WORLD PUMPS

High hopes for hydrogen

As industries worldwide scramble to meet emissions targets, the focus is on hydrogen as an alternative source of power generation. This article examines how pumps and compressors are playing their part in the energy transition and whether hydrogen is a silver bullet.

1. There is significant potential for emissions' reduction within industry by transitioning to green hydrogen.

"The green hydrogen sector is still in its infancy because the quantity of renewable energy is not yet sufficient to produce green hydrogen for all consumers."

Grégory Junot, Sundyne's Compressors Product Line manager

Did you know...?
Hydrogen is a stable source of long-term energy storage.

2. Siemens Energy's Hyflexpower project is part of its mission to ensure that combined heat and power plants (CHPs) are hydrogen-ready. *(Image: Siemens Energy)*

The Hydrogen Council notes that 39 countries have government-backed hydrogen strategies, including the EU and another 12 non-EU countries. Research, development and investment are growing apace, reflecting the excitement around hydrogen's potential as an alternative, environmentally friendly, energy source.

Hydrogen & heavy industry

Heavy industry is where greener methods of power generation such as hydrogen are most urgently needed. The International Energy Agency (IEA) reports that industries such as iron, steel, cement, chemicals and petrochemicals account for over 30% of global total primary energy demand. While hydrogen is already being used by many industries, almost all of it is produced using fossil fuels, offering significant potential for emissions reduction by transitioning to green hydrogen.

The colour of hydrogen

Not all hydrogen is created equal when it comes to its green credentials. True green hydrogen is produced through electrolysis, which separates water into hydrogen and oxygen using electricity from renewable sources such as wind or solar power. Yet, according to the IEA, this accounts for only 0.1% of global hydrogen production. Professor Nilay Shah from the Department of Chemical Engineering at Imperial College London and a member of the UK government's Hydrogen Advisory Council, explains: "The bulk of hydrogen currently in use is grey and probably most of the low-carbon hydrogen in the near future will be blue."

Grey hydrogen is produced by steam reformation of natural gas, which creates emissions. Blue hydrogen is produced in the same way, but the CO_2 emissions are then captured and permanently stored, making it a greener option. Use of 100% green hydrogen is on the horizon but Prof Shah notes that it will take longer to develop because of the need to scale up production of electrolysers and develop the renewable energy required.

Hydrogen is a very versatile gas, making it an attractive option. It can store energy over long periods to complement other renewable electricity sources that may have intermittent supply and it can transport clean energy over long distances via pipelines. Pumps are required to produce hydrogen and compressors are needed to transport and store it.

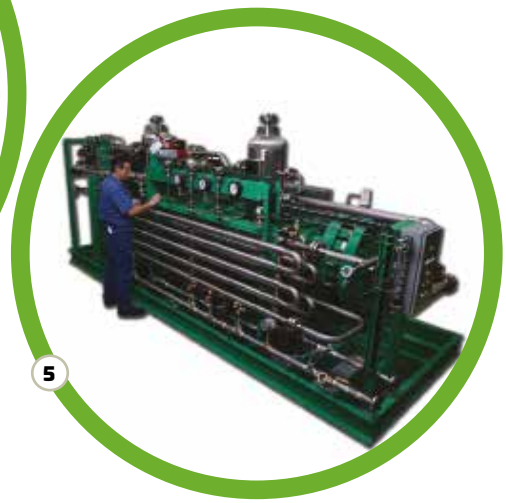
Pumping and compressing hydrogen

One company that has been part of the hydrogen processing industry for more than 50 years is US-based designer and manufacturer of pumps and compressors, Sundyne. Grégory Junot, the company's compressors product line manager, says its pumps and compressors have been involved in all three colours of hydrogen over the years. "It started with grey hydrogen made from fossil fuels. We then became part of blue hydrogen projects combining fossil fuels with CO_2 capture, and nowadays we see more and more green hydrogen projects where renewable energy is used to produce hydrogen."

Sundyne's pumps and compressors are used in ammonia and fertiliser plants, oil refineries, gas processing and in power plants. Centrifugal pumps, such as Sundyne's ANSIMAG or HMD pumps, are used to move water into

Sealless, energy efficient pumps

Sealless pumps are a popular choice for hydrogen applications. With no seals to replace, there is less maintenance and fewer leaks. They also eliminate the need for seal support systems, saving space on the electrolyser skid. Energy-efficient pumps are preferred for electrolyser applications. Features such as a composite material containment shell can bolster efficiency by eliminating eddy currents and preventing hysteresis losses during operation.



3. Siemens Energy's Hyflexpower project at a French paper mill will be the first fully integrated power-to-hydrogen-to-power industrial scale power plant. *(Image: Siemens Energy)*

4. Sundyne's ANSIMAG pumps are ETFE lined sealless pumps. *(Image: Sundyne)*

5. The PPI diaphragm compressors boost hydrogen up to levels required by the particular application. *(Image: Sundyne)*

"2050 carbon neutrality is a big driver of hydrogen use. ... Today there is much greater environmental awareness so green and blue hydrogen are essentially a part of every project."

Grégory Junot, Sundyne Compressors product line manager

the electrolyser – which can be a high or low flow application – at low pressure. The same centrifugal pumps can be used to pump caustic chemicals into the electrolyser to raise the pH in the water (higher than 7) to make it alkaline, which produces a better hydrogen yield. This is also a low-flow, low-pressure application and pumps used in hydrogen applications must be able to stand up to harsh chemicals over a long period.

Once the electrolyser splits the water into its component parts, the hydrogen is between 20-30 bar pressure as it has a very low density, although a much higher pressure is usually required to use, transport or store the gas. Sundyne's PPI diaphragm compressors have a high compression rate and can boost the pressure up to between 300 and 1,000 bar.

Did you know...?
Hydrogen increases energy system resilience.

Realistic targets

According to Prof Nilay Shah of London's Imperial College, a realistic target for heavy industry in terms of its green hydrogen consumption is around 20–30% by 2030 (between 1–2 GW or 8-16 TWh per year) with up to 50% of industry using low-carbon hydrogen by 2050. Challenges to these targets are the need to scale up electrolyser manufacturing, access to certain key materials such as platinum, iridium, scandium and titanium, and to scale up renewable electricity.

For larger capacity use (up to 17,000 m^3), it offers its range of centrifugal compressors.

Energy transition

Junot says the company is seeing a high volume of green hydrogen in giga-production plants (where hydrogen production absorbs 100-1,000 MW of electrical power) and in traditional fossil-fuel plants with blue hydrogen. "The size of the energy transition is enormous with hydrogen emerging as a critical enabler," he says. "The green hydrogen sector is still in its infancy because the quantity of renewable energy is not yet sufficient to produce green hydrogen for all consumers."

The energy transition and the need to ensure that combined heat and power plants (CHPs) are hydrogen-ready has led to the development of Siemens Energy's Hyflexpower project at a French paper mill. It will be the first fully-integrated power-to-hydrogen-to-power industrial scale power plant and will include an advanced hydrogen gas turbine.

The project aims to address the problem of insufficient and unreliable renewable energy by using hydrogen to store the energy. When there is a surfeit of renewable electricity, it will be used with an electrolyser to split water into oxygen and 100% green hydrogen, which will then be stored and used in gas turbines to produce electricity. This will be released back to the grid, supplementing demand when required. During two pilots, the paper mill will be powered with a mix of natural gas and hydrogen, eventually aiming for a 100% hydrogen operation.

While hydrogen may not immediately be a silver bullet, it does offer hope for carbon neutrality and industry is waking up to its potential and preparing for the energy transition. Junot says: "2050 carbon neutrality is a big driver of hydrogen use. ... Today there is much greater environmental awareness, so green and blue hydrogen are essentially a part of every project."

Prof Shah expects hydrogen to be used as an industrial feedstock and fuel fairly soon, suggesting several gigawatts (GW) by 2030, but says: "It will take until 2050 to displace fossil fuels to a low level. I would expect to see the UK using about 250 terawatt hours (TWh) of low-carbon hydrogen per year by then, with a large part of that being used in heavy industry and a mix of blue and green hydrogen."

Hydrogen's ability to store energy over long periods offers energy system resiliency and better use of renewable power generation. In addition, it can transport clean energy over long distances unlocking previously inaccessible renewable resources. The Hydrogen Council sums up hydrogen's potential when it says it "makes possible a holistic and hence faster and more cost-effective decarbonisation."

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