Thank you for the opportunity to provide feedback on the LCFS pathways. If you have any questions or would like to discuss further, please do not hesitate to reach out at apiper@rmi.org.

Lookup Table Pathways Technical Support Documentation

The content below is also being submitted as a comment for the Hydrogen calculator feedback.

Upstream methane leakage

- Methane leakage assumptions should be made using the OPGEE model to its most granular capability.
    - Using the latest version of OPGEE is critical, and making sure the best information available is used as inputs to run the model.
        - These inputs include global warming potential, field of origin and information on operating practices, including all sources of methane, determining accurate boundaries, moving beyond generic emission factors and gas compositions, and reconciling modeled results with measured emissions data, where available.
        - RMI uses OPGEE to analyze hundreds of unique sources of gas worldwide, including many fields and basins within and that provide supply to California.
        - Significant updates have been made to the natural gas and methane fugitive portions in OPGEE 3.0 compared to OPGEE 2.0 and should be used wherever possible. OPGEE 4.0 is on the way and should keep improving on these areas and should be adopted once finalized.
    - A flat upstream methane leakage rate is a bad idea, the OPGEE model can be used to get more granular estimates on leakage depending on the source of the gas.
        - Methane loss from natural gas production systems vary significantly by geography and over time. Figure 2 in this report highlight how rates vary over basin and over time, demonstrating why a flat assumption for methane loss when gas is sourced from multiple places is not advisable.
        - RMI's OCI+ tool can help quantity and compare emissions throughout the oil and gas supply chain.
- Use the EPA's updated global warming potential (GWP) of methane emissions.
    - The EPA has proposed an updated GWP for methane (page 54). CARB should incorporate this updated GWP for methane emissions to more accurately account for the emissions impact of methane leakage.
- Synthesize the standards for California's LCFS and state policy.
    - California Senate Bill 781 is being considered by the California legislature and would require a verified low-methane intensity of all gas procured by the state.
    - It is likely this bill, if signed into law, would require a certification standard and process for determining low methane emissions. One such standard is The MiQ Standard, an independent framework for assessing methane emissions from the production of natural gas.
    - It would be expedient and helpful to align the standards for the California Low Carbon Fuel Standard with any standards established as a result of state law.

        - Even if the bill only applies to specific entities distinct from the LCFS, alignment of these standards will be helpful in reducing confusion and support alignment on the strongest possible methane leakage certification.
- Measurement and verification can and should be used to validate modeling.
    - Methane leakage measurement studies often find that leakage rates estimated with emissions factors are far lower than what is found in reality. When using models for methane leakage assumptions, the inputs and outputs should continuously be validated and tweaked using as much measurement as possible. Partnering with NGOs and other stakeholders doing these measurements is one way to ensure the modeled leakage rates more accurately reflect reality.
    - Measurements are needed to accurately assess whether models are accurately reporting methane leakage rates.
    - Quantifying oil and natural gas system emissions using one million aerial site measurements | Research Square
        - This paper finds that "Total estimated emissions range from 9.63% [9.03%, 10.37%] of natural gas production, roughly nine times the US government estimate, to 0.75% [0.65%, 0.85%] in a high-productivity gas-rich region."

Electrolytic hydrogen and carbon accounting for grid connection

- Align book and claim guidance for the LCFS with more rigorous standards for certifying low-carbon electrolytic hydrogen production.
    - Currently, CARB LCFS guidance for book and claim accounting for low carbon intensity electricity used in electrolysis to produce hydrogen for transportation purposes or used in the production of a transportation fuel requires deliverability, additionality, and temporal matching across three quarters. Targeting harmonization of CARB LCFS with future expected standards of the new 45V clean hydrogen production tax credit requirements for electrolytic based production will support a clear and consistent standard and demonstrate the viability and value of accelerated adoption. This harmonization should only occur if the federal rules are more stringent than the existing regulations for the CARB LCFS. Adopting more relaxed rules to achieve harmonization would be an unadvisable route.
    - Recent academic studies suggest annual matching may lead to emissions increases over the course of the 45V hydrogen production tax credit. Other studies suggest that annual matching can be appropriate in the short term while acknowledging that getting to hourly matching requirements is critical.
    - Some advocates, industry, and academics are proposing an hourly matching requirement to secure this federal incentive on accelerated timelines. Given the federal government's commitment to procure half of its clean electricity on an hourly basis by 2030, we recommend CARB update its temporal matching requirements to quickly and efficiently transition to an hourly matching system.
- Marginal emissions rates compliance pathway
    - Marginal emissions should also be considered as a compliant pathway. The data for local marginal emissions should continue to be updated and the methodology should attempt

to provide even more accurate hourly marginal emissions data to effectively determine the emissions intensity of electrolytic hydrogen production.

- Page 27 of the Lookup Table Pathways provides an important start to this process. Participants in the program should be able to opt into either the three pillar or the marginal emissions compliance pathway for compliance.