California Air Resources Board

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To whom it may concern:

HiiROC response to:
Staff Report: Initial Statement of Reasons, dated December 19, 2023,
'Proposed Amendments to the Low Carbon Fuel Standard'

Thank you for the opportunity to respond to this document and thereby provide comments in relation to the proposed revisions to California's Low Carbon Fuel Standard (LCFS). We welcome California's efforts to reduce greenhouse gas emissions to date and recognise the critical role that the LCFS is playing both in addressing climate change and improving air quality.

We fully support the objective of increasing the stringency of the LCFS program in reducing emissions and decarbonising the transportation fuel sector – in our view the proposals represent an effective means of doing so. We welcome the additional support the proposals create for the hydrogen sector, which will help it to play a full and meaningful role in achieving the aims of the Standard. However, we strongly urge that the proposals should take into account the fact that new pathways for the production of hydrogen at scale will soon be commercially available.

In particular, our own Thermal Plasma Electrolysis (TPE) process offers a route to hydrogen production at point of use which combines the low carbon dioxide footprint of water electrolysis with the low electricity input requirements of steam methane reforming. TPE does this by stripping the carbon from a wide range of hydrocarbon feedstocks, capturing the carbon as an inert solid, and producing low-carbon hydrogen fuel (with no CO_2 emissions created by the process itself).

1. About HiiROC (www.hiiroc.com)

HiiROC, a UK-based company, is developing its Thermal Plasma Electrolysis (TPE) process to produce low-cost, low-CO_2 hydrogen, at a comparable cost to steam methane reforming but without emissions from production and using only one-fifth of the electricity required by water electrolysis.

HiiROC's proprietary technology uses plasma torches to convert gaseous hydrocarbon feedstocks (such as biomethane/ renewable natural gas, flare and industrial waste gases, propane, and natural gas) into low carbon hydrogen and solid, high-quality carbon black. The latter co-product is stable and could simply be disposed of, but it also has existing and emerging end-use applications, ranging from tyres and inks to building materials and soil enhancement. Using our TPE process, hydrogen can be produced where it is needed, utilising existing energy infrastructure, and reducing hydrogen storage and transportation costs.

Our technology is rapidly approaching full commercial deployment, bringing with it the potential to unlock step-change growth in the hydrogen economy around the world.

2. Why are we responding to these proposals?

The California Air Resources Board (CARB) has been clear that hydrogen has a significant role to play in delivering the decarbonisation of transport in California and the LCFS is intended to provide economic incentives to produce hydrogen and thereby displace fossil transportation fuels. The proposals have also highlighted the need to incentivise greater production of clean fuels needed in the future, such as low-carbon hydrogen.

At HiiROC we are committed to delivering the potential for TPE to decarbonise economic activity, diversify production pathways for low-carbon hydrogen and enable the global energy transition that will be required to counter anthropogenic climate change.

Responding to these proposals represents a critical way for us to keep policymakers and regulators informed about the technological advances that we believe will enable delivery of low carbon hydrogen at greater scale and at lower cost than existing alternatives. In particular, we wish to highlight that low-carbon hydrogen can be produced without the generation of process CO_2 emissions, by splitting hydrocarbon feedstocks into hydrogen and solid carbon, and that outputting solid carbon in this way should be treated as equivalent to the storage and capture of gaseous CO_2.

We note that the UK's Low Carbon Hydrogen Standard (LCHS) has recently been amended to recognise this equivalency, with 'Gas splitting producing Solid Carbon' having been added as a production pathway falling within scope.[1]

We hope that our thoughts will be helpful and would welcome the opportunity to discuss them further.

3. Comments about: the key concepts underpinning the regulatory update proposal (page 4)

- *Increasing the stringency of the program to reduce emissions and decarbonize the transportation fuel sector, which will also aggressively reduce our dependence on fossil fuels*
  - We support the aim of increasing the stringency of the program, given the anticipated impacts of reducing emissions and decarbonizing the transportation fuel sector.
- *Strengthening the program's equity provisions to promote investment in disadvantaged, low income and rural communities*
  - In this context, we note that our TPE technology is modular, can be sized to meet local demand and can be deployed to produce hydrogen at point of use. This means that there is significant flexibility in where investment in the technology is deployed, with the potential for 100% of any units installed in California to be sourced and manufactured in the United States.
  - TPE also draws on different supply chains from other low carbon hydrogen production technologies, minimising delivery risk for California's hydrogen economy and enabling a broader spread of investment.
- *Supporting electric and hydrogen truck refuelling*
  - In this context, we note that our TPE technology is modular, can be sized to meet local demand and can be deployed to produce hydrogen at point of use. TPE is also capable of producing hydrogen on a flexible basis; this means it can deliver hydrogen volumes in

[1] https://www.gov.uk/government/publications/uk-low-carbon-hydrogen-standard-emissions-reporting-and-sustainability-criteria : UK Low Carbon Hydrogen Standard, version 3 – Appendix A, A.18 – A.26. The current treatment of Solid Carbon Sequestration is covered in the accompanying Data Annex, DA.53 – DA.55.

response to demand patterns. This makes it particularly suitable for the production of hydrogen at truck refuelling stations.

- *Incentivizing more production of clean fuels needed in the future, such as low-carbon hydrogen*
    - We continue to view low-carbon hydrogen as a key enabler of an effective energy transition. What is important here is the carbon intensity of the hydrogen that is produced, not the production method itself. We strongly advocate for a regulatory framework that is technology-agnostic, providing a level playing field for the full range of production pathways which can satisfactorily deliver low-carbon hydrogen. This will best enable the emergence of price competition, which should in turn deliver a successful energy transition at least cost to consumers.
    - In particular, regulations need to recognise that producing solid carbon from hydrocarbons is an effective way of sequestering that carbon content. See Section 4 below for more specific discussion on this point.
- *Supporting methane emissions reductions and deploying biomethane for best uses across transportation*
    - We believe that deployment of our TPE technology at scale has a number of benefits from the perspective of methane emissions reduction.
        1. Flare gas (i.e. natural gas associated with oil production which is combusted or simply vented to the atmosphere at the point of extraction, rather than being processed for onward use) can be used as a feedstock for the TPE process. Producing hydrogen on site from such flare gas, which would otherwise be flared or even vented directly to the atmosphere, has significant potential to reduce the methane and/or CO_2 emissions arising from the production of oil and gas.
        2. Conversion of methane into hydrogen at the site of oil and gas production also potentially reduces the need to transport methane, reducing the risk of methane emissions through leakage during transportation.
    - We would also argue that the best/most impactful use of biomethane is in the delivery of negative CO_2e emissions. When biomethane/renewable natural gas is used as the feedstock for the TPE process, this offers the capacity for negative emissions to be generated in the production of hydrogen, as the carbon content of the renewable feedstock is being fully captured. We believe that biomethane volumes should be prioritized for utilization in this way, delivering negative CO_2e emissions as well as hydrogen which can be used for transport applications.
- *Strengthening guardrails on crop-based fuels to prevent deforestation or other potential adverse impacts*
    - We support the application of strong verification procedures for all low-carbon fuels, as we believe this is crucial to maintain public confidence in the robust credentials of those fuels.

4. <u>Comments about: 'Allow Indirect Accounting for Low Carbon Intensity Injected into Hydrogen Pipelines physically connected to California and Expansion of Indirect Accounting for Low Carbon Intensity Electricity for Hydrogen Utilized as a Transportation Fuel'</u> <u>(page 34)</u>

We note that the 2022 Scoping Plan Update calls for a significant increase in the production of low-carbon hydrogen, displacing fossil fuels for transportation.

HiiROC's TPE technology, by offering significantly lower electricity consumption compared to water electrolysis (approximately one-fifth), will allow far greater hydrogen production volumes from upstream energy infrastructure investment – including renewable electricity generation capacity. This opens the prospect of reaching California's decarbonization targets sooner and/or at a lower cost, with less major infrastructure investment required. For this reason, we believe (as highlighted earlier) that

the regulatory framework needs to adopt a technology-agnostic approach which will allow all hydrogen production pathways to compete on a level playing field.

We fully support the adoption of "*book-and-claim of low-CI hydrogen to support the 2022 Scoping Plan update energy transition by overcoming bottlenecks in hydrogen production and supply*". We believe this will offer significant encouragement to what remains a nascent market today, by providing critical flexibility in matching supply and demand.

However, we are particularly concerned about the following proposal:

"*Staff is proposing to exclude hydrogen derived from fossil gas from book-and-claim eligibility unless low CI hydrogen is produced using book and claim of biomethane or with CCS and used as a transportation fuel.*"

We strongly urge that the output of solid carbon when producing hydrogen from hydrocarbons should be recognised as fully equivalent to CCS as a means of mitigating emissions of gaseous CO_2.

Carbon capture is inherently part of HiiROC's TPE process – the carbon content of the hydrocarbon feedstock is turned into solid, inert carbon. At no point in the process is CO_2 formed; for this reason, we wish to see the definition of CCS extended, such that it does not require CO_2 to be formed and then captured in order to qualify, and the outputting of solid carbon explicitly recognised as equivalent to CCS.

As we have noted above, biomethane can be used as a feedstock for the TPE process. Coupling this renewable feedstock with CCS, in the form of outputting solid carbon, presents the opportunity to deliver negative CO_2e emissions, which we contend will be an extremely valuable tool in countering anthropogenic climate change.

Once again, on behalf of HiiROC, I would like to thank you for the opportunity to comment on these important issues. Please do not hesitate to get in touch should any of the matters raised above require clarification.

Yours sincerely,

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