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BAC Comments on EPIC Hydrogen Workshop (20-EPIC-01)

Additional submitted attachment is included below.

July 15, 2021

The Honorable Laurie ten Hope
Deputy Director
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Re: Green Hydrogen Workshop (July 1, 2021) – Docket 20-EPIC-01

Dear Deputy Director ten Hope:

The Bioenergy Association of California (BAC) submits these comments in response to the CEC's workshop on green hydrogen, held July 1, 2021. The workshop presented important data and suggestions to accelerate the development of green hydrogen in California. We are concerned, however, about the relatively small focus on hydrogen from organic waste, which can provide the lowest carbon form of hydrogen and help the state to meet its SLCP reduction and carbon neutrality goals. We urge the CEC to increase the focus on organic waste-based hydrogen as the CEC moves forward to promote green hydrogen generally. The Commission will maximize the benefits of green hydrogen by promoting all forms, each of which presents different benefits and all of which are critical to meet California's climate and clean energy goals.

The Bioenergy Association of California (BAC) represents more than 80 local governments, public agencies, private companies, utilities and others that are working to convert organic waste to energy to meet the state's climate change, clean energy, air quality and other goals. BAC's public sector members include cities and counties, air quality and environmental agencies, waste and wastewater agencies, community and environmental groups, research institutions, the University of California, and more. BAC's private sector members include energy and technology companies, agriculture and food processing industries, utilities, investors, and more.

BAC's Recommendations on Green Hydrogen RD&D are below.

1. Importance of Organic Waste-Based Hydrogen to Reduce SLCP Emissions

Hydrogen from organic waste is the only form of hydrogen that can reduce the super climate pollutants known as Short-Lived Climate Pollutants (SLCPs). SLCPs in turn are the only climate pollutants whose reduction benefits the climate right away, which is critical to avoid catastrophic climate change. Climate change is happening more quickly and more destructively than was predicted even a few years ago. In its most recent climate assessment, the IPCC said we have about a decade left to reduce warming or we face catastrophic and irreversible climate impacts. More recently, climate scientists have said that we have only six to seven years left to slow warming or we will go beyond a 1.5 degree Celsius increase that will trigger very dangerous feedback loops. If we focus only on carbon dioxide reductions, we will not begin to reverse global warming for several decades or more and the damage to human life, ecosystems, and the economy will be staggering and largely irreversible.

In a presentation on SLCP reductions in late June, Dr. V. Ramanathan from UC San Diego and the Scripps Institute stated that we have much less than 10 years left to bend the warming curve.[1] He also said that the only lever we have left to make a difference in that time frame is reducing SLCP reductions.[2] Dr. Ramanthan, along with experts from Environmental Defense Fund and ClimateWorks Foundation, said we must go all out – and fast - on SLCP reductions by doing the following:

- Eliminate diesel use right away since it causes black carbon emissions and other climate pollution
- Reduce wildfire emissions and open burning of forest and agricultural waste
- Reduce methane from livestock and from landfill waste

Converting organic waste to hydrogen will help California to meet the SLCP reduction requirements of state law, which requires a 50 percent reduction in black carbon and a 40 percent reduction in methane by 2030.[3] Organic waste-based hydrogen can reduce or eliminate black carbon emissions from diesel, wildfires, prescribed fire, and pile and burn of forest and agricultural waste. According to the *California Forest Carbon Plan* adopted by CalEPA and the California Natural Resources Agency, converting organic waste to energy cuts black carbon and methane by 98 percent compared to wildfires or open burning. Converting organic waste to hydrogen can also significantly reduce methane emissions from landfills, dairies, and wastewater treatment facilities. These are the largest sources of methane emissions in California and by far the most effective way to reduce those emissions is by converting organic waste to energy.

[1] Presentation by Dr. Verrabhadran Ramanathan, UC San Diego, on June 24, 2021, at MoveCA's symposium on SLCP Reductions.
[2] Id.
[3] Health and Safety Code section 39730.5.

2. Importance of Organic Waste-based Hydrogen to Achieve Carbon Neutrality

In addition to reducing SLCP emissions, converting organic waste to hydrogen can provide carbon negative emissions needed to reach carbon neutrality. According to Lawrence Livermore National Lab, bioenergy with carbon capture and storage (BECCS) can provide more than two-thirds of all the carbon negative emissions needed to achieve net carbon neutrality by mid-century.[4] LLNL found that California generates enough organic waste to generate 84 million metric tons of carbon negative emissions annually.[5] This is by far the largest opportunity for negative carbon emissions in California.

Many other reports have reached the same conclusion.[6] According to the International Energy Agency, BECCS can generate up to 8 billion metric tons of negative carbon emissions annually – equivalent to about one-quarter of all global climate pollution.[7]

3. Cost-Effectiveness of Carbon Reductions from Organic Waste Based Hydrogen

The Air Board's recent report to the Legislature on the state's climate investments shows that the investments in organic waste conversion to energy are, by far, the most cost-effective of all of the state's climate investments. Investments in dairy digesters and diverted organic waste projects are cutting carbon emissions at the tiny cost of $9 and $10 per ton.[8] That is a small fraction of the cost of the state's other climate investments and a far more cost-effective way to reduce carbon emissions than other forms of hydrogen. The LLNL report also found that investments in BECCS are very cost-effective and that the most cost-effective way to reach carbon neutrality will be to maximize hydrogen from organic waste along with carbon sequestration.[9]

4. Technical Potential of Organic Waste-Based Hydrogen

The *2017 IEPR* presents a lot of data about the availability of organic waste in California. Since then, California has enacted SB 901 (Dodd, 2018) and adopted a

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[4] Lawrence Livermore National Lab, *Getting to Neutral – Options for Negative Carbon Emissions in California,"* January 2020. Available at: https://www.llnl.gov/news/new-lab-report-outlines-ways-california-could-reach-goal-becoming-carbon-neutral-2045, at page 2.

[5] Id.

[6] See: https://www.iea.org/commentaries/going-carbon-negative-what-are-the-technology-options; and https://psci.princeton.edu/tips/2020/11/15/preventing-climate-change-with-beccs-bioenergy-with-carbon-capture-and-storage.

[7] International Energy Agency: https://www.iea.org/commentaries/going-carbon-negative-what-are-the-technology-options.

[8] CARB's Annual Report to the Legislature: *California Climate Investments Using Cap-and-Trade Auction Proceeds*, issued April 2021, Table 2, at pages 17 and 18.

[9] LLNL report, footnote 4 above, at pages 7-8.

Forest Stewardship Agreement with the US Forest Service that require forest thinning on one million acres per year, which will significantly increase the availability of forest waste and other vegetation removed for wildfire mitigation.[10] According to the Board of Forestry's 2020 *Forest Biomass Utilization Plan*, that will result in an additional 10 to 15 million bone dry tons annually of forest waste.[11] Putting all this organic waste together, California's technically available organic waste and resulting hydrogen potential is presented below. This assumes an 85 percent efficiency factor for conversion to hydrogen.

Fuels Potential from California Organic Waste

Feedstock	Amount Technically Available	Billion Cubic Feet Methane	Million Gasoline Gallon Equivalents	Tons of Hydrogen (assuming 85% conversion efficiency)
Landfill Gas	106 BCF	53	457	
Animal Manure	3.4 M BDT	19.5	168	
Wastewater Treatment Gas	11.8 BCF	7.7	66	
Fats, Oils and Greases	207,000 tons	1.9	16	
Municipal Solid Waste (food, leaves, grass)	1.2 M BDT	12.7	109	
Municipal Solid Waste lignocellulosic fraction)	6.7 BDT	65.9	568	
Agricultural Residue (Lignocellulosic)	5.3 M BDT	51.8	446	
Forest, Sawmill, Shrub & Chaparral Residues	26.2 M BDT	256	2,214	
TOTAL		**468.5**	**4,044**	**4,038,793**

Feedstock Data: Rob Williams and Stephen Kaffka, UC Davis, presentation to the California Energy Commission Jan. 30, 2017; Lawrence Livermore National Lab assessment of forest, sawmill, shrub & chaparral residues, January 2020

Since some organic waste is already being used for electricity generation and low carbon transportation fuels, not all of this will be converted to hydrogen. But the table above shows the extensive potential for hydrogen production from technically available organic waste in California, which is all the more important considering that much of it can be carbon negative.

5. RD&D Needs and Technology Readiness

For all the reasons above, BAC urges the CEC to include organic waste-based hydrogen in planning for green hydrogen, including the assessment of RD&D needs. According to Lawrence Livermore National Lab, bioenergy to hydrogen technology has

[10] https://www.gov.ca.gov/wp-content/uploads/2020/08/8.12.20-CA-Shared-Stewardship-MOU.pdf

[11] https://bof.fire.ca.gov/media/10238/full-12-c-i-joint-institute-wood-and-biomass-utilization-recommendations-for-bof-mtg_11420.pdf.

"medium to high" technology readiness, meaning no technology breakthroughs are needed.[12] The US Department of Energy also classifies biomass-based hydrogen technologies as "mature."[13] Despite these classifications, however, organic waste-based hydrogen is not yet widely deployed and needs EPIC investment to demonstrate its effectiveness, better quantify its emissions and other benefits, and help commercialize its deployment at scale. In particular, BAC urges the CEC to allocate EPIC funding to:

- Demonstrate biomass gasification to hydrogen projects, using forest, agricultural, and urban wood waste.
- Improve non-combustion conversion technologies (fuel cells, linear generators) that can use biogas from anaerobic digestion or biomass gasification/pyrolysis, as well as hydrogen from organic waste.
- Demonstrate Carbon Capture and Storage technologies that can be used with hydrogen from organic waste (BECCS) to generate carbon negative emissions.
- Continue to improve technologies (steam methane reformation, water gas shift) that can convert biogas and biomass to hydrogen.
- Quantify emissions from steam methane reformation and water gas shift reactions that convert organic waste to hydrogen.

Thank you for your consideration of these comments.

Sincerely,

Julia A. Levin
Executive Director

[12] LLNL report, footnote 4 above.
[13] https://www.energy.gov/eere/fuelcells/hydrogen-production-biomass-gasification.