9950 Woodloch Forest Dr.

Suite 1600

The Woodlands, TX 77380

E-mail: raymond.cline@lancium.com

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Hydrogen and Fuel Cell Technologies Office
United States Department of Energy
Forrestal Building
1000 Independence Ave, SW
Washington, DC 20585

Dear Hydrogen and Fuel Cell Technologies Office:

Lancium believes that to realize the maximum production of green hydrogen through renewable generation multiple power utilization structures should be encouraged. We suggest that the clean hydrogen production standard support the following structures to demonstrate the specified *4.0 kgCO2e/kgH2* goal.

1. **Direct Connection to Low Carbon Generation Resource(s):** Hydrogen production facilities are connected via a direct line or within the same installation to one or more low carbon generation resources (wind, solar, nuclear, and like zero carbon generation sources) in such a way as to meet the low carbon intensity goals set forth in the IRA legislation. Such projects will automatically qualify and have a carbon intensity of zero.

2. **Time-Matched Procurement through Power Purchase Agreement(s):** Maximum generation of green hydrogen would greatly benefit from the flexibility afforded by the use of Power Purchase Agreement(s) with low carbon generation resources. Multiple PPAs could be "stacked" to produce a power availability shape necessary to maximize green hydrogen production. For example, stacking PPAs from both wind and solar resources could allow a hydrogen facility to be powered by carbon free electricity with a higher up-time than if it were powered by one wind or solar resource alone. Whether using a single PPA or stacked PPAs, the hydrogen production facility should demonstrate a power utilization that time-matches the combined generation of the PPA resource(s), ie, hydrogen production

should "follow" the output of the PPA generation resource(s). Specifically, the combined generation from the PPA resource(s) must be equal to or greater than the amount of power consumed by the hydrogen production facility, and hydrogen production should be curtailed as the combined generation from PPA resources decreases below the rated capacity of the hydrogen plant. Shorter timeframes for the time-matching would provide greater confidence and connection between the power generation and hydrogen production facilities. We would suggest an hour-by-hour match, though initially a longer timeframe may encourage more green hydrogen production.

3. **Congestion, Ancillary Services, and Renewable Energy Zones**. Two challenges with operating grids with high penetrations of intermittent renewables are congestion and ancillary services, i.e., operating reserves needed to balance supply and demand. It is common for renewable energy resources to be located far from and with limited transmission capacity connecting it to load. As a result, grid operators often curtail flexible renewable generation resources to maintain reliability of the transmission system and relieve congestion. NREL and DOE have developed the concepts of Renewable Energy Zones to identify regions with high renewable production potential that should be prioritized for transmission development. Such regions are, by definition, transmission constrained, and so any load within an REZ will tend to run on renewable energy and, by consuming the electricity locally, reduce the tendency for such resources to be curtailed due to transmission constraints. Similarly, grids with high penetrations of renewables may require "the supply of additional reserve products needed support the variability and uncertainty of wind and solar."[1] Thus, we propose that any hydrogen electrolysis facility located within a defined REZ that provides ancillary services for grid stability should qualify as green hydrogen production.

Sincerely,

Raymond E Cline Jr, PhD
Chief Technology Officer

[1] https://www.nrel.gov/docs/fy19osti/70630.pdf