September 19, 2022

California Air Resources Board
1001 I Street
Sacramento, CA 95814

Rajinder Sahota
Deputy Executive Officer, Climate Change and Research

Matthew Botill
Division Chief, Industrial Strategies Division

Cheryl Laskowski
Branch Chief, Low Carbon Fuel Standard

Re: LCFS 2nd Public Workshop – Comments on proposed Simplified Tier 1 Hydrogen Calculator

To Rajinder, Matthew and Cheryl,

The undersigned are pleased to provide feedback comments in relation to the ongoing proceeding to consider changes to the Low Carbon Fuel Standard (LCFS) program. With this short letter, we comment on the proposal to develop a Tier 1 hydrogen calculator. Currently, CARB is proposing to include steam methane reformation and electrolysis pathways in the Tier 1 calculator only. **We recommend that CARB also include waste biomass pathways, notably for forest and agricultural residues.**

It is estimated that California produces over 50 million dry tons of forest, agricultural, and urban waste biomass each year (Fig. 1). The majority of these residues are either field burned, combusted in wildfire, left to decompose, or landfilled, emitting substantial amounts of carbon dioxide (CO_2), short-lived climate pollutants, and criteria pollutants, thereby undercutting the state's air quality and net-zero emissions goals. As a rough estimate, 50 million tons of waste biomass is equivalent to about 91 million tons of CO_2, or about 21% of the state's greenhouse gas inventory.[1] This excludes the possibility of CO_2 emitted as methane or black carbon – both with significantly higher radiative forcing impacts. Without a strategy to manage waste biomass, California risks falling short of its 2030 and 2045 climate targets.

In light of this problem, in 2020 the Joint Institute for Wood Products Innovation (state research institute established via Executive Order B-52-18) performed a literature review of alternative woody biomass utilization options. Biomass utilization provides dual climate benefits in the forms of avoided emissions (i.e., avoided decomposition, field burning, etc.) and new emissions reductions, such as by displacing fossil fuels. The study found that the most technologically and commercially feasible utilization option for residues was conversion to liquid and gaseous transportation fuels, notably hydrogen, with gasification and pyrolysis as key technology pathways (among others).

[1] 1 dry ton of biomass contains 50% carbon. Therefore, 50 million dry tons of biomass contains 25 million tons of carbon. To convert carbon to CO_2, multiply by 44/12. Therefore, 25*(44/12) = 91 $MtCO_2$ per year.

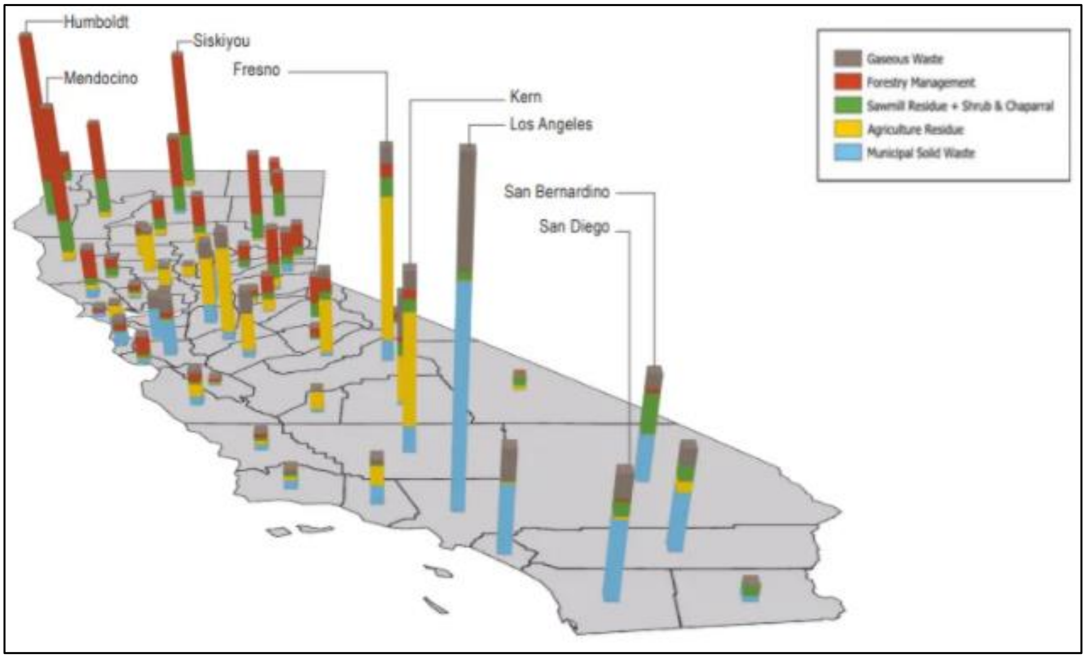

Fig. 1: This diagram provides estimates of waste biomass volumes by county (LLNL 2020).

More recent studies explore in detail how biomass-hydrogen (sometimes referred to as "emerald hydrogen") can support the state's climate, human health, and environmental protection goals:

1. **Transport sector decarbonization:** A state-funded study by UC Davis Institute of Transportation (2021) as well as the 2022 Draft Scoping Plan show that emerald hydrogen has a key role to play in decarbonizing the state's transport sector, such as by displacing fossil fuels in upstream (e.g., refineries) and downstream (e.g., medium- and heavy-duty fuel cell vehicles) applications.

2. **Technological carbon dioxide removal (CDR)**: Studies by Lawrence Livermore National Laboratory (awarded the DOE's Secretary Achievement Award for its outstanding contribution to climate change research), Princeton University, and the California Air Resources Board each show a large-scale need for CDR in order for California to achieve net-zero emissions by 2045. LLNL and Princeton studies highlight emerald hydrogen with carbon capture and storage as the main pathway to deliver tens to greater than 100 million tons per year of permanent CDR (i.e., low likelihood of reversal, compared to nature-based solutions) by 2045 at the lowest-cost. We note that it is not possible to achieve CDR via the production of green or blue hydrogen.[2]

3. **Wildfire and Central Valley field burning mitigation**: California has set ambitious forest treatment and agricultural field burning elimination targets. However, it is unclear how the state intends to achieve these targets. A strategy to collect and convert woody biomass into emerald

[2] For more information, see this Scoping Plan submission from LLNL, UC Berkeley, Princeton, and CSG researchers.

hydrogen can substantially support the cost of forest treatments[3] as well as incentivize farmers to mobilize their residues as opposed to field burning at the conclusion of a crop rotation.

On the back of this research, the state has seeded a number of new programs and initiatives, including notably the Department of Conservation's Forest Biofuels Gasification Program, CAL FIRE's Wood Products Grant Program, the Infrastructure and Economic Development Bank's Climate Catalyst Fund, and the Office of Planning and Research's Feedstock Program. The California Natural Resources Agency has also highlighted the importance of biomass mobilization in multiple planning documents. These programs have provided an important signal for in-state project developers, with at least seven projects capable of producing emerald hydrogen currently in the development process in California[4].

Nevertheless, the scale of the biomass challenge is extraordinary, and the above programs alone are likely insufficient for supporting the mobilization of tens of millions of tons of waste residues per year. In our estimation, a whole-of-government approach is needed; and LCFS incentives can fulfill a current policy gap by providing a recurring revenue stream that can support emerald hydrogen project financing. A transparent, science-based, simplified calculator is crucial, as the cost and uncertainty of estimating the carbon intensity of Tier 2 emerald hydrogen pathways is a high barrier to entry for developers. (We note that a similar conclusion was reached by a 50-person expert working group convened by the Joint Institute for Wood Products Innovation throughout 2021. Please see this document for further consideration as to why a Tier 1 pathway is needed, as well as potential strategies to manage in-state vs. out-of-state fuels production in conjunction with sustainability goals).

As a result, we recommend that CARB include emerald hydrogen pathways in its proposed simplified Tier 1 hydrogen calculator, enabling each of transportation sector decarbonization, CDR, and avoided wildfire and field burning emissions, in addition to technological optionality, given the limits to green hydrogen (i.e., excessive renewables demand, as identified by CARB, p. 69) and blue hydrogen (possibility of undesired fossil lock-in) for the purpose of achieving its 2030 and 2045 climate targets.

We are glad to be able to submit these comments in relation to the LCFS and hope to engage in further discussions with CARB staff. For outreach, please contact Sam Uden (sam@csgcalifornia.com).

Respectfully submitted:

[3] It estimated to cost $2,000-$4,000 to perform a fire prevention treatment on one forested acre. At 1 million acres per year, this equates to $2-4 billion per year, which must be sustained for multiple decades in California. By way of reference, the unprecedented 2022-23 budget appropriated just over $600 million to the main fire prevention programs at CAL FIRE and State Conservancies to cover the next two years, or 10% of the needed funds. Meanwhile, converting forest waste biomass into hydrogen with LCFS incentives can feasibly generate $3,000 per acre to support the cost of ecological forest treatments.

[4] See: Mote, Clean Energy Systems, Yosemite Clean Energy, H Cycle, Raven SR, Aemetis and SG H2 Energy.

Sam Uden, Conservation Strategy Group

Dr. Daniel L. Sanchez, UC Berkeley

Christiana Darlington, CLERE Inc.

Nick Goulette, The Watershed Research and Training Center

Dr. Jonathan Kusel, Sierra Institute for Community and Environment

Steve Frisch, Sierra Business Council

Stacy Caldwell, Tahoe Truckee Community Foundation

Zach Knight, Blue Forest Conservation

Ken Alex, UC Berkeley (Climate & Wildfire Institute)

Ethan Elkind, UC Berkeley (Center for Law, Energy & the Environment)

Erik White, Placer County Air Pollution Control District

Sharmie Stevenson, Fall River Resource Conservation District

Melinda Barrett, Mariposa County Resource Conservation District