



Source: Sunfire GmbH

High efficiency hydrogen electrolysis and synthetic fuels: An interview with Sunfire GmbH

By Stephen B. Harrison | 25 June 2020

Solid oxide electrolysis, high temperature electrolysis, high efficiency electrolysis – they all mean precisely the same thing. At least, that's the view of Nils Aldag, Chief Commercial Officer (CCO) at Sunfire in Dresden.

gasworld spoke with Nils in an exclusive interview to find out how Sunfire has rapidly grown from a being a few passionate people with a patent to become an international entity with 200 employees and multi-million Euro turnover.

Nils, thanks for talking with gasworld today. Tell us, how did Sunfire arrive in the hydrogen space?

Sure, thanks for the invitation. Well, two of the founders of this company put a lot of faith in a patent related to a process which combines electrical power, carbon dioxide and water to produce a

synthetic crude oil substitute. Well, you'd be excited by that idea too, right?

For sure, I would. And what was the next step in the growth trajectory?

Well, I joined as CCO and we set out in the direction of being an EPC contractor and system integrator to leverage that patent. But, along came an opportunity that was too good to miss. A fuel cell manufacturing company that we had been seeking a partnership with came up for sale, and we acquired them.

That sounds like an agile change of direction...

Indeed, it was. And we don't regret it. We secured 25 talented engineers and some great fuel cell experts. They quickly stretched their knowledge into the realms of hydrogen electrolysis. After some decent organic growth and a few bolt-on acquisitions we're now at 200 people. That makes us the largest hydrogen electrolyser synthetic fuels company in the world.

You must have recruited a lot of people to grow to 200. What kind of skills are required to work in the expanding field of hydrogen electrolyser manufacture?

Yes, our HR team have been busy recruiting for sure. We find that for building an electrolyser stack, there are analogous skills in the automotive industry. After all, an internal combustion engine is also a complex metallic assembly which operates at high temperatures and pressures and contains combustible materials.

For the work that we do integrating our electrolysers into liquid fuels projects, we find that people coming from the process industries sector are highly suitable. Experts from the industrial gases sector is also valuable. They bring good knowledge of handling toxic and flammable gases such as carbon monoxide and hydrogen.

Fortunately, we are in a part of the world where there is an abundance of skilled labour to pull from to support our growth.

What kind of hydrogen electrolysers are you now involved in?

We use Solid Oxide Electrolysis Cell (SOEC) technology. At Sunfire, we often refer to it as High Temperature Electrolysis (HTE), but in my opinion, it could equally well be called High Efficiency Electrolysis. It's different to the Polymer Electrolyte Membrane (PEM) and alkaline electrolyte principles. In terms of technology maturity, I would say that we are still the infant – perhaps two years behind PEM, but we're growing up fast and gaining a lot of ground.



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Can you tell us a few things about your electrolysers that makes them stand out from the crowd?

There are three things that really make HTE different. Firstly, the electrolyser gets about 20% of its energy from steam. In addition, HTE is very efficient in overall energy demand. So, if this excess heat comes from a nearby industrial process, we are effectively able to produce about 30% more hydrogen per MW of electrical power consumption than a PEM system. That's a massive head start.

Secondly, our fuel cell stacks have the advantage that they can be operated in two directions. That gives us plenty of market potential and means that our production can benefit from economies of scale.

Last, but not least, HTE can be used to produce either hydrogen or syngas. Compared to alternative technologies this is not an incremental difference. It's a game-changer which means our electrolysers can be the starting point of a synthetic fuels value chain.

Will the future be about one electrolyser technology, or a mix?

That's a bit like the BEV or FCEV question. It's not a binary issue, both will likely have a role to play. The same goes for electrolysers – the future will be a mix. For example, the alkaline electrolyte

systems have a lower capex than some other technologies. And the PEM systems offer a quick ramp-up. We are confident that the energy efficiency benefits and Power-to-Liquids capability of the HTE process will mean that it will also have a substantial role to play.

Furthermore, there is a good case for combining different electrolyzers. Imagine that an HTE electrolyser performs the base load hydrogen production and a PEM cuts in and out for peak shaving to meet a dynamic demand profile. That exploits the benefits of each technology in a hybrid system.



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Sunfire is enabling Power-to-Liquids. Which synthetic fuels do you regard as the most promising?

A decarbonised solution for aviation fuel must be the priority. I just can't imagine how we can use compressed gases or batteries to keep jets up in the air long enough to fly long-distance. To get the right energy density a light weight, fossil-free liquid fuel must be the answer.

Beyond that, e-fuels such as methanol might have potential in land or sea transportation. As a liquid, it's like handling petrol, diesel or marine bunker fuel, so users could readily accept it as an alternative. These fuels are not emissions-free, but I believe we will need a combination of solutions to hit the 2030 decarbonisation targets. We can then refine things further as we move closer to 2050 and the EU Green Deal net-zero goals.

And how far down the synthetic fuels value chain will Sunfire travel?

We have in-house expertise in the Fischer-Tropsch process, but we prefer to keep that in reserve to facilitate our communication with business partners in the fuels production arena. Getting the electrolysers built and scaling them up – that's our focus and it's keeping us busy.

Can you profile a Sunfire hydrogen electrolyser project?

Ok, so let's start close to home. One of our first big projects was with Salzgitter. They are a big steel producer here in Germany. We built and installed a 150 KW electrolyser capable of producing up to 40 cubic metres per hour of hydrogen for their annealing plant.

That was a pilot phase project. We will build on that success to ramp up to 1MW of electrolysis capacity which should cover about 70% of their annealing hydrogen requirements.

We are also working with Paul Wurth to implement hydrogen for direct reduction of iron. The electrolyser required to supply the hydrogen for a blast-furnace will be in the order of 300MW. Bring it on, we're ready to scale up!

And what about Power-to-Liquids. Can you highlight some projects there Nils?

Staying in Germany, let's move to Leuna. Sunfire is working with Total to build a 1MW electrolyser which will feed a process for e-methanol production. Integration into the refinery means that our HTE process can use steam to maximise the efficiency and Total are keen to produce e- fuels.

Further afield, we are also working with Neste on a project for their refinery in Rotterdam, Netherlands. They are a leader in biofuels production where hydrogenation reactions are important. We are preparing a 2.6 MW high-temperature electrolysis system to supply them with the hydrogen required for those processes.

With crude hovering around \$40 per barrel, will that challenge Power-to-Liquids and threaten your business model?

No, we don't think so. People don't choose to go to synthetic e-fuels for cost reasons alone. They use them because of environmental concerns and regulatory incentives. So, we foresee a very healthy market for our products, despite the Q2 2020 crude oil price collapse.