WHITE PAPER

Featured Story

The Hydrogen Economy and the Role of the Valve Industry

Hydrogen is the most abundant element in the universe; however, it does not exist on its own and must be produced from a broad range of sources, some of which are kinder to the planet than others. To reach the goal of net zero, it is important to use energy more efficiently and produce it from sustainable resources.

The variations in hydrogen production are subtle and typically focus on the difference in energy source; the current primary methods are green hydrogen and blue hydrogen. As valves are essential to the production of any type of energy or fuel source, it is interesting to consider what role they will play in the hydrogen economy.

By William Powers, Global Industry Manager of Industrial Gas - Bray International

GREEN AND BLUE HYDROGEN

Green hydrogen is made from renewable resources such as wind, solar, and water, through a process called electrolysis. This process involves taking water and breaking the hydrogen atoms out of it. There is a major global push to meet net-zero greenhouse gas (GHG) emissions and the production of green hydrogen is driving that initiative forward. This trend has been particularly significant in the U.S. and Europe, where CAPEX is spending hundreds of billions of dollars to create these facilities and a large percentage of it will be government subsidized.

Blue hydrogen is produced by capturing the carbon emissions, via a carbon capture unit & storage (CCUS) system, from a steam methane reformer. This unit breaks the hydrogen out of the hydrocarbons to create energy. This is a great solution for refineries or foundries that do not have a renewable energy source and are looking to reduce emissions in the next 10-20 years. A grey hydrogen facility can be converted to blue by adding a CCUS to the steam methane reformer.

AN UPHILL BATTLE

Although the industry is moving toward these low GHG emission methods of producing hydrogen, there is a very long uphill battle that will need to be waged to usurp grey and black hydrogen production. Government regulations and subsidizing, along with major industrial gas supplier buy-ins, have played a major role in the current global project backlogs as they stand today. More specifically, it is beneficial to investigate the global net-zero initiatives and the direction the world is moving towards.

Overall, many major global economies have hydrogen strategies in place that are driving the net-zero mentality forward. The European Union (EU) was the front runner in the net-zero transition in 2019 with the Green Deal and set a target to reduce GHG emissions by at least 55% by 2030, compared to 1990 levels. China, the world's largest emitter of GHGs, announced its goal to achieve carbon neutrality before 2060, though policy details are lacking at this time. India has established a plan to reduce emissions by 33-35% below 2005 levels by 2030, but they do not have a long-term target for carbon neutrality.

In North America, Canada, and U.S. energy mixes are fossil fuel dominated. Both governments have net zero GHG targets for 2050 with an intermediate goal of producing 50-52% less than 2005 levels by 2030.

High gasoline prices and energy security concerns in the wake of Russia's invasion of Ukraine have augmented the focus on the transition to EVs, but also triggered calls to increase the region's oil output, suggesting a stasis in decarbonization focus, at least in the short term.

From a regulation standpoint, Canada's Next Steps for Clean Air and a Strong Economy (Government of Canada, 2022) as well as the U.S. Inflation Reduction Act (2022), are major steps towards supporting GHG targets. Within the IRA, the U.S. will be providing USD $8B for the U.S. Department of Energy to invest in regional hydrogen hubs, accelerating uptake in end-use sectors. In addition, USD $30B will be provided for solar panels, wind turbines, batteries, geothermal plants, and advanced nuclear reactors, including tax credits over 10 years.

Offshore wind, specifically, has seen a swell of interest with major developers, private equity, and oil and gas majors securing lease areas on the U.S. Atlantic coast. This includes collaborative efforts between Atlas Cop-co and Plug Power for turboexpander production to support LH2 production and transportation. This governmental policy push will be complemented by growing corporate net-zero commitments in the coming years to solidify this net-zero transition.

THE NEXT STEPS

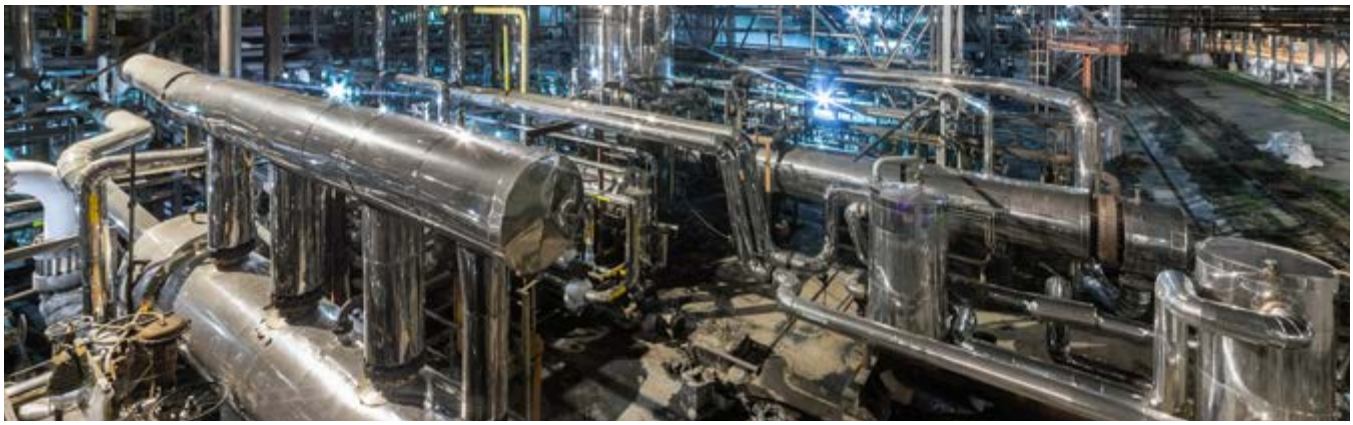
Hydrogen has had several false starts in the past, but momentum has picked up significantly as governments pledge net zero carbon targets as indicated previously. Nevertheless, it is still an early stage of deployment – with several barriers to overcome before a fully developed market can emerge.

What are some of those barriers? In terms of 2023 production, green hydrogen costs roughly USD $10/kg, blue hydrogen costs roughly USD $4/kg, and grey hydrogen costs roughly USD $2/ kg. Green hydrogen has the greatest potential to be more economical than grey hydrogen production, but this is not projected to occur until 2050, based on the current rate of net-zero progress goals.

Electrolyzer efficiencies are also a major concern for green hydrogen expansion. Although there are currently large-scale electrolyzers in production, the process to convert power to hydrogen and back to power has a round-trip efficiency of 18%-46% depending on the size and type of electrolyzer being utilized. Even if electrolyzer efficiencies are reduced, there are significant renewable energy limitations that need to be addressed.

To support some of the current industrial processes that use hydrogen (fertilizers, hydrocracking, desulphurization) it would take 143% of all existing wind and solar power available. This does not factor in any other uses like gas grid enrichment and transportation where hydrogen is currently almost non-existent in the global scope of supply.

Clearly, there is a need for a significant uptick in renewable energy sources. Finally, as there are no international standards associated with hydrogen production, current project scopes are not being harmonized. With all these hurdles, new projects are being added to the backlog daily; the proverbial chicken is therefore coming before the egg. With this information in mind, one can ponder what part valves will play in this economy.



THE ROLE OF VALVES

Valves will be required in the processes used to form various forms of hydrogen, however, not all valves will have the adequate standards necessary. A butterfly valve, for example, whether it is a zero, double or triple offset, has many pros inherent in its design for hydrogen applications. Typically, they offer the lowest cost of ownership, the smallest envelope compared to any other valve type, and low fugitive emission capabilities. In terms of the limitations, butterfly valves are prone to cavitation and are limited in pressure drop capabilities due to the disc being in the flow path. Butterfly valves can be utilized in switch valve applications, desulphurization feed, and hydrogen liquefaction.

Globe valves will be heavily utilized in feed control, offering a variety of flow characteristics with shorter overall strokes, compared to quarter-turn valves, due to their linear function. The linear function, however, can lead to early packing wear and requires greater force to seat the valve which means a larger actuator is typically needed to support required leakage rates. Globe valves can be found in fuel flow regulation and steam control within both the blue and green production chains.

Finally, ball valves will play an important role in the net-zero movement as they offer the highest capacity flow coefficent (Cv) ratio of any valve type, while still being able to support erosive/abrasive media extremely well. Similar to butterfly valves, ball valves are prone to cavitation and offer limited differential pressure and temperature capabilities within hydrogen production. Ball valves will be heavily utilized in ESD shutdown applications as well as hydrogen compression and storage.

FINAL THOUGHTS

Clean hydrogen is not going to be easy to adapt to on a global scale. While there will be an uphill battle to establish green hydrogen as the primary method for hydrogen production, it is possible to overcome these hurdles, and valve manufacturers are ready to answer the call to support this booming economy to move the global market forward into the future.

ABOUT THE AUTHOR

With over 5 years of experience in Global Industrial Gas Market Development and over 12 years in the valve industry, William Powers has established exceptional expertise in building and nurturing strategic partnerships with major clients in the industrial gas sector with an emphasis on delivering exceptional customer service via a keen understanding of market dynamics and business growth potential. William is currently the Global Industry Manager for the Industrial Gas market with Bray.

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