FUELLING T ROAD TO G

In the past few years, the call for greener technologies has grown, spurring investment and innovation in new methods of producing the energy the world needs to keep moving – from transportation to manufacturing to the gas used to heat homes. Chief among the growing green focus is hydrogen, a renewable energy carrier with the ability to provide a sustainable fuel for a host of applications. Hydrogen has the potential to be green and renewable in that it can be developed using renewable means, such as wind or solar, while not adding carbon emissions in the process. To get there is part of the journey, as it is not an instant transition.

For traditional fuel producers to join in, the predicted hydrogen boom will require an investment in both infrastructure and finding ways to make hydrogen truly green, or at the very least, blue. Figure 1 shows the different colours assigned to the production methods used to create hydrogen – such as purple for nuclear hydrogen creation, brown for coal, and green and turquoise for renewable methods. However, for the purpose of this article the focus will be on blue, a method that uses fossil fuels but captures carbon emissions in the process.

Whether in transportation or residential and industrial applications, large scale adoption of hydrogen fuel will also require safe monitoring tools and a significant education piece to share with the public at large. Pushing fossil fuels entirely from the landscape in the immediate – short-term – future is not realistic when many considerations are involved.

Switching over to hydrogen

Getting to green hydrogen is the ultimate goal in providing truly clean energy. Still, intermediate steps can be implemented to build up a hydrogen-fuelled economy and help to reduce or offset the costs of changing over. Moving to vehicles fuelled by

Brandon Bromberek, Emerson, USA, outlines the variety of hydrogen production options, and why this energy should be considered as fuel for the road to green.

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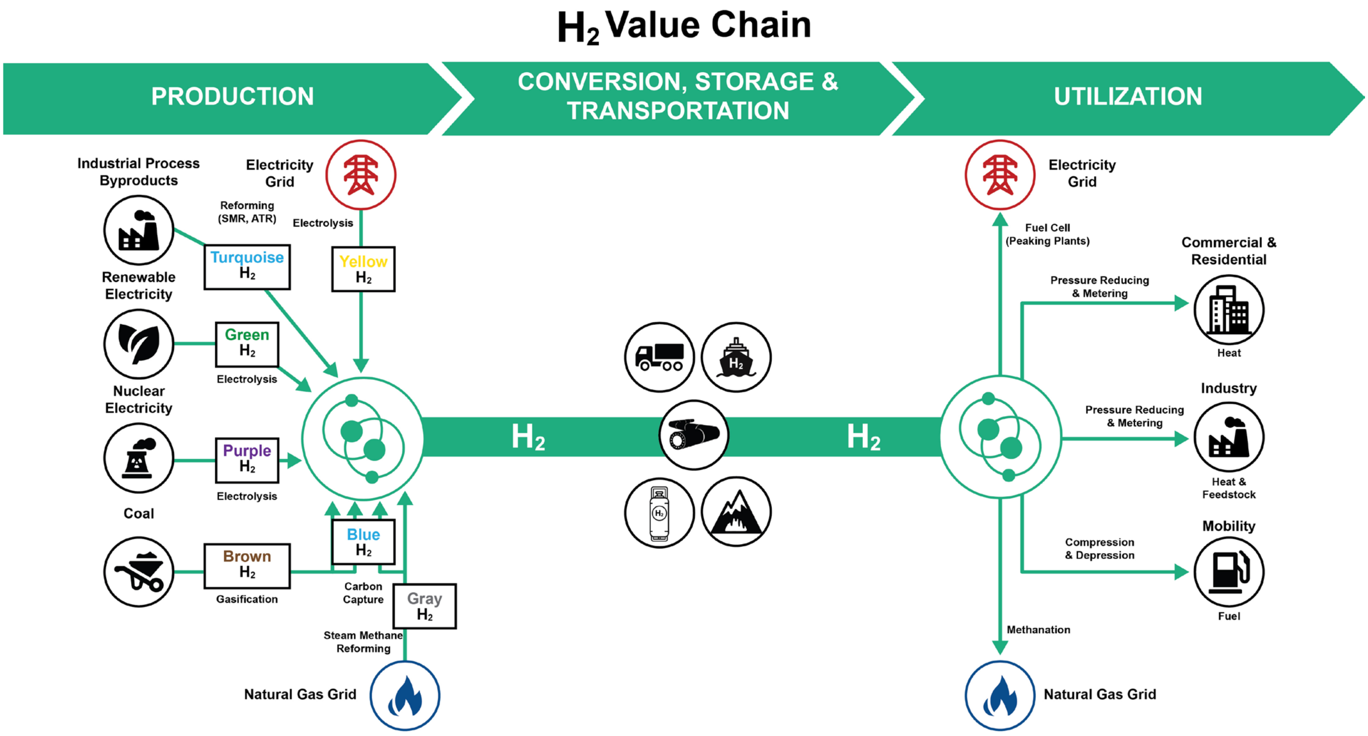

Figure 1. A colour-coded graphic of hydrogen production, conversion, and utilisation.

Figure 2. The Emerson Micro Motion HPC015 with rupture disk safety feature.

hydrogen alone will be a complex step, with many elements and industries needing to align.

It will not be a matter of just plugging a new device into a hydrogen line. Pushing the boundaries of our energy dependency and the legacy of fossil fuels in our daily lives and industry requires a detailed look at the infrastructure and how we have historically built our society around the many uses of fossil fuels.

Hydrogen as a fuel source requires different storage and dispensing equipment as well as different safety precautions. One of the main benefits of hydrogen is that it is very compressible, making it possible to store large quantities of it, but to keep it compressed requires high-pressure storage devices. Dispensing or transporting hydrogen means the pipelines, meters, and dispensers must be robust enough to withstand the pressure.

Blue hydrogen as an intermediate step

As stated earlier, green hydrogen production is the holy grail of alternative energy. Using wind and solar power to create hydrogen sounds ideal, but it is expensive. Using solar or wind also requires a significant investment in unique infrastructure. Some countries, however, are working on just such solutions as long-term alternatives to fossil fuels with the goal of bringing down the cost and increasing adoption of hydrogen in businesses and homes over time.

There is another option – blue hydrogen – which already offers a significant reduction in harmful emissions but still uses fossil fuels to produce the hydrogen. Blue hydrogen can be seen as an intermediate step to help build and meet the demand for hydrogen at a reasonable cost, while countries build out the necessary infrastructure for full scale adoption.

Referencing Figure 1, it becomes clear that there are a number of ways to create hydrogen. Creating what is known as blue hydrogen is achieved by reacting natural gas with high-temperature steam to create a mixture of hydrogen, carbon monoxide, and a small amount of carbon dioxide that can be captured to avoid it entering the atmosphere. If the carbon is not captured, the process is referred to as grey hydrogen.

In both blue and grey options, fuels generally considered part of the emissions challenge are used to create hydrogen, which releases only water vapour into the atmosphere when used as a fuel.

However, by capturing the carbon emissions produced, the process becomes cleaner than just using fossil fuels for combustion downstream, making blue hydrogen a very desirable and cost-effective step toward the greening of energy production and consumption. Blue and grey hydrogen production makes up approximately 70% of all hydrogen produced today.

Technological and device requirements

As mentioned, hydrogen is compressible. Kept compressed and under high pressure is the only way that the energy in hydrogen is practically usable. If it were not compressed and left at atmospheric pressure, a full industrial storage tank of approximately 850 l would be needed to power one car for approximately 100 miles. That is not efficient.

When compressed, hydrogen becomes far more efficient, and only a fraction of that storage tank is needed to power one vehicle. Compression also means it can be transported more easily, either in tanker trucks or added to a natural gas pipeline and stripped back out at the destination point. However, early testing has shown that in some cases, end-use appliances meant to run off natural gas can still perform relatively efficiently on blends of natural gas and 20% hydrogen. This benefits some distribution networks that will not need to spend the time and expense to separate out the hydrogen downstream, and it becomes a way to reduce the need for natural gas.

Transporting the hydrogen mixed in with natural gas means that the pipeline must be checked for corrosion, as a possible weak spot in the pipeline can potentially lead to catastrophic ruptures. Using non-intrusive corrosion measurement tools is recommended as well as ensuring those devices are wirelessly connected back to the main data collection point.

Measurement and dispensing of compressed hydrogen requires a flowmeter that can withstand the pressure of hydrogen and safely dispense the gas without danger to personnel or customers. The industry-accepted pressure standards for dispensing hydrogen are 350 bar and 700 bar. The safety standards that must be met are set out in the American Society of Mechanical Engineers (ASME) B31.3 and ASME BPVC KD-3 codes. The latest flowmeters for high pressure and hydrogen fuel applications now offer an added safety feature in the form of a rupture disk, which is a first line of defence in case of a primary containment breach. If the rupture disk is activated by a tube breach, the seal in the rupture disk will be broken to allow for the controlled release of pressure. During this event, the meter's onboard diagnostics will send out an alert so steps can be taken to shut down the flow.

A vision for a hydrogen future

The future is uncharted land, though there are many roads being forged that promise a greener and cleaner future that will still allow us to maintain the level of lifestyle we have become accustomed to, with global transportation, import and export of goods, as well as a daily commute.

Many of the roads tentatively travelled right now are being built on partnerships between manufacturers pivoting to meet the demands of an extreme high-pressure fuel; producers learning to adopt new processes to meet a burgeoning demand; and investors eager to invest in the future. Blue hydrogen is the bridge to a greener future.