.[134]

b. *A correction is requested on page 58 regarding the specified microorganisms that generate landfill gas.*

On page 58, it is stated that "Landfill gas is biogas produced by anaerobic bacteria that exist naturally in solid waste landfills". While bacteria are involved in the production of biogas, other microorganisms called archaea are also involved in the process. There is a common misconception that all the methanogenic organisms that produce biogas are bacteria, but some

[1] Footnote 134 in the Draft 2021 IERP, Vol.III was used to reference the cost of a power-to-gas process. The presentation refers to a chemical methanation plant in Germany, with no documentation on cost. Petouhoff, Mike. 2021. "Introduction of EPIC Initiative The Role of Green Hydrogen in a Decarbonized CA - A Roadmap and Strategic Plan." Accessed July 28, 2021. https://efiling.energy.ca.gov/GetDocument.aspx?tn=239050&DocumentContentId=7248

of the organisms involved in biogas production have been reclassified into a unique domain of organisms called archaea[2]. The sentence should be corrected as below.

> Landfill gas is biogas produced by anaerobic ~~bacteria~~ **microorganisms** that exist naturally in solid waste landfills.

II. Requested additions

a. *An addition is requested on page 59 regarding methanation as relevant to renewable gas generation*

The section entitled Converting Biogas to Renewable Gas beginning on page 59, describes the process in which the methane is separated from the other components of biogas; biogas is typically 60% methane and 40% CO_2. Methods that are currently used in the field result in the release of the CO_2 present in the biogas. In this section of the IERP, it should be mentioned that there is an industrial scale process that can be used to convert the CO_2 into renewable methane using a methanogenic microorganism and green hydrogen. This method can increase the production of renewable gas by 70-100%, while eliminating the release of climate-damaging CO_2, and instead recycling the carbon into a low-carbon intensity fuel. Methanation can be completed by a chemical catalyst in the Sabatier process[3] or by a biological catalyst in the biomethanation process[4]. Both of these processes use the CO_2 in the production of methane instead of releasing it into the environment. When renewable electricity is used in the process, the resulting product is a renewable gas.

b. *An addition is requested on page 70 regarding the advantageous storage functionality of green methane.*

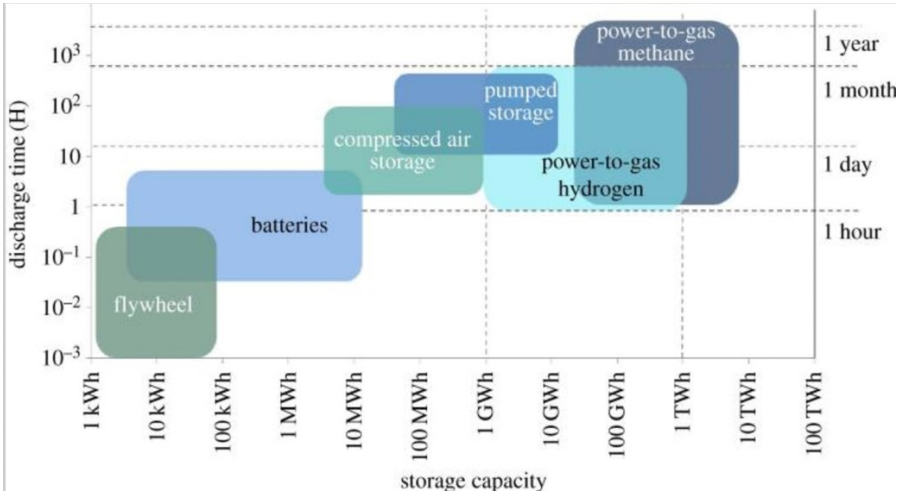
---

[2] "Towards a natural system of organisms: proposal for the domains Archaea, Bacteria, and Eucarya". C R Woese, O Kandler, M L Wheelis. Proceedings of the National Academy of Sciences, Jun 1990, 87 (12) 4576-4579; DOI: 10.1073/pnas.87.12.4576. For example, Krause et al. state: "Early studies describe methanogens as bacteria, but they have since been reclassified into a unique domain of prokaryotes known as Archaea". Max J. Krause, Giles W. Chickering, Timothy G. Townsend & Debra R. Reinhart (2016) "Critical review of the methane generation potential of municipal solid waste", Critical Reviews in Environmental Science and Technology, 46:13, 1117-1182, DOI: 10.1080/10643389.2016.1204812

[3] Kristian Stangeland, Dori Kalai, Hailong Li, Zhixin Yu, "CO_2 Methanation: The Effect of Catalysts and Reaction Conditions", Energy Procedia (105), 2017: 2022-2027. https://doi.org/10.1016/j.egypro.2017.03.577

[4] https://www.epa.gov/sites/default/files/2019-10/documents/harrison_rngworkshop_2019.pdf and https://www.greencarcongress.com/2020/10/20201021-p2g.html

Power-to-gas is first mentioned in the section entitled Grid Reliability on page 70. It is indicated that when electricity is stored in the hydrogen molecule in the power-to-gas process that "hydrogen has the potential to be more cost-effective as a long- duration storage medium than lithium-ion batteries and pumped hydroelectric facilities". It should also be mentioned that if green hydrogen is taken further with power-to-methane that there is even greater storage capacity and there are virtually no barriers to storage because the newly synthesized methane can be stored on the gas grid. The graph below published by the California Hydrogen Council demonstrates that power-to methane has an even greater storge capacity and discharge time than power-to-hydrogen[5].



c. *An addition is requested on page 141 to include reference to the potential role of renewable gas generated with CO_2 from industrial processes.*

In the section on the Role of Clean Fuels in Utility Gas Systems, three incentives are proposed to encourage the use of renewable gas. The Draft 2021 IERP, Vol. III highlights an important concept that the LCFS program should be expanded beyond transportation. Electrochaea strongly supports the following statement: "Consider modifications to the LCFS program so that renewable gas incentives that apply to transportation fuels are expanded to

[5] Philos Trans A Math Phys Eng Sci. 2017 Jul 28; 375(2098): 20160400.
First published in white paper: California Hydrogen Business Council. 2015. The case for hydrogen.

applications other than transportation, such as the industrial sector." Electrochaea also strongly supports the notion that incentives should be added for other feedstocks. However, listing the possible feedstocks may limit some ways that can be used to prevent GHG emissions. Electrochaea requests that the following phrase be added to the following on page 141:

> Evaluate other incentives for renewable gas production including from feedstocks beyond the primary feedstocks currently used, such as crop residue, ~~or~~ forest biomass, **or CO_2 captured from necessary industrial processes, such as fermentation, cement and steel production.**

Electrochaea appreciates the opportunity to participate in the evaluation of the Draft 2021 IERP, Vol. III, which is an important component of the State's strategy to combat climate change.

Sincerely,

/s/ Mich Hein

Mich Hein, CEO
Electrochaea Corporation
Mich.Hein@electrochaea.com