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Internal Revenue Service
CC:PA:LPD:PR (Notice 2022-58)
Room 5203
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2 December 2022

To whom it may concern:

HiiROC response to: Notice 2022-58
'Request for Comments on Credits for Clean Hydrogen and Clean Fuel Production'

Thank you for the opportunity to respond to this document and thereby provide comments in relation to the planned clean hydrogen production credit under § 45V of the Internal Revenue Code (§ 45V credit) and the clean fuel production credit under § 45Z (§ 45Z credit). We welcome the intention stated on the part of the Department of the Treasury and the Internal Revenue Service to issue guidance here and hope that our comments will be of help.

In our view the proposals represent an effective means of encouraging the development of a hydrogen economy and thereby reducing the emission of greenhouse gases to the atmosphere. However, we strongly urge that the proposals should take into account the likelihood 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 that combines the low carbon dioxide emissions of water electrolysis with the low electricity input requirements of steam methane reforming. TPE does this by stripping the carbon from hydrocarbon feedstocks, leaving valuable hydrogen fuel and sequestering the carbon as a solid (with no CO_2 emissions).

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 converts gaseous hydrocarbon feedstocks (such as biomethane/ renewable natural gas, flare and industrial waste gases, or natural gas) into clean 'emerald' hydrogen and solid carbon. The latter is stable and can simply be disposed of, but it also has existing 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, using existing infrastructure and avoiding storage and transport costs.

Our technology is rapidly approaching full commercial deployment, bringing with it the potential to unlock step-change growth in the hydrogen economy. Included in our current programme of pilot projects are a wide range of hydrogen end use applications

With the publication of the Inflation Reduction Act, we view the United States as an attractive market for our technology and we are developing plans to enter the market via a subsidiary or joint venture.

General comments about the planned tax credits and incentivising hydrogen production
We believe that the tax credits represent an attractive means of encouraging hydrogen generation and thereby stimulating the development of a wider hydrogen economy.

However, we wish to point out that novel low-emission production pathways for hydrogen, such as our own, are likely to be commercially available as alternatives to water electrolysis and steam methane reforming with carbon capture and storage in the near future. The tax credit framework needs to be flexible enough to support these new processes, which then have the potential to drastically reduce the emissions associated with energy usage at a lower cost than 'conventional' hydrogen production technologies.

In order to unlock this opportunity, in the case of our TPE process, there are a number of factors that the framework will need to be able to accommodate:

- Accreditation of novel production technologies, as soon as possible, as a recognised hydrogen production pathway under the GREET Hydrogen model. If the tax credit framework is going to rely upon GREET to calculate emissions intensity, then the latter needs to accommodate all available production pathways. To our knowledge, GREET does not currently do so. This risks excluding newer technology pathways from support, acting as a significant drag on the evolution of a vibrant hydrogen economy.
- Recognition that the production of solid carbon is a form of carbon sequestration – equivalent to permanent geological storage of carbon dioxide but capturing all the carbon content of the hydrocarbon feedstocks used. This will have a significant impact on the calculation of the GHG emissions intensity of hydrogen production technologies outputting solid carbon.
- Appreciation that the production of solid carbon, where this can be monetised via the existing market for carbon black, leads to avoided carbon dioxide emissions in the production of carbon black by conventional means (i.e., oil furnace production). Recognizing this could further reduce the calculated GHG emissions intensity of hydrogen production technologies outputting solid carbon.
- Recognition that the use of biomethane/renewable natural gas, waste industrial gases and flare gases as feedstocks for the production of low carbon hydrogen, where the carbon content of those feedstocks is then sequestered as solid carbon output, offers a valid route to generating negative emissions of carbon dioxide equivalent.

Responses to specific points raised in the request for comment

SECTION 2 BACKGROUND .01 Credits for Clean Hydrogen

- We fully agree with the approach of linking the § 45V credit to the lifecycle greenhouse gas emissions rate that results from the production of hydrogen. However, we would reiterate the points made above that:
    - Novel production technologies need to be fully recognised within the GREET model, as soon as possible, as producing qualified clean hydrogen. We understand that this will require further evolution of GREET.
    - Calculations of the greenhouse gas emissions intensity of production processes such as ours need to recognise that outputting solid carbon is effectively a form of carbon sequestration – equivalent to permanent geological storage of carbon dioxide but capturing all the carbon content of hydrocarbon feedstocks.

- Given the potential for TPE to create negative emissions, once equivalence as a form of carbon sequestration has been recognised, we wonder whether it is appropriate to exclude the possibility of allowing § 45V credit 'for qualified clean hydrogen produced at any facility that includes carbon capture equipment for which a credit is allowed to any taxpayer under § 45Q'. However, we would welcome further discussion on this point.

SECTION 3 REQUEST FOR COMMENTS .01 Credit for Production of Clean Hydrogen

(1) Clean hydrogen.

- *What, if any, guidance, is needed to clarify the definition of qualified clean hydrogen?*
    - The definition is clearly set out: "qualified clean hydrogen is defined in § 45V to include hydrogen that is produced through a process that results in a lifecycle greenhouse gas emissions rate of not greater than 4 kilograms of carbon dioxide equivalent (CO2e) per kilogram of hydrogen".
    - **However**, what is less clear is how the lifecycle greenhouse emissions rate itself should be calculated. Therefore, we would welcome further direction on this topic.
    - In particular, a guidance document setting out some of the critical assumptions within GREET (e.g., what is the level of upstream fugitive methane emissions that is applied to production pathways using methane as a feedstock) would be helpful.
    - Please note that, as mentioned earlier, we believe new production pathways for clean hydrogen will need to be added to the GREET model as soon as possible.
- *(a) Which specific steps and emissions should be included within the well-to-gate system boundary for clean hydrogen production from various resources?*
    - We are supportive of a broad system boundary which includes accounting for fugitive upstream methane emissions. For any production technology relying on natural gas as a feedstock this is a key part of the CO_2e emissions footprint, albeit one we hope will decrease in importance over time as action is taken to reduce methane emissions across the supply chain.
        - We note that fugitive upstream methane emissions are believed to vary widely between different sources of natural gas. Given the importance of fugitive upstream methane emissions in determining the overall emissions intensity of hydrogen produced from natural gas feedstocks, we believe that different rates will probably need to be applied to different sources of natural gas. This will be necessary to ensure that hydrogen produced is actually 'clean' in nature and to avoid unintended consequences relating to the transportation of natural gas and calculated emissions intensity levels.
    - In order to set a level playing field for different hydrogen production technologies, we believe that it is important that the well-to-gate system boundary sets a minimum threshold for the hydrogen output i.e., defines output pressure and output purity, and includes emissions from any additional processes that are required for the hydrogen produced to meet that minimum threshold. This might include, therefore, additional compression or purification processes that are necessary to ensure that hydrogen produced hits pre-defined parameters.
        - For reference, we note that the UK's Low Carbon Hydrogen Standard requires hydrogen producers to account for the emissions associated with meeting a theoretical minimum pressure level of 3MPa and a theoretical minimum purity of 99.9% by volume at the production plant gate, in their emissions calculations.
    - Equally, it is important to account for all inputs required for a particular production method (e.g., input chemicals, materials or water).

  - We are comfortable with the system boundary sitting at the production gate (i.e., not accounting for downstream transportation emissions once hydrogen has left the production site).
    - However, we note that this potentially penalises technologies such as our own which are particularly suited to distributed production at the point of use.
  - One clear exception to the above point relates to the deployment of Carbon Capture and Storage technologies to reduce the emissions profile of produced hydrogen. In this instance, as well as accounting for emissions relating to the carbon capture process itself, we believe that emissions from the transport of carbon dioxide to its ultimate place of storage should also be taken into consideration.
- *(b)(i) How should lifecycle greenhouse gas emissions be allocated to co-products from the clean hydrogen production process?*
  - We support the allocation of lifecycle greenhouse gas emissions to co-products from the clean hydrogen production process, where these co-products are going to be valorised.
    - We note that, however, this is only valuable where the emissions footprint of those co-products is going to be accounted for in their ultimate use.
- *(b)(ii) How should emissions be allocated to the co-products (for example, system expansion, energy-based approach, mass-based approach)?*
  - We are comfortable with the energy allocation method being used. Here we believe it is most important that the approach taken should be easily understood and consistently applied.
- *(b)(iii) What considerations support the recommended approaches to these issues?*
  - In the case of our own TPE process, we believe that where emissions are allocated to solid carbon output produced as a co-product, it would also then be appropriate to account for carbon dioxide emissions avoided in the production of carbon black by conventional means (i.e., oil furnace production).
- *(c)(i) How should lifecycle greenhouse gas emissions be allocated to clean hydrogen that is a by-product of industrial processes, such as chlor-alkali production or petrochemical cracking?*
  - Where the hydrogen is a by-product (i.e., the industrial process is going to be undertaken anyway, regardless of any hydrogen produced) we suggest it might be appropriate for no emissions to be allocated to the hydrogen output from that production process itself. Should the hydrogen be valorised, it might be appropriate for emissions to be allocated to the hydrogen output in some way.
  - Two of the use cases currently being explored for our process use as feedstock industrial waste gases or natural gas that would otherwise be flared. It is highly likely that the decarbonisation of industrial processes, rather than the production of hydrogen, will be the primary driver here. We would welcome further discussion with you on how best to account for emissions in these instances.
- *(d) If a facility is producing qualified clean hydrogen during part of the taxable year…, should the facility be eligible to claim the § 45V credit only for the qualified clean hydrogen it produces, or should it be restricted from claiming the § 45V credit entirely for that taxable year?*
  - What is important here is that the facility produces as much clean hydrogen as possible and that any clean hydrogen produced is recognised as clean and is incentivised as such.
  - It is possible that, over the course of a year, a facility could produce hydrogen with varying emissions intensity levels, potentially due to factors outside of its direct control. Should some output exceed the maximum emissions intensity threshold, to our mind it would then be draconian for all the facility's output during that taxable year to become ineligible for support via the § 45V credit.
  - For the above reasons we believe that a facility should be allowed to claim the § 45V credit for, but only for, its qualified clean hydrogen production in a taxable year.

- *(e) How should qualified clean hydrogen production processes be required to verify the delivery of energy inputs that would be required to meet the estimated lifecycle greenhouse gas emissions rate as determined using the GREET model or other tools if used to supplement GREET?*
    - We believe that existing monitoring, reporting and verification frameworks and approaches should be adaptable for qualified clean hydrogen processes, but we would welcome further engagement with you on this point.
    - We would also argue that a similar approach needs to be taken for verifying all process inputs (chemicals, materials, water etc.), not just energy inputs.
- *(e)(ii) What granularity of time matching (that is, annual, hourly or other) of energy inputs used in the qualified clean hydrogen production process should be required?*
    - We suggest that time matching of energy inputs on an hourly basis would be appropriate unless there are specific reasons why this is constrained.
    - The Treasury and the IRS may also wish to consider the additionality of the energy inputs being matched against hydrogen production.

(2) Alignment with the Clean Hydrogen Production Standard

- *For purposes of the § 45V credit, what should be the definition or specific boundaries of the well-to-gate analysis?*
    - We suggest that the § 45V credit should be aligned as much as possible to the Clean Hydrogen Production Standard, if only for ease of understanding and accessibility.
    - We also refer to our comments above in relation to setting the definition and system boundaries for well-to-gate analysis [response to 3.01(1)(a)].

(3) Provisional Emissions Rates

- *(a) At what stage in the production process should a taxpayer be able to file such a petition for the provisional emissions rate*?
    - We suggest that this option should be available up to the production of first hydrogen; we would welcome further discussion with you on this point.
- *(b) What criteria should be considered by the Secretary in making a determination regarding the provisional emissions rate?*
    - We would argue that the most important consideration should be that it has not yet proven feasible to gain a 'regular' determination for the purposes of § 45V.
    - The criteria used to reach a provisional determination would presumably not be that different from those applied in a normal determination – the difference would be likely to relate to greater use of estimations and assumptions, for the purposes of gaining a provisional determination.
    - Evidence about the emissions intensity of production would need to be presented and assessed before a provisional determination is reached. We would anticipate this to be conditional on a normal determination then being granted in the future.

(4) Recordkeeping and Reporting

- *(a) What documentation or substantiation do taxpayers maintain or could they create to demonstrate the lifecycle greenhouse gas emissions rate resulting from a clean hydrogen production process?*
    - We suggest that existing frameworks and approaches should be utilised as far as possible.

- *(f) Should indirect book accounting factors that reduce a taxpayer's effective greenhouse gas emissions (also known as a book and claim system), including, but not limited to, renewable energy credits, power purchase agreements, renewable thermal credits or biogas credits be considered when calculating the § 45V credit?*
    - Yes.
    - However, careful consideration needs to be given to the additionality represented by such indirect book accounting factors. We would be happy to discuss this further with you.
- *(g) If indirect book accounting factors … are considered in calculating the § 45V credit, what considerations (such as time, location and vintage) should be included in determining the greenhouse gas emissions rate of these book accounting factors?*
    - Strict matching on a time and vintage basis should be a requirement. Geographic matching need not be required if emissions from, for example, use of electricity transmission and distribution networks, are taken into account when calculating emissions intensities.
    - Additionality may also need to be a consideration here.

(6) Coordinating Rules

- *(c) Coordination with § 45Q*
    - We suggest that the Treasury and the IRS will need to consider how they classify the splitting of hydrocarbon feedstocks into hydrogen and solid carbon, and the equivalence of outputting solid carbon to carbon capture. Please see our earlier comments in the '**General comments about the planned tax credits and incentivising hydrogen production**' section above.

(7) Please provide comments on any other topics related to § 45V credit that may require guidance.

- Please refer to the points made in our '**General comments about the planned tax credits and incentivising hydrogen production**' section above.

SECTION 3 REQUEST FOR COMMENTS .02 Clean Fuel Production Credit (§ 45Z)

(2) Establishment of Emissions Rate for Sustainable Aviation Fuel

- *What methodologies should the Treasury Department and IRS consider for the lifecycle greenhouse gas emissions of sustainable aviation fuel for the purposes of § 45Z(b)(1)(B)(iii)(II)?*
    - We believe it would be helpful if the methodology adopted is as close as possible to that used for the definition of clean hydrogen production, at least in so far as the latter is used in the production of sustainable aviation fuel.

(3) Provisional Emissions Rates

- *(a) At what stage in the production process should a taxpayer be able to file a petition for a provisional emissions rate?*
- *(b) What criteria should be considered by the Secretary to determine the provisional emissions rate.*
    - Please see our responses above to the similar questions in relation to Provisional Emissions Rates for clean hydrogen production.

(7) Please provide comments on any other topics related to § 45Z credit that may require guidance.

- We note that one of the areas where we hope to apply our TPE process for producing hydrogen in future is for the onward production of (i.e., as a feedstock for) sustainable aviation fuels.
- With this in mind, please refer to the points made in our '**General comments about the planned tax credits and incentivising hydrogen production**' section above.

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 about require clarification.

Yours sincerely,

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