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H Cycle Comments on the Implementation of the Clean Hydrogen Program

Additional submitted attachment is included below.

H Cycle
444 Castro Street, Suite 710
Mountain View, CA 94041

December 15, 2022

California Energy Commission
Energy Research and Development Division
Docket Unit: MS-4
Docket Number: 22-ERDD-03
Project Title: Clean Hydrogen Program

Submitted electronically directly to the docket (22-ERDD-03) at https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=22-ERDD-03.

RE: Comments on the Clean Hydrogen Program

Dear California Energy Commission (CEC):

H Cycle, LLC ("H Cycle") appreciates the opportunity to comment on the scope, requirements and considerations proposed for the Clean Hydrogen Program. H Cycle is a developer of low-cost, low-carbon, renewable hydrogen production facilities that deploy a proven waste-to-hydrogen thermal conversion technology. H Cycle is currently developing multiple projects in the Western United States. Our process can utilize a diverse composition of waste biogenic feedstocks (post-separated municipal solid waste, agricultural residues, woody biomass from wildfire risk reduction projects) to produce a renewable hydrogen product, thereby reducing methane emissions from landfill and other waste disposal methods. The H Cycle process delivers low-carbon hydrogen that can be used as an energy source for decarbonizing hard-to-abate sectors such as low-carbon fuel refining, heavy-duty trucking and sustainable aviation. We are excited to work with the CEC to deploy our solution and support the State in meeting its climate, sustainability and air quality goals.

Comment Scope

H Cycle's comments broadly address two topic areas discussed during the Staff Workshop on the Implementation of the Clean Hydrogen Program on December 1, 2022:

1. H Cycle recommends expanding project eligibility to include all non-fossil hydrogen production technologies for the Large-Scale Centralized Clean Hydrogen Production component of the Clean Hydrogen Program.
2. H Cycle recommends that the CEC reevaluate the parameters by which average water use for biomass gasification is estimated in Mehmeti et al. (2018), as cited in the Clean Hydrogen Program workshop presentation.

H Cycle
444 Castro Street, Suite 710
Mountain View, CA 94041

We request that the CEC take H Cycle's recommendations into account as the Commission develops programs to deploy clean hydrogen solutions to support the accelerated decarbonization of California's economy.

Comments Detail and Background

1. For the Large-Scale Centralized Clean Hydrogen Production component of the Clean Hydrogen Program, H Cycle recommends expanding project eligibility to include all non-fossil hydrogen production technologies. There are a number of hydrogen production methods beyond electrolysis, such as those listed under the California Low Carbon Fuel Standard Regulation's definition of "Renewable Hydrogen", that are commercial-ready, able to produce >5 metric tons per day and result in net-zero or even net-negative carbon emissions.[1] Adopting a neutral stance on production technology for pre-commercial hydrogen production would promote the build-out of a more diversified and robust hydrogen economy, accelerating the decrease in California's levelized cost of hydrogen to parity with fossil hydrogen. Limiting the Large-Scale Centralized Clean Hydrogen Production funding to electrolysis inhibits the rapid commercialization of other non-fossil methods of hydrogen production, some of which are more energy-efficient (i.e., lower electricity requirements) than electrolysis. For instance, H Cycle's hydrogen comes from the thermal conversion of waste organic materials, and can be produced at lower cost and with a lower carbon footprint than electrolysis. The H Cycle process requires approximately 4-5 times less electricity per kilogram of hydrogen than the electricity required for electrolysis. Additionally, the use of our feedstock circumvents the decomposition of organic waste in landfills and avoids methane emissions, allowing H Cycle to achieve a negative carbon intensity versus zero (or greater) for electrolysis.

A greater inclusion of non-fossil hydrogen production technologies would also strengthen the CEC's alignment with the climate goals laid out by the Governor's Office. In a letter penned to California Air Resources Board ("CARB") Chair Liane Randolph in July of 2022, Governor Newsom instructed the agency to "accelerate refinery transitions away from petroleum to the production of clean fuels."[2] Expanding the scope of hydrogen production methods beyond electrolysis would increase the opportunity set of facilities capable of supporting such a transition towards renewable diesel and sustainable aviation fuel production. This scope expansion would also align with other State objectives, such as SB 1440 (Hueso, Chapter 739, Statutes of 2018) for renewable gas production and the Advanced Clean Fleets Regulation for the adoption of zero-emission heavy duty vehicles. For thermal conversion specifically, the scope expansion would furthermore

[1] Low Carbon Fuel Standard Regulation, § 95481 (131); https://ww2.arb.ca.gov/sites/default/files/2020-07/2020_lcfs_fro_oal-approved_unofficial_06302020.pdf

[2] Governor Gavin Newsom Letter of July 22, 2022, to CARB Chair Liane Randolph, at page 3, available at https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf?emrc=1054d6

444 Castro Street, Suite 710
Mountain View, CA 94041

promote implementation of compliance solutions for SB 1383 (Lara, Chapter 395, Statutes of 2016) and AB 939 (Sher, Chapter 1095, Statutes of 1989), regulations that target the reduction of landfill methane emissions across the State.

2. H Cycle requests that the CEC reevaluate the parameters by which average water use for biomass gasification is estimated in Mehmeti et al. (2018), as cited in the Clean Hydrogen Program workshop presentation. H Cycle notes that the Mehmeti paper's water utilization metrics are derived from the US National Renewable Energy Laboratory's H2A Central Hydrogen Production Model ("H2A Model").[3] We believe that both Mehmeti's paper and the H2A Model represent one view of the water load for gasification; however, we would challenge a number of the underlying assumptions for the representative gasification project.

For instance, the Model assumes that the project's power load is generated from an onsite combined heat and power unit, consuming a significant amount of water for cooling and make-up. This assumption is not extended to electrolysis or other technologies, making this a poor like-for-like comparison. Furthermore, wet cooling is assumed for the gasification project, which is quite inefficient and can be improved using dry cooling technologies (e.g., electric heating and cooling). Lastly, in reviewing the H2A Model H Cycle notes that the paper's theoretical gasification project has a process design that is poorly integrated and is unrealistic compared to how such a facility would be engineered in practice. As an example, water used for scrubbing should be generated from discharge derived from the water-gas shift process downstream of the unit, significantly minimizing water volume.

H Cycle additionally notes that total water consumption in the H2A Model amounts to approximately 80 kg per kg hydrogen, which is nearly four times lower than the 305 kg per kg hydrogen referenced in slide 23 of the CEC presentation. H Cycle requests clarity as to what underlying assumptions support the 305 kg number.

H Cycle has been involved in detailed process engineering work to commercialize the first of our waste-to-hydrogen thermal conversion facilities – our work includes a thorough review of actual demonstration data from a previous thermal conversion unit processing municipal solid waste. The results of our analyses to date indicate significantly less water consumption than the CEC presentation. H Cycle would also direct the CEC to the Argonne National Laboratory's GREET model, which assumes water consumption of 4.3 gallons (16.4 kg) per kg hydrogen, much more in line with H Cycle's empirical data.

Biomass gasification is a promising method for producing clean hydrogen at scale today. Contrary to the CEC presentation, biomass gasification can result in water (and electricity) consumption

[3] Steward, D.; Ramsden, T.; Zuboy, J. H2A Central Hydrogen Production Model, Version 3 User Guide; National Renewable Energy Laboratory: Lakewood, CO, USA, 2012.

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Mountain View, CA 94041

metrics that are competitive, if not superior to electrolysis technologies. We urge the CEC to revisit the assumption of water requirements for biomass gasification, such that this option for clean hydrogen production is considered seriously to accelerate California's clean hydrogen economy.

Conclusion

We hope that the CEC will consider our input and analysis as the agency implements the Clean Hydrogen Program. Further, we hope that our comments regarding 1) inclusion of all non-fossil hydrogen production technologies in the Large-Scale Clean Hydrogen Production component of the Clean Hydrogen Program and 2) the reevaluation of water consumption assumed for biomass gasification are taken into consideration as part of ongoing efforts to foster an effective and comprehensive clean hydrogen economy. H Cycle looks forward to continuing engagement with the CEC as the Clean Hydrogen Program is developed. We are available at your convenience to discuss our comments in further detail.

Sincerely,

Robert G. Morgan
Chief Executive Officer