



Image: Beam Suntory whisky distillery



### CHALLENGE: DECARBONIZING ENERGY-INTENSIVE WHISKY PRODUCTION

Transition the whisky distillation process from using fossil fuels to hydrogen power in high-temperature spirit stills in a cost-effective manner.

### SOLUTION: AN ULTRA-EFFICIENT, ZERO-EMISSION WATER ELECTROLYZER FOR GREEN HYDROGEN PRODUCTION

Supercritical collaborated closely with Parker Hannifin and its distributor, KC Controls, to source corrosion-resistant fittings and valves, capitalizing on Parker's extensive hydrogen experience and manufacturing capabilities.

### BENEFITS: MARKET LEADERSHIP IN ZERO-EMISSION WHISKY PRODUCTION

The groundbreaking electrolyzer reduces CO2 emissions from whisky production by 615g per liter of whisky.

The high efficiency of the electrolyzer means it uses 88% of renewable energy, with only 12% waste.

## SUPERCritical

### GROUNDBREAKING ELECTROLYZER PROVIDES A GENEROUS SHOT OF ZERO-EMISSION ENERGY TO WHISKY DISTILLERS

Discover how Parker collaborated with hydrogen equipment manufacturer SUPERCritical and helped them bring their first-of-its-kind, zero-emission, ultra-efficient, and iridium-free green hydrogen generator to market, during the most globally challenging economic environment in decades.

“ Supercritical is pioneering hydrogen technology to enable decarbonisation of the hardest-to-abate sectors. This needs to be done with urgency. Fast, decisive action with high-quality and short lead times on critical componentry is imperative to change at pace. Parker's alignment on Supercritical's vision and their support in the WhiskHy project is a first class example of how game-changing start-ups and established industry leaders can catalyse change together. ”

Luke Tan, CPO and Co-Founder of Supercritical

## WhiskHy Green Distillery Project: Background

The Scotch Whisky Association, to which Beam Suntory is aligned, set a target of Net Zero for the industry by 2040. To achieve this a cost-effective energy solution was required. By implementing a low-cost high-efficiency Supercritical electrolyzer in their production process the reduction in CO2 goals can be met if Green electricity is used for the electrolysis process input.

Many distilleries in Scotland are located in remote areas, not connected to the gas and electricity grids. They are often reliant on delivered fossil fuels like fuel oil or LPG as an energy source making the use of hydrogen fuel an attractive option for decarbonizing the distillery sector.

Scotland has abundant renewable energy resources (wave, tidal, offshore, and onshore wind) making green hydrogen using water electrolyzers a viable energy source. However, due to electrolyzer costs and efficiencies, the short-term cost difference between the current fuels used and green hydrogen is a major barrier to switching. Supercritical partnered with Beam Suntory to support them in their mission to decarbonize their high-temperature spirit stills.

A study between Supercritical and Beam Suntory found that Supercriticals low-cost hydrogen production method, using wastewater on-site, could deliver high-pressure hydrogen at 200 bar for storage at distillery sites and requires 189x less storage volume than H2 at ambient. The new electrolyzer is also 40% smaller than other electrolyzers and uses 15% less energy. It operates at a cost of approx. £1.59/kgH2 and offers a decarbonization opportunity of up to 606k tonnes of CO2e in the Scottish whisky sector alone.

Switching to zero-emission hydrogen as a fuel from LPG means Beam Suntory's distillery could maintain its high efficiency of production as it operates 24/7 and reduce its CO2 emissions by 615g per liter of whisky produced.<sup>1</sup>



Image source: Supercritical

## Supercritical: Innovative Technology For Critical Times

In the increasingly competitive race to develop carbon-free energy sources to halt, and hopefully reverse global warming, creating a commercial or technological advantage is paramount if you want your innovation to be a front-runner - especially in the world's notoriously difficult-to-decarbonize sectors such as chemical, heavy industry, transport and heating.

Supercritical has achieved just that with its unique and groundbreaking, ultra-efficient, zero-emission membraneless water electrolyzer that operates at **220 bar** and requires no compression phase - and therefore no need for a compressor in the process - and produces - with input electricity from a renewable source - green hydrogen at **200 bar** for **25% less** than traditional electrolyzers which are comparatively expensive and inefficient.

For example, one litre of water contains 111.11g of hydrogen, which has an energy value of 3.7 kWh. Most electrolyzers only effectively produce 2.27kWh of hydrogen energy per litre. The efficiency of the Supercritical electrolyzer is high (**88% LHV Efficiency**) which means 88% of the renewable energy provided to make the hydrogen is used, with only 12% waste, a whopping 3.25kWh of hydrogen per litre. Other technologies waste up to 40%.<sup>2</sup>

Supercritical uses heat and pressure in a unique electrolyzer design without fragile membranes - which is often the first point of failure on conventional

electrolyzers - to extract significantly more hydrogen energy than conventional electrolyzers.

Produced as efficiently as this, hydrogen is a viable alternative for fossil fuels where electricity cannot be used directly or where longer-term energy storage is needed - especially in the aforementioned hard-to-abate sectors.

## The Challenge

During the design stage of the Supercritical electrolyzer it was found that to maximize asset integrity, safety, and prolong lifespan, the most suitable material to build the 'hot' sections of the electrolyzer with was a nickel superalloy. **Herein lay the challenge.**

Whilst well established and used widely in industry, nickel alloy is not commonly stocked as standard with most suppliers of components or equipment. Add in the complication of global industrial and commercial malaise in the aftermath of COVID and a war on mainland Europe and 2022 saw the price of nickel soar to a high of over \$48,000.00 per tonne<sup>3</sup> in March 2022 and the availability plummet, massively disrupting the supply chain and adversely affecting purchasing lead times and production.

Bespoke equipment for the electrolyzer was available - albeit at a high cost and with long lead times - but instrumentation was another matter. Components had a lead time in excess of 52 weeks in some instances. These lead times could not be worked with if the project was to be a success. **This is where Parker Hannifin stepped in.**

## The Solution

Parker has over 60 years of experience in hydrogen to support customers with their decarbonization challenges and is a world leader in motion and control technology. As a leader in component manufacture and a global player in the energy industry, and with long-established global manufacturing and distribution capabilities, they had the perfect credentials to address Supercritical's challenges.

Upon hearing Supercritical's story and ambition, and seeing the benefits of their innovative electrolyzer design, Parker reviewed their global network for manufacturing capability and closely examined the logistics. Consequently, it was decided that Parker would establish the manufacturing of the necessary components in the UK to supply Supercritical with what they needed, assisting them in becoming the first to market.

An agreement was reached to supply Supercritical with fittings and valves that would not corrode or dissolve under the harsh process conditions being experienced. These components could be manufactured at Parker's UK facility in Barnstaple within the timeframe required by Supercritical.

Only an established, hydrogen-experienced manufacturer like Parker, with a one-stop-shop offering and working closely with a trusted distributor like **KC Controls**, could promise and deliver on such a commitment. This approach has opened the way for Parker to be considered for future projects.

## The Benefits

Parker's ongoing commitment to supporting clean technologies and achieve global sustainability in the industry through the adoption of carbon-reducing energy sources like green hydrogen - along with a large portfolio of high-quality components proven to be

compatible and effective for use with hydrogen – meant they were able to supply Supercritical with the components required to keep their WhiskHy project on-track and help their unique electrolyzer technology maintain its accelerated route to market with a lead time of just **16-weeks from order to delivery**.

In the future, now that a relationship has been created, Supercritical can utilize Parker's 100+ years of engineering experience, manufacturing locations in 45 countries, and extensive network of local, independent businesses supplying products and services to customers in 104 countries to roll out their innovative technology around the world safe in the knowledge that it has the backing and support of is a long-established global engineering company who can supply what they need, when they need it, anywhere in the world.

With Parker's long-established manufacturing resources and distribution operations extending to approximately 17,000 locations globally already in place and functioning smoothly Supercritical now has access to Parker's standard portfolio of H<sub>2</sub>-proven components as well as custom options that can be created from existing Parker lines quickly, safely, and competitively with quality assured.

In this particular instance, Parker was able to supply a comprehensive suite of hydrogen user-ready parts and customized components that Supercritical needed along with a host of core Parker products that included fittings and valves. All backed up by a long list of quality standards and hydrogen certifications such as EC-79, ISO 19880-3, and ISO 15848 giving Supercritical and other H<sub>2</sub> customers the confidence in knowing that the highest levels of performance and safety can be achieved 24/7 with Parker components - wherever they are needed.



## References:

1. Supercritical – WhiskHy Executive Summary PDF
2. Supercritical - <https://www.supercritical.solutions/post/simple-hydrogen-packing-a-punch>
3. <https://tradingeconomics.com/commodity/nickel>

Supercritical develops partnerships with industry to move and think beyond fossil fuels with innovative clean technology solutions. It was such a partnership with Parker that enabled them to progress their WhiskHy project with Beam Suntory.

Supercritical undertook a study that found there was an opportunity to decarbonize the distillery assets cost competitively with hydrogen by 2030 when compared to LPG by providing a zero-emission electrolyzer to decarbonize the distillery and produce circa 57,000 bottles of hydrogen-distilled whisky. Which is believed will represent the first hydrogen-fired bottles of whisky ever created on an industrial scale.