August 29, 2025

Center for Resource Solutions
1012 Torney Avenue
San Francisco, CA 94129

Re: Renewable Hydrogen Update to the Green-e® Renewable Fuels Standard – Draft for Stakeholder Comment Period

Dear CRS:

The Bioenergy Association of California (BAC) and California Hydrogen Business Council (CHBC) appreciate the opportunity to comment on the Draft Green-e Standard for Renewable Hydrogen ("Draft Standard"). BAC and CHBC support waiving incrementality requirements in states that have an RPS or CES, but opposes limiting thermochemical conversion to Steam Methane Reformation. Excluding other thermochemical processes would exclude the vast majority of organic waste from being used as potential feedstock for renewable hydrogen, including forest and agricultural residues and woody waste that would otherwise be landfilled. This would greatly limit the potential for renewable hydrogen to generate carbon negative emissions, reduce Short-Lived Climate Pollutant emissions, mitigate wildfire and its impacts, and reduce open burning of agricultural waste. BAC and CHBC urge CRS, instead, to adopt sustainability and emissions standards for renewable hydrogen rather than excluding whole technology categories without regard to their benefits or impacts.

BAC and CHBC represent over100 members that are converting organic waste to energy to meet the state's clean energy, climate change, wildfire reduction, landfill reduction, and circular economy goals. BAC's public sector members include cities and counties, Tribes, air quality and environmental agencies, waste and wastewater agencies, public research institutions such as the University of California and Lawrence Berkeley National Lab, environmental and community groups, and a publicly owned utility. BAC's private sector members include energy and technology companies, waste haulers, agriculture and food processing companies, investors and consulting firms, and an investor-owned utility. CHBC's members include utilities, air quality organizations, producers, distributors, and offtakers of hydrogen, including transit districts.

BAC and CHBC submit the following comments on the Draft Standard for renewable hydrogen.

I. THERMOCHEMICAL CONVERSION SHOULD NOT BE LIMITED TO STEAM METHANE REFORMATION.

BAC and CHBC urge CRS not to limit thermochemical conversion processes to Steam Methane Reformation (SMR) of biomethane. This would exclude the vast majority of organic waste generated in California, reduce opportunities to reduce Short-Lived Climate Pollutant emissions, prevent carbon negative hydrogen production, and hamper many other important goals such as wildfire mitigation, avoiding open burning of woody waste, and reducing landfill waste.

A. Limiting Thermochemical Conversion to SMR Excludes the Majority of Organic Waste.

The University of California at Davis, the California Energy Commission, and Lawrence Livermore National Lab (LLNL) have all found that cellulosic waste makes up the vast majority of California's technically available organic waste.[1] The chart below shows that cellulosic waste (the rows presented in green) makes up about 80 percent of California's organic waste stream.

California's Bioenergy Potential from Organic Waste

Feedstock	Amount Technically Available	Billion Cubic Feet Biomethane	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 M 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	
BIOGAS POTENTIAL		**468.5**	**4,044**	**4,038,793**

Source: Rob Williams and Stephen Kaffka, UC Davis, presentation to the California Energy Commission on 1/30/17; Lawrence Livermore National Lab assessment of forest, sawmill, shrub & chaparral residues, Jan2020

[1] California Energy Commission, *2017 Integrated Energy Policy Report (IEPR),* page 254, Table 20; University of California Davis assessment of technically available organic waste presented in the 2017 IEPR; Lawrence Livermore National Lab, *Getting to Neutral – Options for Negative Carbon Emissions in California,* January 2020. LLNL-PRES-795982.

Cellulosic waste can be converted to renewable hydrogen through gasification or pyrolysis, which are both thermochemical conversions. The gas that is generated from that conversion can then be converted to hydrogen using a water-gas-shift. The gas that is generated from these processes is not biomethane and the conversion process needed is not SMR. In other words, by limiting eligible thermochemical conversion to biomethane that is converted to hydrogen using SMR, the Draft Standard excludes the cellulosic waste as an eligible feedstock for renewable hydrogen. This not only excludes the vast majority of California's organic waste, but it precludes numerous important benefits for the climate, public health and safety.

B. Limiting Thermochemical Conversion Limits Opportunities to Reduce Short-Lived Climate Pollutation Emissions.

Climate scientists agree that the reduction of Short-Lived Climate Pollutants is the most urgent measure needed to address climate change.[2] As the United Nations Environment Program stated, "Cutting methane is the strongest lever we have to slow climate change over the next 25 years and complements necessary efforts to reduce carbon dioxide. The benefits to society, economies, and the environment are numerous and far outweigh the cost."[3] That is because SLCP reductions are among very few measures that benefit the climate right away. According to the California Air Resources Board, reducing SLCP emissions also benefits public health since both methane and black carbon (particulate matter) are harmful air pollutants.[4]

In California, two of the largest sources of black carbon emissions, which are 3,200 times more damaging than carbon dioxide on a 20-year global warming basis, are wildfires and open burning of forest and agricultural residues.[5] According to the California Air Resources Board:

> "Forests are burning at increasing rates and at increasing levels of severity. This trend raises concern over the long-term resilience of these forests and ability to sequester carbon, mitigate climate change, and provide resource amenities. Many studies have demonstrated net benefits for fuel treatments and forest

[2] See, *Short-Lived Climate Pollutant Reduction Strategy*, adopted by the California Air Resources Board, March 2017, at page 1; https://www.unep.org/news-and-stories/press-release/global-assessment-urgent-steps-must-be-taken-reduce-methane

[3] https://www.unep.org/news-and-stories/press-release/global-assessment-urgent-steps-must-be-taken-reduce-methane.

[4] *Short-Lived Climate Pollutant Reduction Strategy*, adopted by the California Air Resources Board, March 2017, at pages 22 and 27.

[5] Id. at page

management activities . . . Fuel treatments are key elements of strategies to restore forests."[6]

Fuel treatments to reduce wildfire and restore healthy forests are now generating millions of tons of forest residues annually. Agricultural residues in California are also significant, as the table in section A above shows.

According to the California Environmental Protection Agency and California Natural Resources Agency, converting forest or agricultural residues to energy instead of open burning cuts both methane and black carbon by 98 percent.[7] This is why California's recent climate plans all call for increased conversion of waste biomass to energy. That includes the *California Short-Lived Climate Pollutant Reduction Strategy*, the *California Forest Carbon Plan*, and the *2022 Climate Change Scoping Plan.*[8]

C. Limiting Thermochemical Conversion Severely Restricts Opportunities to Generate Carbon Negative Emissions Need to Reach Carbon Neutrality.

Both the California Air Resources Board and Lawrence Livermore National Lab have found that bioenergy with carbon capture and sequestration (BECCS) can provide significant carbon negative emissions that will be needed to reach carbon neutrality by 2045,[9] which is California's goal.[10] According to LLNL, BECCS can provide two-thirds of all the carbon negative emissions that California needs to reach carbon neutrality by mid-century, but that is only if cellulosic waste is included.[11] LLNL also found that the most beneficial form of BECCS is the conversion of organic waste to hydrogen.[12] Excluding 80 percent of that waste by limiting the eligibility of thermochemical conversion to biomethane and SMR makes no sense and would severely hamper California's ability to reach its goal of carbon neutrality by 2045.

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[6] *Short-Lived Climate Pollutant Reduction Strategy*, above, at pages 46-47 [footnotes in the cited text have been omitted in the quote].

[7] *California Forest Carbon Plan* adopted by the California Environmental Protection Agency, California Natural Resources Agency, and CalFire in May 2018, at pages 130, 135.

[8] *California Forest Carbon Plan*, above, at page 41; *Short-Lived Climate Pollutant Reduction Strategy*, above, at pages 3-4; *2022 Climate Change Scoping Plan for Achieving Carbon Neutrality,* at pages 96, 120, 251-252.

[9] *2022 Climate Change Scoping Plan for Achieving Carbon Neutrality*, issued by the California Air Resources Board on November 15, 2022; Lawrence Livermore National Lab, *Getting to Neutral – Options for Negative Carbon Emissions in California,* January 2020. LLNL-PRES-795982.

[10] AB 1279 (Muratsuchi, 2022)

[11] Lawrence Livermore National Lab, *Getting to Neutral – Options for Negative Carbon Emissions in California,* January 2020, at page 2.

[12] Lawrence Livermore National Lab, *Getting to Neutral – Options for Negative Carbon Emissions in California,* January 2020.

D. Limiting Thermochemical Conversion Hampers Efforts to Mitigate Wildfire, Reduce Open Burning and Landfilling of Organic Waste.

California and other western states are facing severe and life-threatening wildfires due to climate change and other factors. Those wildfires harm public health and safety, biodiversity, water supplies and quality, local communities, air quality, carbon sequestration, and much more.

To mitigate wildfire risk and severity, as well as restoring healthier and more resilient forests, California has agreed with the U.S. Forest Service to conduct forest fuel removal on one million acres annually.[13] The California Air Resources Board, as part of the *2022 Climate Change Scoping Plan*, recommends that the state treat up to 2.3 million acres annually to mitigate wildfire and restore carbon sequestered in California's forests.[14] This will generate tens of millions of tons of forest waste annually. According to the Nature Conservancy, much of that material has only one or two commercial uses, which are conversion to bioenergy and sawmills.[15] For the non-merchantable part of forest residues, which is not suitable for wood products, the only viable use is bioenergy. For this reason, the Nature Conservancy found that increasing bioenergy and sawmills "offers the most promising means of accelerating forest restoration."[16]

California has successfully increased forest fuel treatments, although still has a long way to go to reach the goal of one million acres annually. Unfortunately, most of the forest biomass that has been removed is still sitting in piles in or near the forest. According to the Placer County Air Pollution Control District, leaving those forest residues in piles actually exacerbates wildfire risks and impacts. The main alternative is to pile burn that material, which generates enormous amounts of climate and air pollution. It is better than wildfires, but conversion to hydrogen instead of pile burning is be far preferable from a climate change and an air quality standpoint.

California also needs alternatives to pile burning for its significant agricultural residues. Agricultural waste such as orchard and vineyard prunings, nut shells, fruit pits, etc, are not suitable for compost, but can be converted to hydrogen using gasification. They cannot be converted using SMR.

In addition to forest and agricultural residues, a significant portion of California's organic landfill waste is made up of woody waste and other cellulosic waste that can be converted to hydrogen, but not all of it can be converted to biomethane and not using

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[13] Forest Stewardship Agreement between the State of California and the US Forest Service, available at: https://www.gov.ca.gov/2020/08/13/california-u-s-forest-service-establish-shared-long-term-strategy-to-manage-forests-and-rangelands/.

[14] *2022 Climate Change Scoping Plan for Achieving Carbon Neutrality*, issued by the California Air Resources Board on November 15, 2022, at page 99.

[15] See, eg, The Nature Conservancy, *Accelerating Forest Restoration,*

[16] Id. at page 3.

SMR. Several projects are in development that will convert waste biomass that is diverted from landfills and will use gasification to do so. These projects will provide enormous benefits for local air quality and the climate by reducing landfill waste, flaring of landfill gas, and the use of diesel in heavy duty trucks. The hydrogen that these projects will generate should not be excluded from the Green-e standard.

E. The Green-e Standard Should Focus on Feedstock Sustainability and Technology Neutral Performance Based Standards.

BAC and CHBC urge CRS to focus the renewable hydrogen standard on sustainability and objective, performance-based standards. Including or excluding specific technologies without regard to their environmental performance will exclude some of the most beneficial sources of hydrogen, such as the ones described above, and may inadvertently allow sources that are not as environmentally sustainable. Failing to adopt performance based standards and sustainability criteria will almost certainly not achieve CRS's goal of assuring "accuracy, transparency and environmental quality."

BAC and CHBC urge CRS to, at a minimum, include gasification and pyrolysis of cellulosic waste with sustainability criteria and emissions performance requirements. This would be consistent with the California Air Resources Board's inclusion of hydrogen from both biomass and biogas in the Low Carbon Fuel Standard. It would also be consistent with recommendations from Lawrence Livermore National Lab in its report on how California can achieve carbon neutrality. And it would be consistent with the California Department of Conservation's forest biomass to low carbon biofuels incentive program, which voters approved in Proposition 4 last fall, to encourage conversion of forest waste to low carbon biofuels including hydrogen.

BAC and CHBC recognize that both forest and agricultural biomass require sustainability criteria. California has adopted those in several different laws and regulatory programs. In essence, those criteria:

- Exclude purpose grown crops and edible food from eligible agricultural waste biomass; and
- Limit eligible forest biomass to material that is removed for wildfire mitigation, forest restoration, or protection of public safety or infrastructure.

Eligible biomass should also have to meet the lifecycle carbon emissions standard that other fuels must meet and should not cause an increase in local air pollution.

Adopting feedstock sustainability criteria and objective emissions standards will provide a far more effective framework for renewable hydrogen than the one proposed in the Draft Standard for thermochemical conversion.

II. CARBON INTENSITY SHOULD INCLUDE AVOIDED EMISSIONS AND THE USE OF CO-PRODUCTS SUCH AS COMPOST OR BIOCHAR.

BAC and CHBC urge CRS to require a full lifecycle analysis of carbon emissions. The description of how greenhouse gas emissions will be calculated in Section V is incomplete and could lead to highly inaccurate outcomes. While the section uses the term "well to gate," it does not require that emissions be calculated on a lifecycle basis. Since renewable hydrogen is not generated at "the well" or sold at "the gate," using a more scientifically precise term would be far more accurate and transparent, as CRS aims to be. If CRS does not choose to use the more scientific term of "lifecycle" emissions, then it should list all potential emissions, including avoided emissions and carbon capture and sequestration. As written, the description in Section V is quite incomplete and could be misunderstood or misapplied.

If the standard does not state explicitly that applicants must conduct a full lifecycle analysis, then it is essential also to add at least the following to what is already described in Section V of the Draft Standard:

- Avoided emissions of methane, black carbon, carbon dioxide or other climate pollutants (greenhouse gases and Short-Lived Climate Pollutants) that is not required by law from the conversion of organic waste to hydrogen.
- Carbon capture and sequestration, including the production and use of biochar as a co-product of biomass gasification.

III. BAC AND CHBC SUPPORT WAIVING INCREMENTALITY REQUIREMENTS FOR STATES WITH AN RPS OR CES.

BAC agrees with the Draft Standard that incrementality requirements (requirement for new renewable power, time-matching, etc.) should not be applied to renewable hydrogen that is produced and used in states with an RPS or CES. To add incrementality requirements in states that have significant requirements for new renewable power would be to add unnecessary barriers and expenses and result in much less development and participation. In other words, requiring incrementality in RPS states would have the opposite of the intended effect by stifling renewable hydrogen development instead of encouraging it.

BAC and CHBC appreciate the opportunity to provide these comments and would be happy to provide any additional information or citations that would be helpful.

Sincerely,

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