A Plan to Achieve the Elusive Hydrogen Economy

By Steve Hill, NewHydrogen CEO

Why hydrogen?

Hydrogen is the cleanest and most abundant element in the universe, and we can't live without it. Hydrogen is the key ingredient in making fertilizers needed to grow food for the world. It is also used for transportation, refining oil and making steel, glass, pharmaceuticals and more.

The term "hydrogen economy" was coined in the 1970s by John Bockris. He envisioned a future in which hydrogen, produced using renewable energy like solar power, would be a primary energy carrier, similar to electricity. Bockris' work was driven by concerns about fossil fuel depletion and environmental pollution.

The idea of using hydrogen for energy storage and transport dates back to the early 20th century. Geneticist J. B. S. Haldane proposed a system of wind turbines producing hydrogen and oxygen through electrolysis in 1923, to address the variability of renewable energy.

Despite a century of intense interest, the hydrogen economy has not come to pass. Several challenges have slowed its realization:

- **High costs,** especially renewable green hydrogen produced via electrolysis
- **Limited infrastructure,** transportation, storage and integration with existing energy infrastructure
- **Energy inefficiency**, with losses at multiple points from production to end use
- **Evolving regulatory frameworks**, which create uncertainty for investors and project developers
- **Public perception and safety concerns**
- **Competition from battery technologies,** particularly in the automotive sector

A breakthrough technology is needed to dramatically accelerate hydrogen adoption. To be successful, this technology must address the following factors:

- **Cost** – hydrogen must be low-cost
- **Clean** – production of hydrogen should avoid the use of dirty hydrocarbons, such as coal, oil and natural gas
- **Availability** – hydrogen must be widely distributed to support a variety of applications

The Core Challenge

With the exception of geologic hydrogen – deposits of hydrogen gas found in some parts of the world – hydrogen does not exist in a free state. It is found in abundance throughout the world in the form of water – part of tightly bound H_2O molecules. Breaking it apart to obtain hydrogen (H_2) requires a considerable amount of energy.

In the U.S. low-cost hydrogen is produced via **steam reforming (SMR)** of natural gas, a method that is relatively inexpensive but is highly carbon intensive. However, very few nations are blessed with an abundance of natural gas or other hydrocarbons, such as coal and oil.

Therefore, to realize the hydrogen economy, our worldwide focus must shift to water, which is a very low cost, renewable and readily available feedstock. The key question is: **How do we split water cheaply and cleanly?**

The Electrolyzer Dilemma

At this time, using electrolyzers is the only commercially available method of splitting water. This technology uses electricity to separate water into hydrogen and oxygen, a method first demonstrated in 1800 and industrialized in the early 20th century.

Unfortunately, electrolyzers are far from a low-cost solution. Challenges include:

- **High capital costs**
- **Dependence on rare and expensive catalysts**
- **Operating Costs – primarily electricity consumption and inefficient electrochemical processes**

Simply put, using electricity to split water is not very efficient and the resulting cost of producing hydrogen is very expensive – considerably more expensive than producing hydrogen by steam reforming natural gas – especially in the U.S.

A New Path: Heat Instead of Electricity

NewHydrogen is developing a fundamentally different solution: ThermoLoop™, a thermochemical process that uses heat, instead of electricity, to split water to make clean hydrogen.

By using heat directly, ThermoLoop bypasses the inefficiencies and high costs of electricity-based systems. It can be powered by any heat source, such as concentrated solar, industrial waste heat or nuclear, making it flexible, scalable and potentially much cheaper.

At the heart of ThermoLoop is its use of novel materials and reactions that keep the process running at nearly the same temperature. Traditional thermochemical cycles suffer from significant energy loss due to heating and cooling fluctuations. ThermoLoop’s stable temperature approach addresses this long-standing barrier, enabling continuous, 24/7 hydrogen production wherever there’s heat and water.

Even when using large industrial heaters powered by electricity, ThermoLoop's theoretical heat-based thermodynamic efficiency suggests it can outperform electrolyzers on a cost-per-kilogram basis. That can make ThermoLoop technology not just an alternative, but a direct threat to the electrolysis-first strategy dominating today's clean hydrogen buildout.

A Critical Juncture for Hydrogen

Continuing to rely on inefficient electrolyzer technology won't help us achieve the promised hydrogen economy. These 200-year-old systems still depend on large amounts of electricity and face major cost and scaling challenges. Despite billions of dollars of investment, electrolyzers have struggled to deliver the cost reductions and reliability needed to help unlock the global hydrogen economy.

Alternative land-intensive solar hydrogen proposals face intermittency issues and scaling challenges.

To unlock the hydrogen economy, we must look beyond legacy approaches. ThermoLoop isn't just an alternative, it's a breakthrough. ThermoLoop offers a lower cost, cleaner and more efficient path forward and has the potential to be the key to finally delivering on the promise of the hydrogen economy.