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David Crane
Leadership Team

Department of Energy
Response requested via e-mail

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Date: **November 7, 2022**
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Clean Hydrogen Production Standard (CHPS):

H_2-Industries comments on the DOE draft guidance document, Version Oct. 2022

Dear David,

Thank you to involve H_2-Industries in the current DOE feedback loop. The request for feedback on the draft Clean Hydrogen Production Standard (CHPS) was received by Prof. Dr. Ing. Klaus Lederer, Chairman of the Advisory Board of H_2-Industries.

H_2-Industries Inc. is a holding company engaged in the development of technology for production, transport, storage, and release of clean hydrogen (www.h2-industries.com). One of H_2-Industries' main technology solution is the conversion of organic waste and non-recyclable plastics into clean hydrogen, capturing CO_2 in conjunction with other valuable processing pathways, e.g., towards Syngas without releasing harmful emissions into the atmosphere.

With upstream emissions in the lifecycle GHG emissions, such as waste conversion of plastic fractions from MSW to Hydrogen, it is important to check the carbon intensity by production technology and by feedstock.

Example non-recyclable plastics: As plastics waste streams cause already a wide variety of critical problems on a global scale, low GHG emission conversion pathways of such feedstock to Hydrogen or Syngas should receive our full attention and support.

According to Worldwide Fund for Nature (WWF), plastics production will more than double by 2040 and marine plastic pollution will triple. This could lead to a fourfold increase in the concentration of macro plastics in the oceans by 2050 and by 2100 lead to an alarming 50-fold increase in microplastics in the oceans [WWF 2022, www.wwf.de/plastic-biodiversity-report].

1) Proposed CHPS lifecycle definition [Source: Latham & Watkins Oct. 12, 2022|Number 3021]

- DOE proposes that "the emission sources that would be accounted for in the lifecycle target proposed in the draft guidance **include upstream processes** (e.g., electricity generation, fugitive emissions), as well as downstream processes associated with ensuring that CO_2 produced is safely and durably sequestered."

- Upstream processes include the generation of the electricity used, the extraction of any feedstock, and fugitive emissions from feedstock delivery.

- Downstream processes include any fuel combustion used for compression of captured CO_2 and fugitive emissions from CO_2 transport and sequestration

- DOE indicates that "the lifecycle target corresponds to a system boundary that terminates at the point at which hydrogen is delivered for end use."

2) H_2-Industries feedback in a nutshell:

- **Upstream history:** Life-Cycle assessments of upstream plastics production result in remarkable gross CO_2 emissions for the manufacturing process chain with 1.6 up to 3.7 kg CO_{2e}/kg Polymer [Sources: "A. Alsabri et.al., "Life-Cycle Assessment of Polypropylene Production in the Gulf Cooperation Council (GCC) Region", Polymers 2021, 13, 3793 and Eionet Report – ETC/WMGE 2021/3, table 2-3 on page 18, att.].
  Consequence → upstream CO_2 emissions already far beyond 4 kg CO_{2e}/kg Hydrogen.

- *Therefore, GHG emissions tied to the plastics upstream manufacturing history should not be added on top of waste to hydrogen conversion process technologies for waste conversion processes with an integrated CO_2 capture step.*
  Same for GHG emissions out of the different types of upstream waste collection systems (landfill recovery, MSW waste collection, …).

- *A process differentiation between combustion and endothermic conversion to Hydrogen and (captured) CO_2 in the absence of air/Oxygen is recommended → the combination of high temperature reforming without air/oxygen with a water-gas shift step improves Hydrogen yield and conditions for CO_2 separation.*

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- **Downstream pathway:** Waste to Hydrogen conversion processes can be used as an alternative pathway to landfill sites, notorious for releasing harmful Methane emissions at a global warming potential of **82.5** (GWP based on 20 years, vs. GWP CO_2 = 1; Source: 2022 DOE, AMR/SA174; A. Elgowainy, Argonne National Lab)

  → *consideration of a "CO_2 credit" is recommended to support related Methane emission reduction efforts* [Dr. Romanas Savickas, "Waste to Hydrogen as future scenario", https://www.linkedin.com/pulse/waste-hydrogen-future-scenario-dr-romanas-savickas].

- "Although some CO_2 is produced by thermochemical processing, the International Panel on Climate Change (IPCC) regards *(even)* incineration of the biogenic fraction of waste as CO_2-neutral, a definition that encompasses waste such as animal carcasses, scrap wood, waste vegetable oils and post-consumer wastepaper".
  [Dr. Romanas Savickas, "Waste to Hydrogen as future scenario", see above]

  → *classification of Hydrogen out of such biomass conversion processes as "clean".*

Best wishes for a fast-track and successful realization of DOE's ambitious hydrogen deployment programs. Please let us know in case of questions.

Kind Regards,

H_2-Industries Inc.
Date:
Place:

Michael Stusch
CEO

Attachment:

Eionet Report – ETC/WMGE 2021/3, "Greenhouse gas emissions and natural capital implications of plastics (including biobased plastics)", May 2021