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SCALING UP GREEN HYDROGEN

SUCCESSFULLY SCALING UP GREEN HYDROGEN ACROSS THE VALUE CHAIN

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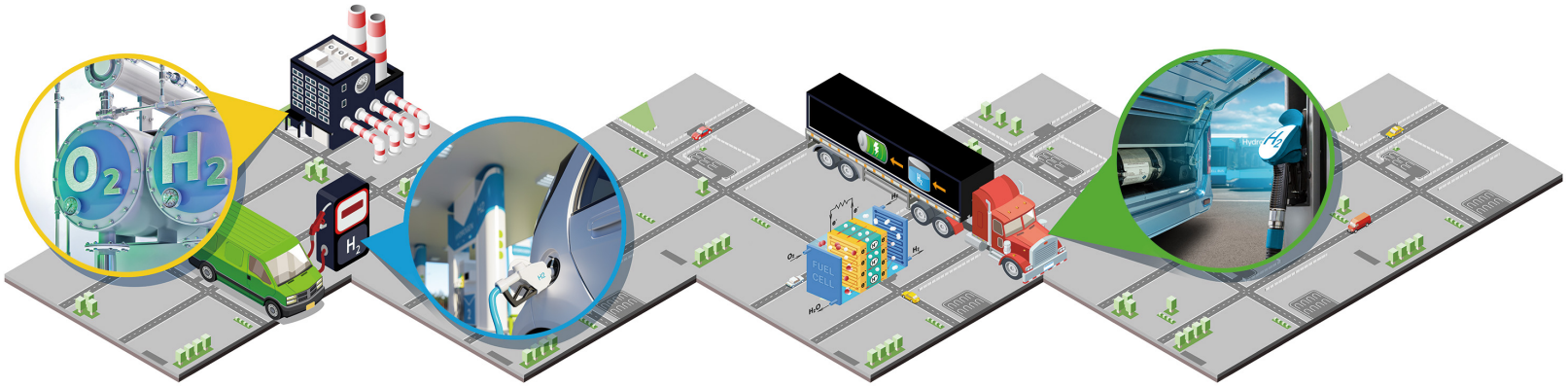

From the electrolyzer, to the fueling station, to the fuel cells, it can be advantageous to work with a central trusted partner across the entire hydrogen fuel value chain.

Green hydrogen is proving to be one of the most viable global energy sources and a path to decarbonization. As global interest and investment in hydrogen-powered vehicles and power systems grow, the green hydrogen industry is poised to thrive. However, that success depends on reliable green hydrogen production, storage, transportation and dispensing. With the right solutions and processes in place across the supply chain, we can make a safe, efficient green hydrogen future possible today.

Creating a Zero-Emissions Future

What makes green hydrogen so attractive as a renewable source of energy is that it can provide sufficient, reliable universal power with zero emissions. Countries around the world have developed policies, programs and projects to accelerate green hydrogen production and use. Many governments have developed hydrogen road maps and are setting ambitious targets. Targets set by China, Japan and Korea will see over a million hydrogen-powered vehicles on the road by 2030. Canada has developed a hydrogen strategy with the goal of becoming net-zero by 2050. In the wake of these targets, projects have begun. Canada, for instance, has already become home to the world's largest green hydrogen plant, with plans for more to come.

Although projects have started, most of the infrastructure and processes required to support the transition to green hydrogen still need to be built, and scale-up remains a challenge. The good news is that technological solutions and digital transformation that have already been proven in related applications and industries, including the greater hydrogen industry, can help solve many of the challenges that companies across the value chain face now.

Production

The process of producing hydrogen using water and electricity is called electrolysis. Electricity breaks water down into its base elements, hydrogen and oxygen, in a unit called an electrolyzer. These electrolyzers can range in size from small devices to large-scale, central production facilities. For example, skid electrolyzers can be placed outside of factories to replace public utility electricity, or they can be used to power entire communities. By combining electrolytic cells and stacks, green hydrogen production can be scaled according to the needs of the application.

However, within the great advantages of scalable clean energy lie a few challenges. R&D efforts are currently being made to increase electrolyzer system efficiency overall, as well as electrolyzer operating life, power density and stack size. These improvements will reduce material costs and lead to more flexible systems adapted to intermittent and fluctuating power supplies.

Because of the great scalability of electrolyzers, manufacturers need to consider how they access the components necessary for the full range of electrolyzer sizes. The nature of hydrogen adds even more complexity. It's the smallest and the lightest element,

Key technology partners should have an extensive range of measurement, control and electrical equipment suitable for installation in hazardous areas of the electrolyzer. The benefit is safe, reliable and precise process control, with optimized production for the desired hydrogen purity.

and, if mishandled, consequences can be disastrous. Electrolyzer components need to be reliable and built for hazardous environments to keep people and property safe.

Working with a technology supplier that has an extensive portfolio specifically designed for hydrogen applications can simplify the supply chain, saving time and money. And, in many cases, it can be much easier to work with one supplier that has a complete portfolio, especially as companies scale their production. This frees up equipment manufacturers and producers to focus on developing and delivering their products.

It's especially important to work with an expert supplier equipped with a wide range of measurement, control and electrical equipment specifically designed to improve reliability and safety in the hazardous areas of electrolyzers. In addition to valves, valve systems, flow meters, regulators and pressure transmitters, they should also have smart technologies, such as scalable process control and safety solutions, that can reduce operational complexity, lower risk and improve the performance of green hydrogen facilities, from electrolyzers to Balance of Plant (BoP) assets, while providing sitewide safety system capabilities. An Integrated Control and Safety System (ICSS) is also a critical tool to ensure optimized start/stop sequencing with embedded sequence diagnostics.

Conversion, Storage and Transportation

Before hydrogen can be used for power, it has to be converted, stored or transported. With pressures of up to 15,000 psi in the value chain, hydrogen must be effectively, efficiently and safely controlled. There can't be any inboard or outboard leaks due to integrity issues with static or dynamic seals. Even some metals can be negatively affected by prolonged exposure to H2, a process called hydrogen embrittlement. And there are also risk assessments and strict regulations to meet.

Working with hydrogen requires serious, dependable control to ensure systems operate safely. Companies need to know they don't have any loss across their systems, and they need to know how much hydrogen is passing through any transmission/transfer points. Integrating components that reliably monitor and measure hydrogen into systems is essential.

Every system includes certain final control elements (FCE), such as shut-off and metering valves, high-pressure regulators, pneumatic actuators and solenoid valves. Reliable, high-quality control and safety circuits provide the precision necessary to maintain appropriate pressure and flow rates and preserve hydrogen purity, and can be monitored remotely. Sensors should be integrated to monitor pressure, temperature and flow rates. If smart equipment is used, data can be collected to improve productivity and ensure high operational yields.

This is also where it's important to have a supplier with a complete portfolio. But what's even more important is working with partners with extensive hydrogen experience and expertise, familiar with the regulations and certifications. They understand the plantwide ecosystem and have the safety and controls equipment needed to monitor, measure and control hydrogen effectively and efficiently. They should also have the flexibility to address a vast range of designs and applications.

Mobility

A key element of the transition to hydrogen-powered vehicles is the fuel cell. Fuel cell power systems can be used to power passenger cars, commercial vehicles and more. Like electrolyzer manufacturers, fuel cell manufacturers can benefit from a strong, expert supplier with an extensive portfolio.

For fuel cells, that portfolio should include high-reliability flow control, pressure regulators, safety junction boxes and flameproof cable glands. Designs should be compact and lightweight to enable manufacturers to create systems with high-power density and extended cell life. Manufacturers can lower risk of fuel cell system failure with solutions that provide stable pressure regulation, safe distribution and equipment connectivity.

Example of ASCO™, Rosemount™ and TESCOM™ components from Emerson, used for measurement and control processes throughout the hydrogen fuel value chain.

Once hydrogen-powered vehicles populate the road, drivers will need to fuel them. As fueling stations transition to green hydrogen, they face several challenges, such as sustainability, safety and maintenance. First, there's the concern of accurately monitoring the hydrogen flow to ensure customers dispense the right amount of fuel, every time, quickly and safely. Accurately maintaining the condition of fueling stations and their critical components can ensure stations are available for users at any given time, whether they're deployed in dense or remote areas. Fueling station equipment can leverage digital transformation to solve some of these critical challenges.

Starting at the device level, smart senor technology and the data it provides can lay the foundation on which digital transformation is built. Building on this foundation, utilizing a programmable logic controller (PLC) with integrated edge gateway capabilities can provide complete control and turn aggregated data into real-time information/analytics of the fuel-dispensing process or the condition of the system itself.

The power of digital transformation can be scaled greatly beyond just one fueling station to a vast network of stations, where information can be aggregated to help optimize the entire network. Dispensing accurate fuel volumes at the highest flow rates safely, as well as reducing the probability of leaks and monitoring the condition of the fueling station, ensures robust operation and optimal yield.

The PLC, combined with an edge gateway, can also perform analysis and visualization of diagnostic and process data, which can be provided locally to the fuel station operator and remotely to the hydrogen supplier, simplifying supply chain logistics. Having remote access to filling rates and preventive maintenance information means hydrogen suppliers are filling tanks only when necessary and providing maintenance only when needed.

From storage tanks to tube trailers to dispensers, fueling station systems must also be safe and easy to maintain, as well as meet the highest performance and regulatory standards. And as we've seen throughout the value chain, hydrogen's explosive nature must be taken into consideration. To reliably protect personnel, customers and property, ultrasonic gas leak detection systems continuously monitor fueling stations for ultrasound generated from the release of pressurized gas. Pressure transmitters designed for high-pressure measurement and flow meters specifically designed for hydrogen-dispensing applications can accurately measure pressure and gas flow. Connecting these important devices that monitor critical parameters to a higher-layer gateway can be used to deliver real-time warnings and alerts to staff on premises or remotely, providing further safety enhancements.

The First Step to Sustainable Success

Building the infrastructure and processes needed to transition to green hydrogen requires a partner who can support companies at each stage of their scale-up. Taking a scalable approach will reduce risk while making meaningful progress.

Because green hydrogen is still a relatively new business, companies must rely on partners with broad knowledge and expertise that have already proven themselves in the hydrogen industry, from production and storage to conversion, transportation and mobility. These expert partners already know the regulations and certifications needed and how they change depending on region. And they likely already have a physical presence to manufacture close to customers and their markets.

Emerson, for instance, has been involved in the hydrogen industry since its beginnings. Since then, we've developed full capabilities across the hydrogen-fueling value chain around the globe. And we're very excited about providing innovative solutions for other new challenges as this expanding frontier presents them.

The Time Is Now

Green hydrogen is exceptionally clean and efficient, but as we've seen, building the infrastructure, controlling the gas and making it available for consumption requires expertise. Companies are better equipped to forge ahead if they partner with a specialist that already has a strong presence and relevant experience, holds deep industry and regulatory knowledge and can provide the needed solutions. This strategic partnership will give them a strong position and long-lasting competitive advantage as they make the promising future of green hydrogen a reality.

About the Author: Nicolas Marti is the business development manager EMEA — alternative fuel & combustion at Emerson. He joined Emerson in 2012 and specializes in hydrogen technology, including technologies for hydrogen filling stations and onboard H2/CNG applications. He received his education at the Paul Cézanne University Aix-Marseille III.

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