To: U.S. Department of Energy
Hydrogen and Fuel Cell Technologies Office

From: Cemvita Factory, Inc.

Contact: Zach Broussard
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Date: November 14, 2022

Re: Comments on Clean Hydrogen Production Standard (CHPS) Draft Guidance

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Submitted via electronic mail to: cleanh2standard@ee.doe.gov.

Executive Summary

Cemvita Factory, Inc. (Cemvita) is an industrial biotechnology company headquartered in Houston, Texas. We have developed a biological pathway to convert petroleum into geologic hydrogen in-situ in the subsurface. We recently completed a successful field trial of this biotechnology in the Permian Basin of west Texas, and will soon begin a second, larger field trial to pilot our technology on a larger scale. Data from our first field trial indicates that we will have the capability to produce hydrogen in situ, and extract it while the carbon dioxide by-product is sequestered downhole, resulting in a carbon intensity of nearly zero $kgCO_2e/kgH_2$.

Cemvita supports the CHPS draft guidance as written. This includes the definition of "clean hydrogen" as hydrogen with lifecycle greenhouse gas emissions of $\leq$2 $kgCO_2e/kgH_2$. We also support the DOE's initial target of 4.0 $kgCO_2e/kgH_2$ for the purpose of guiding evaluations of funding applications under the Regional Clean Hydrogen Hubs Program and the Clean Hydrogen Research and Development Program. Furthermore, Cemvita agrees with DOE's lifecycle system boundary as described in the draft guidance.

Questions and Answers

Question (1)(b):

Lifecycle analysis to develop the targets in this draft CHPS were developed using GREET. GREET contains default estimates of carbon intensity for parameters that are not likely to vary widely by deployments in the same region of the country (e.g., carbon intensity of regional grids, net emissions for biomass growth and production, avoided emissions from the use of waste-stream *materials). In your experience, how accurate are these estimates, what are other reasonable values for these estimates and what is your justification, and/or what are the uncertainty ranges associated with these estimates?*

Answer:
LCA models can vary in accuracy and inclusion. The GREET model has the possibility of being lobbied for inclusion or exclusion of major emissions sources and markets. Historically, the biggest flaw in the GREET model has been a tendency to overprotect against perverse incentives. In doing so, the model fails to address many real environmental issues. It has a strong tendency to reject anything oil and gas related, even if solid data can be provided that shows the actual benefits of the implementation of assets and technologies to resolve these issues.

Some examples of this include:

- Flare gas not being included. While it is true that including flare gas can introduce the possibility of intentional flaring to secure a pathway, then building infrastructure to resolve it, many flares already exist which cannot be easily addressed, and there is no incentive to try to eliminate those environmental hazards.
- CO_2 generated from oil and gas production is not included as a reasonable source, even though sources like amine plants at gas gathering facilities collectively emit millions of tons of CO_2 per year. Because of this, these CO_2 sources will not be prioritized and will continue to be a problem.
- Landfill gas was given a higher carbon intensity to avoid the construction of new landfills purely for the purpose of gas production.

These types of exclusions, many of which were not present in GREET 1.0, have been introduced in later versions of GREET, creating uncertainty for businesses attempting to execute projects that address these real issues.

For the GREET model to function properly, if an emissions source can be demonstrated to have been consistently problematic with no reasonable economic resolution to date, then the emissions reductions from that source should be counted.

Question (2)(b):
Use of some biogenic resources in hydrogen production, including waste products that would otherwise have been disposed of (e.g., municipal solid waste, animal waste), may under certain circumstances be calculated as having net zero or negative CO_2 emissions, especially given scenarios wherein biogenic waste stream-derived materials and/or processes would have likely

resulted in large GHG emissions if not used for hydrogen production. What frameworks, analytic tools, or data sources can be used to quantify emissions and sequestration associated with these resources in a way that is consistent with the lifecycle definition in the IRA?

Answer:
Many depleted oil wells currently sit abandoned and uncapped. It is well documented that such wells may pose a significant environmental problem in the form of fugitive methane emissions. Cemvita's goal is to utilize those wells to produce hydrogen in-situ in the subsurface. In the process of doing so, we will be able to eliminate those fugitive methane emissions by repurposing the wells for hydrogen production, capturing any methane produced during the process, and pairing on-site gas turbine power generation with carbon capture, utilization and/or sequestration to produce clean electricity that enhances overall project economics. This results in the elimination of methane emissions from abandoned oil wells, combined with the production of low carbon intensity clean hydrogen.

Question (3)(a):
How should the GHG emissions of hydrogen commercial-scale deployments be verified in practice? What data and/or analysis tools should be used to assess whether a deployment demonstrably aids achievement of the CHPS?

Answer:
In practice, GHG emissions of hydrogen commercial-scale deployment should be verified through a lifecycle analysis that is: (1) performed using a generally accepted methodology, (2) conforms to the lifecycle system boundary described in this draft guidance, and (3) is verified by a relevant third party. Relevant third parties could include DOE, EPA, U.S. national laboratories, or outside consultants specializing in GHG lifecycle analysis. Cemvita was recently awarded a grant under the DOE's Hydrogen Shot Program, and is using its award to work with Argonne National Laboratory to develop best practices for data analysis in the context of quantifying $kgCO_2e/kgH_2$ in lifecycle analyses.

Question (3)(c):
Should renewable energy credits, power purchase agreements, or other market structures be allowable in characterizing the intensity of electricity emissions for hydrogen production? Should any requirements be placed on these instruments if they are allowed to be accounted for as a source of clean electricity (e.g. restrictions on time of generation, time of use, or regional considerations)? What are the pros and cons of allowing different schemes? How should these instruments be structured (e.g. time of generation, time of use, or regional considerations) if they are allowed for use?

Answer:
Cemvita recommends allowing renewable energy credits, power purchase agreements, and virtual power purchase agreements in characterizing the intensity of electricity emissions from hydrogen production. This will allow project developers the flexibility to move faster to develop clean hydrogen projects, without having to necessarily also develop their own clean energy and power storage resources. As long as lifecycle analysis can show that hydrogen produced by a project meets the clean hydrogen production standard, then it does not make sense to tie projects to specific electrons, so long as more low- or zero-carbon energy is being added to the grid, whether directly or indirectly, as a result of those projects.

Question (3)(d):
What is the economic impact on current hydrogen production operations to meet the proposed standard (4.0 kgCO2e/kgH2)?

Answer:
A Cemvita commercial-scale geologic hydrogen facility capable of producing 15,000 tons per year of hydrogen would repurpose 50 depleted oil wells, have a CAPEX of approximately $75 million, and an OPEX of approximately $1 per kilogram of hydrogen produced. Such a facility would bring both short-term construction jobs and long-term field operations jobs to rural, low-income communities that will lose jobs as the U.S. winds down domestic oil production over the coming decades. Cemvita needs workers from the upstream oil and gas industry to apply their skills to clean hydrogen production. We envision a world in which no fossil energy worker or community is left behind. We are looking to bring new opportunities to those communities which would enable workers to meaningfully participate in the energy transition.