H2View Introduces

H2Pro

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Israel's H2Pro has developed an all-new kind of electrolyser that is designed to beat existing systems on capex, renewables integration, and system efficiency, in the hopes of producing the lowest possible levelised cost of hydrogen (LCOH).

The company's Decoupled Water Electrolysis (DWE) technology separates the production of hydrogen and oxygen in real time, eliminating the need for a membrane to improve flexibility and reducing efficiency loss.

"The unique DWE system architecture almost entirely eliminates shunt currents, unlocking a market-beating peak efficiency," Chief Business Officer, Rotem Arad, told H2 View.

"It also delivers superior efficiency across a wide load range, including at very low partial loads. The efficiency is between 10 and 15% better than state-of-the-art PEM systems from our minimum turndown up to nominal load conditions."

This, the company says, could open the door to grid applications, behind-the-meter operations, and low-cost green molecules for a range of use cases.

Cyclical operation

Between oxygen and hydrogen cycles, the electrical current is paused, and switching valves allow lye to recirculate for some seconds to flush most of the bubbles from the stack. Then, using a patented process, flush lye is evenly pushed out of the stack as the other lye enters.

Other proprietary mechanical techniques ensure any residual bubbles are removed before switching between hydrogen and oxygen evolution modes.

This decoupled cyclical operation is the key to the DWE's flexible operation. Each electrode 'set' is sequentially charged and discharged, similar to a battery absorbing and then releasing power.

During the hydrogen production phase, electricity is consumed and hydrogen is released at a bifunctional electrode into the recirculating electrolyte solution, while the counter electrode charges. This hydrogen production phase lasts approximately 15 minutes. During the shorter discharge phase, the electrical current is reversed as oxygen is produced.

The system consists of multiple sets, a majority of which, at any given time, are in hydrogen generation (or charge) mode, and the rest are in discharge mode. Each set is controlled individually, adjusting current density for the available load input. Thus, the charge/discharge nature of the process allows for a precise load-following operation resulting in "hyper-flexibility."

Hydrogen crossover between alkaline electrolyser membranes at low loads is a common limitation. This generally limits their safe operating range from 30% to 100% of nominal power consumption. However, at 30% power consumption, their hydrogen production efficiency can be cut in half.

"Alkaline electrolysers like to be turned on, ramped up and left alone," said Arad. "Our system meets alkaline electrolysers on their competitive capex and beats them soundly on their turndown performance."

This makes the H2Pro system particularly suited to purchasing zero or negative cost, off-peak electricity.

Ultra-low capex

Intentionally intermittent operation of an electrolyser drives down utilisation because the capital investment is idle for a portion of the time. For a highly capital-intensive electrolyser, such as a solid oxide system, this would elevate the LCOH significantly.

However, H2Pro believes its systems will be so low-cost, they will still beat high-utilisation alternatives.

"The ultra-low capex of the H2Pro system makes the business case for intermittent operation during off-peak periods attractive," Rotem said. "We will be selling systems at around €500/kW when we commercialise and scale production.

"For that all-in price, customers will get a fully functional electrolyser from the rectifier at the front end to the hydrogen at the back end."

H2Pro's commercial product line will be aimed at projects at least 25MW in size – a scale it believes is easily manufactured and assembled, thanks to the lack of membrane and the small number of parts in the electrodes.

The whole system can also be PFAS and PGM-free, reducing initial capital cost, supply chain dependencies, and the risk that maintenance costs will rise in line with precious metals prices.

H2Pro will complete construction of a 0.5MW pilot system in 2025, which will commence operation early in 2026. From there, H2Pro will focus on a 5MW demo system, which will be online the following year. That will be the basis of a 25MW commercial project in 2028.

Grid applications and renewable-only potential

Low, zero and negative power pricing is on the increase. As more non-programmable, renewable electricity generation capacity from wind and solar comes onto the grid, the periods where prices fall to zero are becoming longer and more frequent.

During peak solar hours or strong winds, renewable power generation exceeds the capacity of the grid to absorb and transmit that power. The result is negative pricing to incentivise renewable power producers to curtail their production.

And it is exactly here that H2Pro sees business potential. "We foresee a business model where green hydrogen producers operate only during periods of low, zero and negatively priced power," said Arad. "This would serve the dual function of producing renewable hydrogen at the lowest possible cost and balancing the grid."

Conventional classes of electrolyser consume power to maintain their warm-standby mode, often requiring battery energy storage systems to connect them to renewables-only schemes. However, this only increases capital spending and the LCOH.

H2Pro says its DWE systems beat this issue, with hydrogen production taking place at ambient temperature.

"Our technology is vastly different from conventional electrolysers, which consume many times more power during warm standby," said Arad. "There is no performance degradation associated with frequent intermittent operation. High efficiency is guaranteed for the full operating life."

Balancing intermittent hydrogen production with the needs of offtakers requires hydrogen storage between the production location and the offtaker.

As more hydrogen pipeline and underground hydrogen storage infrastructure is built, the feasibility of tapping into this increases.

Hyper-flexible electrolyser operation aligns perfectly with the plans for the European Hydrogen Backbone and the regional pipelines within that vision, such as H2med, which is slated to be Europe's first green hydrogen corridor.

Fit for industrial applications

Hydrogen is produced by the H2Pro electrolyser at around 8 barg. This is sufficient pressure to supply the hydrogen pipeline distribution in many small to medium-sized factories, such as glass making.

For higher-pressure applications such as hydrogen injection into a hydrogen transmission pipeline, compression would be required. However, since the initial stages of compression from atmospheric pressure to 8 barg are avoided, the size, capital cost and power consumption of the compressor are minimised.

Momentum building

Yara, ArcelorMittal, Sumitomo Corporation, Hyundai, Breakthrough Energy, and Temasek Holdings have invested in H2Pro since the company was founded in 2019.

Arad said, "Our investors have supported our evolution. Initially, we sought to develop a thermally activated DWE system to focus on energy efficiency. Research into this process is ongoing with great progress.

However, to adapt to the changing needs of the market while accelerating commercial deployment, we decided to first introduce an electrically activated DWE process, which directly solves problems related to grid volatility and direct connection to renewables."

If H2Pro can prove its DWE technology at commercial scale, it could challenge the cost and flexibility benchmarks set by today's PEM and alkaline systems – offering a new route to low-cost green hydrogen production.