DOCKETED	
Docket Number:	19-MISC-03
Project Title:	The Natural Gas Infrastructure and Decarbonization Targets
TN #:	228815
Document Title:	Electrochaea Comments Response to Workshop on Natural Gas 19-MISC-03
Description:	N/A
Filer:	System
Organization:	Electrochaea
Submitter Role:	Public
Submission Date:	6/21/2019 10:31:09 AM
Docketed Date:	6/21/2019

Comment Received From: Electrochaea
Submitted On: 6/21/2019
Docket Number: 19-MISC-03

Response to Workshop on Natural Gas 19-MISC-03

Additional submitted attachment is included below.

Electrochaea GmbH • Semmelweisstr. 3 • 82152 PLANEGG • GERMANY

June 21, 2019

California Energy Commission
Docket Unit, MS-4
Re: Docket No. 19-MISC-03
1516 Ninth Street
Sacramento, CA 95814-5512

Re: Staff Workshop (Docket No. 19-MISC-03) "The Natural Gas Distribution Infrastructure and Decarbonization Targets"

Electrochaea appreciates the opportunity to submit these comments on the Staff Workshop (Docket No. 19-MISC-03) "The Natural Gas Distribution Infrastructure and Decarbonization Targets". Electrochaea supports a diverse and multifaceted approach to meeting California's aggressive goals to minimize climate change. All means of supporting the goal of carbon-neutral energy integration should be utilized. Transitioning an existing infrastructure, the natural gas grid, to a carbon-neutral energy infrastructure will enable a faster and greater degree of decarbonization in many, if not most, sectors of our economies and societies[1]. It is the unacknowledged solution to provide 100% renewable energy in the form of green electricity and renewable natural gas. We should not perceive them as two separate sectors, but as a complementary system in which one supports the other[2,3].

1. A multifaceted approach to carbon neutrality in California is the best way to meet the state's 2050 GHG emission goals.

California's goals to reach statewide GHG emissions 80% below 1990 levels[4] will require a multitude of activities in all sectors of the state's economy. The state should take advantage of all possible methods and not restrict the use of a means, such as renewable biomethane and renewable natural gas, that can be used to advantage to assist in the achievement of the California's goals. Adding power choices reduces cost and risk[3,5].

[1] H Blanco, W Nijs, J Ruf, A Faaij (2018) "Potential of Power-to-Methane in the EU Energy Transition
[2] M Lambert (2018) Power-to-Gas: Linking Electricity and Gas in a Decarbonising World? Oxford Energy Insight: 39, The Oxford Institute for Energy Studies.
[3] http://news.mit.edu/2018/adding-power-choices-reduces-cost-risk-carbon-free-electricity-0906
[4] Initiated with Executive Order S-3-05 from California Governor A. Schwarzenegger, June 1, 2005 and most recently with the published strategy California's 2017 Climate Change Scoping Plan by the California Air Resources Board.
[5] https://www.nytimes.com/2019/01/17/opinion/green-new-deal-climate-change.html

Renewable biomethane, produced by biomethanation of renewable hydrogen and biogenic sources of carbon dioxide, should be included in the approach. Electricity generated from renewable biomethane combined with wind and solar generated electricity is a solution that can be used to balance and secure the state's supply of electricity. In the 2018 E3 report[6], and the presentation given at the Staff Workshop on June 6, 2019[7], this synergism has not been given enough consideration. Interestingly, in an earlier E3 report[8], a high electrification scenario and a mixed electrification and decarbonized gas scenario are compared, in which it is concluded that both scenarios can meet California's goals at a similar cost, yet the mixed scenario may be easier to implement. The mixed scenario is cited in having advantages because (1) some practices are difficult to electrify, (2) the storage aspect of gas is beneficial for daily and long-term seasonal load balancing, (3) an existing infrastructure is used, avoiding the high cost of additional transmission lines, and (4) risk is diversified. E3 concludes that a promising pathway to a green California includes a diverse use of technology including electrification and decarbonized gas[8]. It is unclear why a different conclusion was promoted at the June 6, 2019 workshop.

More attention should also be given to planning how California can decrease emissions in other sectors of the economy[9]. For example, in California GHG emissions from transportation are at least 39% of the state's total emissions. "Business as usual" is predicted to double these emissions by 2030[9]. Renewable low-carbon intensity natural gas can assist in the solution to this problem. Compressed or liquid renewable natural gas, derived from biogenic sources of CO_2, are gaining acceptance especially in the refuse business and in public transportation[10]. RNG is a beneficial component of California's goal to significantly decrease GHG emissions in the transportation sector[11].

2. RNG can enable a greater penetration of renewable electricity generation at a lower cost.

As the use of variable renewable energy (VRE) sources of carbon-neutral electricity (wind and solar) get closer to 100%, the problems and challenges associated with the variable nature of wind and solar

[6] Final Project Report CEC-500-2018-012 "Deep Decarbonization in a High Renewable Future" prepared by Energy and Environmental Economics, Inc.
[7] Presentation for CEC Staff Workshop PIER-16-011 entitled "Draft Results: Future of Natural Gas Distribution in California", by E3 and UCI.
[8] "Decarbonizing Pipeline Gas to Help Meet California's 2050 Greenhouse Gas Reduction Goal" (2014) Energy and Environmental Economics, www.ethree.com
[9] "Pathways for Deep Decarbonization in California" prepared by Energy Futures Initiative, May 2019, www.energyfuturesinitiative.org
[10] http://biomassmagazine.com/articles/15967/california-refuse-vehicles-go-full-circle-with-redeem-rng
[11] AM Jaffe (2016) The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute, Contract No. 13-307, STEPS Program, UC Davis.

increase nonlinearly[12,13]. The problems include the cost and the predicted curtailment, as illustrated in the chart below from Jenkins et al., 2018[12]. At 100% wind and solar, curtailment may be as great as 40% and the capacity may need to be overbuilt 3-8 fold[12].

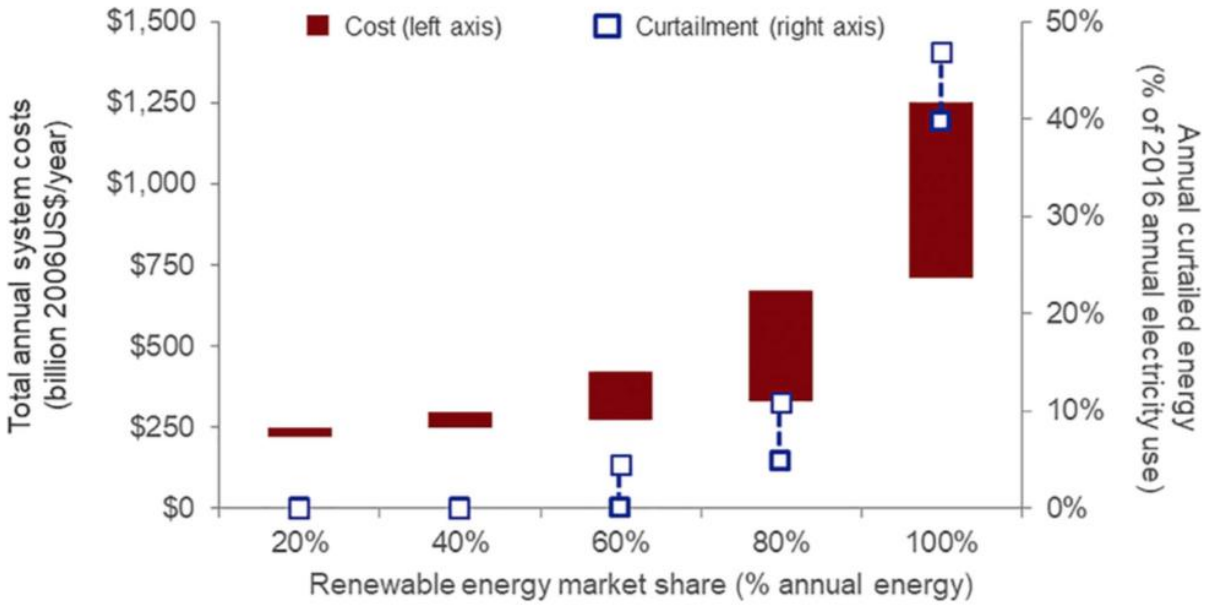

Figure 2. Nonlinear Increases in Total Annual Electricity System Cost and Curtailed Wind and Solar Energy as Renewable Energy Share Increases

Graphic is authors' with data from Frew et al. (2016), see Table 1 for full citation. Low cost and curtailment correspond to "Agg. PEV" scenario (with continent-wide transmission, flexible EV charging) and high cost and curtailment correspond to "Indep. PEV" scenario (limited transmission, flexible EV charging). Curtailment is converted to percentage of 2016 annual electricity use based on *U.S. EIA, Electric Power Annual*, Table 2.2: "Sales and Direct Use of Electricity to Ultimate Customers." From Jenkins et al. 2018.

Low-carbon technologies that can be counted on to meet demand in all seasons and for long durations (firm plants), such as peaking power plants fueled by renewable biomethane, can be used to achieve the most affordable pathway to deep decarbonization of electricity[12]. When the peaker plants are run on renewable biomethane, they will provide carbon-neutral electricity, just like wind and solar

[12] JD Jenkins, M Luke, S Thernstrom (2018) "Getting to Zero Carbon Emissions in the Electric Power Sector", Joule 2:2487-2510

[13] NA Sepulveda, JD Jenkins, FJ de Sisternes, RK Lester (2018) "The Role of Firm Low-Carbon Electricity resources in Deep Decarbonization of Power Generation", Joule 2:2403-2420

electricity generation. As California's production capability of carbon-neutral biomethane increases, further construction of VRE resources will be enabled. Our question to the CEC is, "Why take E3's recommendation to eliminate a means of electricity generation that can and will have the same carbon-neutral footprint as wind and solar?"

3. California should take advantage of biogenic sources of CH_4 and CO_2 for energy production.

The predictions of the availability of biogenic sources of carbon that can be used for energy is controversial. A transparent analysis and accounting of the biomass resources that are currently available and expected to be available through 2050 is needed.

Electrochaea's patented process, based on biological methanation, makes it possible to store renewable energy and recycles 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 when renewable power is available, thereby stabilizing the market for electric power. As a greater percentage of VRE is used, the more relevant this technology will be. In the first step, green electricity is used to generate hydrogen by electrolysis. In the second step, hydrogen and CO_2 are fed into a specifically designed bioreactor where large and stable cultures of archaea (single-celled microorganisms) convert hydrogen and CO_2 into high-quality renewable biomethane. The renewable biomethane can be used on the spot or injected into the existing natural-gas network, where it can be stored and used on demand anytime, anywhere.

Electrochaea's biomethanation technology can also directly use biogas as the CO_2 source, effectively doubling the amount of methane that is recovered from anaerobic digesters and landfill gas, which are generally 50% CH_4 and 50% CO_2. In addition, Electrochaea's power-to-methane technology can use other sources of CO_2 that may be currently emitted into the atmosphere[2], including CO_2 emitted from ethanol fermentation plants.

In E3's presentation at the workshop, it was stated that there are not enough biogenic resources to meet the demand for natural gas; only 16-25% of the total natural gas throughput in 2050 could be produced from these biogenic resources. Yet, these biogenic resources can be used to produce renewable natural gas and should not be wasted. Why not use this RNG as part of a balanced approach to developing a carbon-neutral California?

In addition, there are sources of CO_2 in the state that have not been discussed, such as that from industries including cement makers. Worldwide cement production accounts for approximately 8% of the world-wide GHG emissions[14]. In an effort to target and eliminate multiple sources of CO_2

[14] https://www.bbc.com/news/science-environment-46455844

pollution, methods to capture and reuse this carbon dioxide are being designed and tested. This large source of CO_2 can also be used to produce biomethane.

4. A carbon-neutral gas grid, containing renewable biomethane and upgraded biogas, will be the largest and lowest cost battery.

Two of the largest challenges, in meeting California's 2050 GHG emission goals, are meeting daily and seasonal demands for electricity, and preventing the overgeneration and curtailment of renewable energy resulting in increased cost and reduced environmental benefits[15]. Since the electrical grid is only a means of transmission, and not a means of storage, the generation of electricity must be curtailed intermittently to prevent overloading grid capacity. And, to meet peak demand, previously stored energy must be deployed. A balanced transmission of electricity requires a flexible, high capacity and long-term storage method, combined with a redistribution of demand[15].

That storage infrastructure is already available and has already been paid for in the form of the gas grid[8]. In analogy to the electricity grid that has been decarbonized step-by-step over the last three decades, we should decarbonize the existing and well-established gas grid and exploit the opportunities that this major part of our energy sector offers. Since the gas grid stores energy in the form of the chemical bonds in methane, it can be viewed as a battery. In the realm of renewable energy storage, carbon-neutral electrons derived from wind and solar can be stored in the form of chemical bonds. This process, referred to as power-to-gas is a legitimate technology that is currently operating on the industrial scale in Europe.

The current gas grid should be co-opted for RNG storage and distribution. Use of the gas grid is shortest path to use the electrons that are generated by wind and solar, because every electron can be used. Using these electrons, instead of curtailing them, or selling them for a negative price, will stimulate the growth of more carbon-free sources of electrons in the state.

5. Maintenance of the existing distribution and storage system should be continued to decrease the potential for fugitive methane.

Maintenance of the existing gas grid and storage systems are essential. Instead of decommissioning an infrastructure that already connects the entire country, it should be maintained and used for the purpose it was designed; to easily and cost-effectively deliver energy to where it is needed. Maintenance and stewardship of the asset will serve to limit fugitive methane.

[15] P Denhol, M O'Connel, G Brinkman, J Jorgenson (2015) "Overgeneration from Solar Energy in California: A Field Guide to the Duck Chart. Technical Report: NREL/TP-6A20-6503. www.nrel.gov

6. Work together to support a balanced means to achieve California's and the world's goals to establish a fossil-free environment in the most efficient and timely manner.

A synergistic approach, supporting multiple technologies and strategies to eliminate the use of fossil-fuels in our society, is likely to be the lowest cost and least risky way forward. Electrochaea encourages the CEC to guide the state forward in an inclusive manner that does not restrict the use of one of our well-established infrastructures, but encourages the transition to a carbon-neutral iteration.

Sincerely,

Mich Hein, Ph.D.[16]
CEO
Electrochaea GmbH
Semmelweisstr. 3
Planegg 82155
GERMANY

[16] Mich Hein and his wife Elizabeth Bray have owned a home in California since 1985; we consider the fine State of California to be our home state. Our daughter attended Cal Poly SLO and currently resides in the Bay Area.