DOCKETED	
Docket Number:	21-IEPR-01
Project Title:	General Scope
TN #:	241310
Document Title:	H Cycle LLC Comments - H Cycle's Comments on 2021 IEPR, Volume III, Renewable Gas and Hydrogen
Description:	N/A
Filer:	System
Organization:	H Cycle LLC
Submitter Role:	Public
Submission Date:	1/28/2022 8:07:58 AM
Docketed Date:	1/28/2022

Comment Received From: H Cycle LLC
Submitted On: 1/28/2022
Docket Number: 21-IEPR-01

H Cycle's Comments on 2021 IEPR, Volume III, Renewable Gas and Hydrogen

Additional submitted attachment is included below.

444 Castro Street, Suite 710
Mountain View, CA 94041

January 28, 2022

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

Re: 2021 IEPR, Volume III – Renewable Gas and Hydrogen (Docket 21-IEPR-01)

Dear Commissioner McAllister:

H Cycle, LLC ("H Cycle") submits the following comments on Volume III of the Draft 2021 Integrated Energy Policy Report ("IEPR"). H Cycle's comments are focused on the chapter in Volume III on hydrogen and renewable gas. H Cycle requests the California Energy Commission ("CEC") consider the following:

- The definition of green hydrogen should include hydrogen produced from organic and biomass resources, not just electrolytic hydrogen produced using renewable power.
- The definition of renewable gas should not exclude hydrogen, and the definition of biomethane should include gas produced from the non-combustion thermal conversion of organic and biomass resources, in addition to anaerobic digestion, in order to be consistent with existing State law.

H Cycle believes these considerations will maximize the opportunities to decarbonize the gas sector, as well as the industrial and other sectors that currently rely on fossil natural gas and have limited carbon abatement alternatives.

About H Cycle

H Cycle is a developer of low-cost, low-carbon hydrogen production facilities that deploy a proven waste-to-hydrogen thermal conversion technology. Our solution can utilize a diverse composition of organics-heavy waste feedstocks (municipal, agricultural, forest) to produce valuable renewable hydrogen, allowing us to displace methane emissions from landfill disposal and support California's waste diversion targets under Senate Bill 1383, as well as other State priorities related to forest management and providing alternatives to agricultural burning. The non-combustion, waste-to-gas conversion process delivers low-carbon hydrogen that can be used as an renewable energy source for decarbonizing hard-to-abate sectors such as heavy-duty trucking, as well as gas utilities, existing fossil-fueled power plants and other industrial applications like cement production. H Cycle is backed by Azimuth Capital Management and

counts Omni Conversion Technologies and the Larsen and Lam Climate Initiative among its key partners.

Comments Detail and Background

Definition of Renewable Hydrogen

Volume III, Chapter 4 of the IEPR defines green hydrogen as hydrogen produced by splitting water using renewable electricity. However, green or renewable hydrogen can also be produced from waste organics and biomass through thermal conversion. There is ample precedent for such an approach, as adopted by various California State agencies and the legislature in the citations described below.

(1) SB 1383 broadly defines renewable gas (not just biogas/biomethane) as important to meeting the state's Short-Lived Climate Pollutant ("SLCP") reduction goals, and directed the CEC to develop an assessment of renewable gas to support the State's climate targets. SB 1383 also directs State agencies to consider actions to support increased production and use of renewable gas to meet the State's SLCP reduction goals.
(2) Pursuant to SB 1383, the 2017 IEPR defines renewable gas as gas generated "from organic waste or from renewable electricity" and includes biogas, biomethane, synthetic natural gas, renewable hydrogen and gaseous products composed of the aforementioned (pg. 245). It highlights municipal solid waste as the second largest source of renewable gas potential in the state, outside of landfills (pg. 254 and elsewhere).
(3) SB 1440, following on SB 1383, specifically highlights biomethane as an important strategy to addressing state climate goals and reducing SLCP emissions. In implementing SB 1440, the California Public Utilities Commission ("CPUC") includes hydrogen blending standards and biomethane procurement in the scope of the Rulemaking (R.13-02-008) and will consider standards for injection of renewable hydrogen into gas pipelines to advance state priorities, once the current Proposed Decision on biomethane procurement is acted upon.
(4) In the December 2021 Proposed Decision on Integrated Resources Planning (R.20-05-003), the CPUC definition of renewable hydrogen includes hydrogen produced through non-combustion thermal conversion of biomass.
(5) CalRecycle defines biogas from organic diversion projects used to generate hydrogen as "renewable hydrogen" in documents related to SB 1383 (pg. 27 of "Analysis of the Progress Toward the SB1383 Organic Waste Reduction Goals").
(6) The Low Carbon Fuel Standard includes biomass and biogas as eligible renewable hydrogen production pathways.
(7) The CPUC allows hydrogen from biomass conversion in the Self Generation Incentive Program.
(8) The Fiscal Year 2021-2022 Budget (SB 155) allocates $50 million specifically for biomass-to-hydrogen pilot projects in the Sierra Nevadas to create carbon-negative fuels from materials resulting from forest vegetation management.

Including organic and biomass wastes as eligible feedstocks in the definition of renewable hydrogen will support existing programs and policies that drive the conversion of organic waste to reduce SLCP emissions. Furthermore, biomass conversion, when coupled with carbon capture and utilization or storage ("CCUS"), offers a cost-effective approach to negative carbon emissions (or drawdown of emissions). A recent report by Lawrence Berkeley National Laboratories ("Getting to Neutral", 2020) determined that bioenergy with CCS ("BECCS") can provide the majority of the carbon-negative emissions needed by the State to reach carbon neutrality by 2045, stating (pg. 5): "Gasifying biomass to make hydrogen fuel and CO_2 has the largest promise for CO_2 removal at the lowest cost and aligns with the State's goals on renewable hydrogen." The report also states (pg. 6):

> …the lowest cost pathway to negative emissions requires building the capacity to handle California's full amount of waste biomass, requiring the construction of a fleet of gasification, pyrolysis, and biogas upgrading/ purification plants, which we estimate to be on the order of 50 to 100 facilities, the largest of which would be located in the Central Valley. These state-of-the-art, low-emissions facilities will reduce air pollution from existing burning of biomass, and also displace polluting fuels from the road.

More specifically, the report identifies the potential climate benefit (negative + avoided emissions) from biomass gasification to hydrogen in California as being equivalent to 126.5 million tons of CO_2/year, at a weighted-average cost of $29.77/ton (see Table 40, pg. 130). Compared to California's greenhouse gas inventory, the potential emissions benefit is more than the greenhouse gas emissions from every passenger vehicle in the State (119.11 million tons CO_2) and more than the emissions of every industrial facility and power plant operating in the State (125.3 million tons CO_2 combined). The costs are similar to current prices in California's Cap-and-Trade program, whose last auction cleared at $28.26/ton for current allowances and $34.01/ton for advance auction allowances. What's more, the report finds that the emissions benefits and costs for biomass gasification-to-hydrogen *are the same in 2025 as they are in 2045* (Table 40), suggesting that a near-term focus on building dozens of biomass gasification-to-hydrogen facilities could have a similar climate benefit as removing every car, truck and SUV from California's roads, cost effectively, within about five years. Based on these findings, biomass-to-hydrogen may well be the most significant near-term climate strategy for the State to pursue.

Finally, the CEC has funded through its CalSEED and EPIC programs innovative startups/programs that convert biomass into renewable gas including renewable hydrogen. We do not believe the Commission intends to define biomass-derived hydrogen as not qualifying for "green" or "renewable" consideration when it has directly funded such exciting innovations, nor to suggest that it does not contribute to California's climate goals.

H Cycle requests that the Commission revise the definition of green hydrogen in the report to include all renewable feedstocks and/or set a performance-based definition of green hydrogen on a carbon lifecycle basis.

Definition of Biomethane

Chapter 4 states, "Renewable gas, also known as biomethane, is biogas that has been upgraded to pipeline quality standards." This statement is inconsistent with the definition of renewable gas, defined in the 2017 IEPR, as well as with State law, which defines biomethane in the Public Utilities Code Section 650 as follows:

> *(a) The methane is produced from the anaerobic decomposition of organic material, including codigestion.*
> *(b) The methane is produced from the noncombustion thermal conversion of any of the following materials, when separated from other waste:*
> *(1) Agricultural crop residues.*
> *(2) Bark, lawn, yard, and garden clippings.*
> *(3) Leaves, silvicultural residue, and tree and brush prunings.*
> *(4) Wood, wood chips, and wood waste.*
> *(5) Nonrecyclable pulp or nonrecyclable paper materials.*
> *(6) Livestock waste.*
> *(7) Municipal sewage sludge or biosolids.*

The current definition in Chapter 4 is also inconsistent with later sections (e.g. pg. 65), which rightfully expand the definition to include conversion of biomass into renewable gas through gasification and pyrolysis. Additionally, H Cycle notes that the CPUC has recently issued a Proposed Decision on biomethane procurement (R.13-02-008), which includes biomethane from biomass conversion.

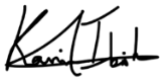
Expanding the definition of renewable gas will aid in achieving the State's climate objectives, as a significant fraction of the State's renewable gas potential is found in cellulosic and lignocellulosic waste. These wastes are not suitable for anaerobic digestion and are ideally suited for biomass conversion processes; it is estimated that 85% of the state's bio-energy potential lies in such wastes, as shown in the excerpt from *Getting to Neutral* (pg. 31) below.

Category	2025 Amount	2045 Amount
Agriculture Residue	10.4 M BDT/yr	12.7 M BDT/yr
Municipal Solid Waste	12.3 M BDT/yr	13 M BDT/yr
Landfill and Anaerobic Digester Gas (Gaseous Waste)	7.1 M tons/yr	6.1 M tons/yr
Forest Biomass	24 M BDT/yr	24 M BDT/yr
Total	**54 M tons/yr**	**56 M tons/yr**

Conclusion

In summary, H Cycle requests that the definition of renewable gas in Chapter 4 be revised to align more closely with existing State laws and programs. Furthermore, H Cycle requests that the definition of green hydrogen in Chapter 4 be revised to encompass all renewable feedstocks, including biomass conversion. H Cycle thanks the California Energy Commission for the opportunity to comment on the Draft 2021 Integrated Energy Policy Report and is available to discuss these considerations at your convenience.

Sincerely,



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