ISSN 2633-1209

SEPTEMBER 2022 / **ISSUE #31**

MOBILITY | POWER | TECHNOLOGY | POLICY

H2VIEW MAGAZINE

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Clean, green hydrogen at an affordable price

Edward Campbell of **BoMax Hydrogen** explains why the company believes the breakthrough is closer than ever.

Clean, green hydrogen at an affordable price to compete in the markets has been unavailable, until now. At least, that's the view of BoMax Hydrogen, LLC, which produces clean hydrogen onsite and at room temperature using inexpensive reaction components.

The process, which is scalable, is photo-driven by light in the visible spectrum and can be provided by either LEDs or sunlight. Excited nanoparticles emit electrons that transfer to an enzyme component, catalysing the formation of hydrogen gas for use in fuel cells. The innovation behind BoMax has the potential to drive down green hydrogen production to costs of $1 per kg of hydrogen.

So how is such a cost to be achieved? The first cost analysis performed on this carbon-neutral process established that the price per kg according to hydrogen produced in the lab as $6.44 per kg of hydrogen in 2020. Recently, an exciting development in procuring source material for this reaction has shown that lowering costs to $1 per kg of hydrogen is within the scope of the BoMax team. A partnership forged with a subject matter expert and source provider will drastically reduce the costs of the two most expensive reaction components down by 85%, by bringing their manufacture to in-house production.

Successful reaction component scaling and performance in the recent construction of the alpha prototype also points to reaching the target of $1 per kg of hydrogen.

BoMax Hydrogen, LLC began its work in 2014 which formed to seek a patent for this green technology. Funds were raised to open a lab to first validate the work >>

Figure 1. The BoMax Hydrogen Process

Hydrogen gas is produced by action of visible light hitting a nanoparticle, which in turn emits electrons that are transferred to an absorbed enzyme component that, next, combines two electrons and hydrogen ions from water. A sacrificial electron donor fills the nanoparticle positive hole and keeps the process going.

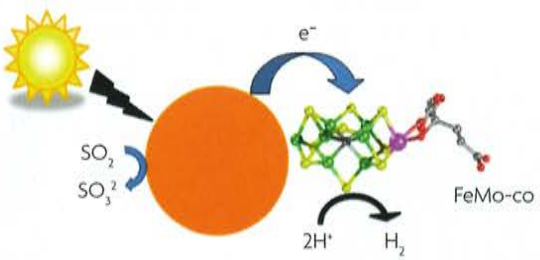


Figure 2. Hydrogen Production Increases

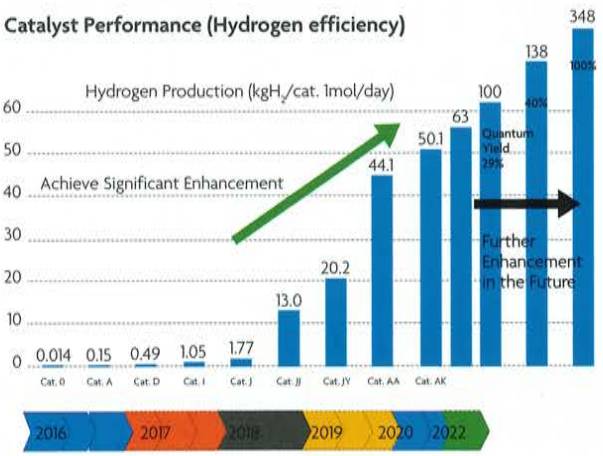


Figure 3. Long Range Hydrogen Production

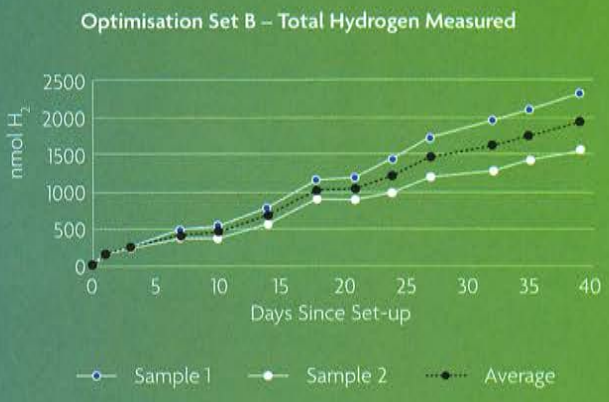
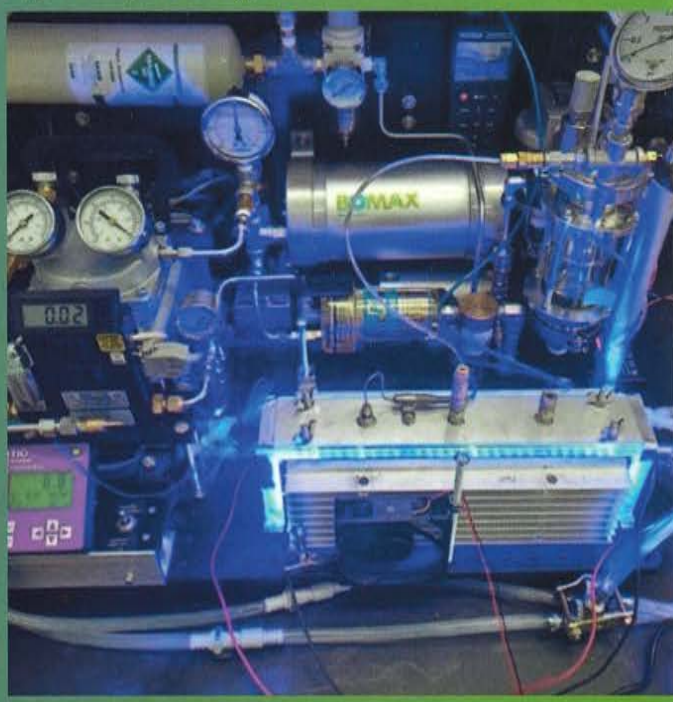


Figure 4. Alpha Prototype



>> which was based on Dr. Deborah Maxwell's dissertation work at the University of Central Florida. Soon after, optimisation of the process began and has since achieved a 3,000+ fold increase in the rate of hydrogen production (*see Figure 2*).

Duration of sustainable hydrogen production has shown 39 days continuous hydrogen production (*see Figure 3*). This alone has significant commercial applicability as well as a catalyst feature of turning the hydrogen production on and off and on again for 75 days without diminishing hydrogen production.

The past year has proven that scaling the reaction components solution 100-fold has enabled the development of an alpha prototype. This prototype is a proof-of-concept of how to produce hydrogen in a scaled-up manner and how to collect for use in demonstration fuel cells. Further, cost reductions were demonstrated by all but one piece of equipment coming from off the shelf purchases. Part of the business plan is to recycle the catalyst to retrieve the cadmium and use it to make fresh nanoparticles. Plans are underway to construct a beta prototype which will produce 1-5kg of hydrogen per day. This will be enough hydrogen to run a fuel cell to power an average size home or serve as a back-up generator. Remote location electricity generation will be made possible with pairing of a beta prototype sized unit and a fuel cell to meet the goal of providing power to underserved communities in the US, as well as globally.

Completion of the beta prototype is expected in 2024, which will lead to manufacturing and introduction to the markets.

This innovative technology will be successful because BoMax Hydrogen has proven its potential to be scalable and adaptive to the needs of the emerging demand for clean green hydrogen. By constructing its alpha prototype, BoMax showed that a 100-fold scaling up of the reaction components was possible after optimising the hydrogen production at the research scale. The alpha prototype hardware allows for hydrogen collection and storage. Proving its scalability points to eventual success with the hydrogen production capability.

Furthermore, to establish benchmarks, BoMax technology is compared to electrolysis. The CAPEX costs of BoMax equipment in the alpha prototype is much less compared to a similar-sized hydrogen producing electrolyser. For example, in order to compare technologies, a BoMax beta prototype producing 1-3 kg of hydrogen per day is similar in concept to an actual electrolyser in Japan that provides hydrogen for forklifts in operation at an airport. The CAPEX for the electrolyser is $ 3.3m (though one would have to acknowledge these costs will decrease with scale-up); the cost right now for the first BoMax unit is $ 800,000, and will drop with each successive unit. In addition, in the alpha unit most of the components are off-the-shelf. This will be much the same for the beta units.

Concluding thoughts

The BoMax Hydrogen production system can be paired with other renewable energy technologies like battery, wind and solar to provide carbon-free and low-cost energy.

Solving the challenge of utilising renewable energy and leaving behind heavy reliance on fossil fuels will require an integrative approach involving numerous green technologies. BoMax Hydrogen believes it has one such technology. H2V