The Inflation Reduction Act Section 45V: Catalyzing the Green Hydrogen Revolution

Introduction

The Inflation Reduction Act (IRA) represents a transformational moment in renewable energy strategy. The introduction of the Hydrogen Production Tax Credit (PTC) under Section 45V is instrumental in promoting the production of green hydrogen, a key ingredient in accelerating a sustainable energy economy and reducing carbon emissions in hard-to-abate, industrial sectors such as oil refining, fertilizers, chemicals, steel, maritime, aviation, and transport.

The 45V Hydrogen PTC: Insights and Implications

The 45V tax credit introduces a variable rate from $0.60 to $3.00 per kilogram of hydrogen, with the amount dependent on the lifecycle emissions of the hydrogen production process. The legislation outlines three critical pillars that projects must satisfy to qualify for the full credit:

1. **Colocation with Clean Energy Sources or Deliverability (Section 45V(c)(2)(C)(i))**: Projects must be regionally co-located with new clean energy sources as defined by the Department of Treasury. This criterion fosters ecosystems where hydrogen production and renewable energy generation are closely integrated, enhancing energy efficiency and reducing transportation emissions.
2. **Utilization of Clean Energy or Additionality** (**Section 45V(c)(2)(C)(ii)**): Projects must use clean energy sources developed within the last three years, ensuring that the hydrogen produced is derived from the latest, most efficient and sustainable technologies available.
3. **Hourly Matching Requirements by 2028** (**Section 45V(c)(2)(C)(iii)):** Under the IRA, projects must adhere to hourly matching requirements by 2028. This means that hydrogen production must align with the actual hourly generation profiles of renewable energy sources, ensuring a direct and immediate use of renewable energy as it is generated.

Hourly Matching: The Core Challenge

The stipulation for hourly matching by 2028 is perhaps the most challenging for green hydrogen manufacturers, as it necessitates a level of operational flexibility not commonly found in traditional green hydrogen production technologies. Hourly matching requires producers to adjust hydrogen production in real time to match the fluctuating supply of renewable energy. This is a hurdle for traditional hydrogen electrolyzers that are designed for steady, continuous operation, and are not equipped to quickly and safely adjust in response to intermittent power sources like solar and wind, or to different energy input costs from a renewable electric grid.

Electrolyzer Design: A Key for Hourly Matching

Dynamic Operations: Verdagy's eDynamic® electrolyzer is engineered for dynamic response to fluctuations in renewable energy sources. The eDynamic electrolyzer allows real-time adjustment of operating currents (5% to 100% range) and hydrogen production rates to match the hourly variations in renewable energy availability, thus allowing asset owners to utilize renewable energy sources most efficiently and to obtain the full $3.00/kg Production Tax Credit under the IRA.

Swift Response: The eDynamic electrolyzer adapts its operation in near real-time (1 minute). This rapid response capability is critical for managing the intermittent nature of renewable energy sources, allowing hydrogen production to be matched consistently and optimally with the availability of renewable energy.

The electrolyzer's internal circulation fosters rapid thermal equilibrium, minimizing temperature imbalances that could otherwise lead to inefficiencies or downtime. This capability is critical given the natural variability of renewable energy generation. Patented feedforward, and feedback control algorithms are implemented within the eDynamic electrolyzer, enabling it to preemptively adjust to expected changes in power availability without experiencing significant pressure or temperature variances.

Reduced Gas Cross Over: Furthermore, the eDynamic electrolyzer operates at atmospheric pressure, minimizing gas crossovers, a common challenge in electrolysis where hydrogen permeates the oxygen stream and vice versa. This advancement not only enhances the safety profile of the electrolyzer but also ensures that the purity of the hydrogen produced is maintained at optimal levels, a key requirement for the use of hydrogen. Customers obtain very low crossover values of 0.01% to 0.02% of oxygen in hydrogen (Figure 1) with Verdagy, compared to a range of 0.5% - 5%[1]with most PEM-based electrolyzers, and well below typical safety specifications of 4%.

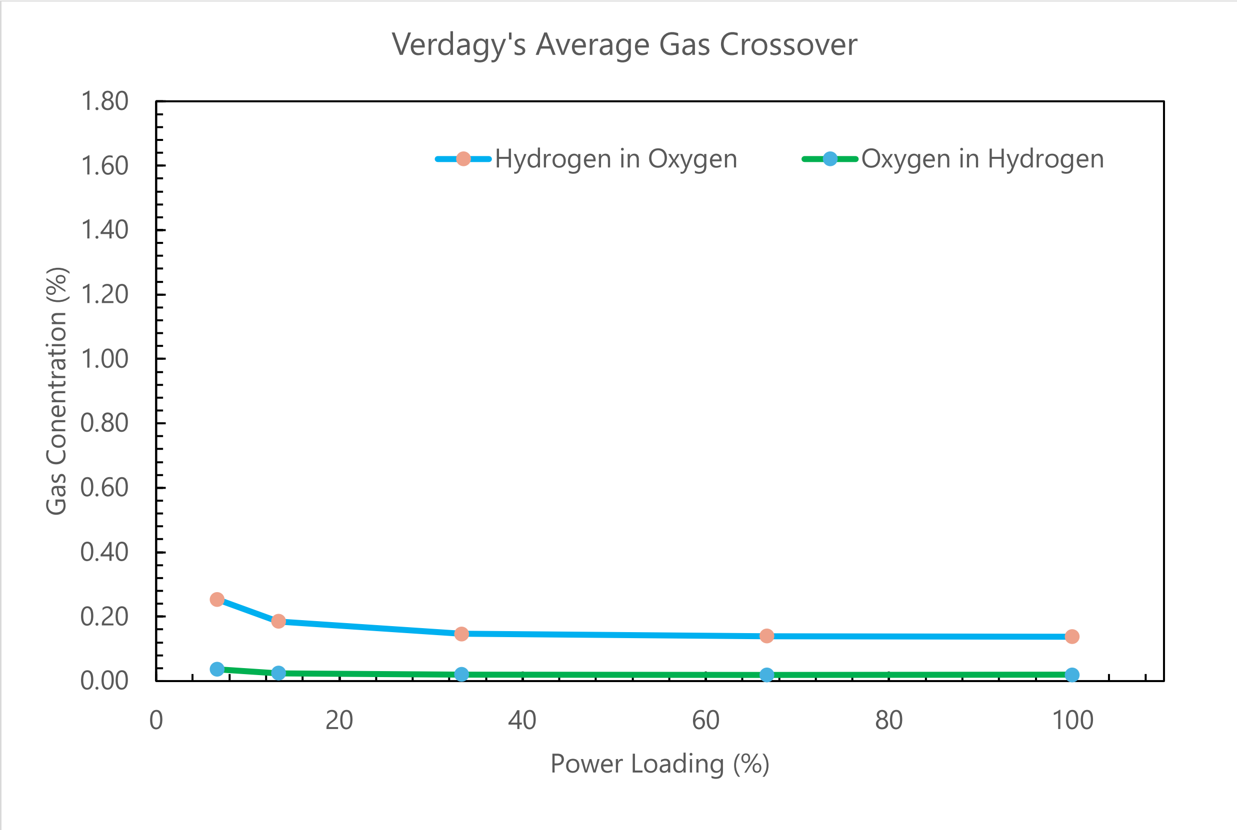

Figure 1: Verdagy's low gas crossover

Conclusions:

1. Verdagy's eDynamic facilitates full compliance with Section 45V of the Production Tax Credit included in the US Inflation Reduction Act by enabling precise hourly matching of hydrogen production to renewable energy generation, thus ensuring eligibility for the full $3/kg tax credit.
2. The use of Verdagy electrolyzers, characterized by high current density, leads to higher green hydrogen outputs and lower production costs (LCOH).
3. Verdagy eDynamic electrolyzers, with their wide operational range and rapid response to fluctuations in renewable energy sources, are key to maximizing the use of renewable power and gaining the full PTC tax credit, thus, achieving the lowest levelized cost of hydrogen (LCOH).

References:

1. Assefi, A. S., Kelso, P. J., Scott, K., & Strachan, M. R. (2021). Hydrogen crossover in proton exchange membrane electrolysers: The effect of current density, pressure, temperature, and compression. International Journal of Hydrogen Energy, 46(39), 20612-20625.

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