



Accelerating the Transition to Hydrogen Fuel



EMERSON™



Hydrogen Key to Environmental Sustainability Goals

Environmental sustainability strategies within the industrial, transport and buildings sectors must be addressed through operational improvement, greater energy efficiency, waste and emissions management and capture, low carbon electrification and clean fuels.

Supporting this, green hydrogen is emerging as *the* clean fuel of the future and a key enabler to achieve global decarbonization objectives.

Growing Demand for Green Hydrogen

The hydrogen fuel industry is growing faster than ever before, with government and private investment continuing to change the market landscape daily. Although green hydrogen production remains in its relative infancy, many industries are starting to shift to sustainable sources.

To meet that demand, we are seeing the construction of more and larger production plants and pilot projects emerging in areas such as offshore green hydrogen production. This demand must be supported by new distribution infrastructure, which in turn will increase the number and type of viable end user applications in the areas.



Increasingly Competitive Market

Equipment manufacturers and system integrators are supporting the industry with innovative solutions that ensure safe and efficient production, transportation, distribution and use within a wide range of applications. To demonstrate their competitive edge, these companies are now looking to scale up their designs, improve efficiencies and provide turnkey repeatable solutions that minimize project timescale.

In addition, new companies are entering from different markets and adapting existing designs and applications to make them suitable for hydrogen. By adopting the latest automation technologies, manufacturers and integrators enhance their ability to serve this growing market.





Key Challenges Faced by Technology Providers

For technology providers, natural gas distributors, OEMs and contractors, hydrogen presents an opportunity to expand their capabilities, but to be successful they must develop equipment and processes that:



Operate safely, reliably and efficiently



Scale up responsively to market demand



Reduce cost and complexity



Delivered on-time, on-budget with low complexity



Exploit economies of scale

Green Hydrogen Production Challenges

To meet growing demand, the production of green hydrogen is being ramped up around the world. This requires scaling up of new technologies on a commercial level. Safety continues to be the top priority, but producers are also looking for electrolyzer systems that operate more efficiently and reliably. Their customers are also demanding hydrogen with higher purity. Manufacturers and technology providers must solve these issues, while also responding quickly to changing requirements.

- Maximize safety of plant and personnel
- Migrate, integrate and scale up
- Reduce production costs
- Ensure gas purity and precise metering
- Balance capital and operational spend
- Standardize automation and control systems across their product fleet
- Meet market standards
- Ensure user plant integration
- Lack of long-term operation and lifecycle management experience
- Lack of experience integrating the latest automation and control systems
- Delivered on-time, on-budget with low complexity
- Exploit economies of scale



Transportation, Storage and Distribution Equipment Challenges

New infrastructure will maximize the availability of hydrogen for industry and consumers. Fundamentally, conversion, storage, transportation via pipeline or tankers and distribution via refueling stations requires effective, efficient and safe control of hydrogen at very high pressures. Technology providers and equipment manufacturers must deliver those, but also ensure they help operators to lower the total cost of ownership, be compliant with local regulations and provide a competitive advantage, especially through greater access to actionable information related to operational performance and equipment health. Some specific requirements include:

Transportation and Storage

- Dependable control to ensure systems operate safely
- Accurate metering of hydrogen transmission/transfer
- Integration of monitoring/measurement into management systems
- Prevention of inboard and outboard leaks
- Ensure against embrittlement (prolonged exposure to hydrogen)

Distribution and Refueling Stations

- Protect personnel, customers and property
- Maximize return on investment
- Maximize refueling station equipment availability
- Accurate monitoring of flow dispensed repeatedly, quickly and safely
- Drive operational efficiency through fleet connectivity
- Aggregated information from network of fueling stations
- Comprehensive technical support and replacement components

Fuel Cell Application Challenges

Fuel cells offer an energy source that is independent from the power grid, making them ideal for mobility applications, such as passenger cars and commercial vehicles, and portable backup power for hospitals, data centers and mission-critical applications. Within mobility applications, reliability and safety is key, yet often there's a lack of expertise to optimize the use of hydrogen.

Such diverse uses, brings a unique set of operational challenges for OEMs, including the need for:

- Highly reliable flow control and pressure regulation
- Compact and lightweight designs
- High power density and extended cell life
- Reduce the risk of fuel cell failure
- Stable pressure regulation, safe distribution and equipment connectivity
- Exploit economies of scale



Gaining a Competitive Advantage

In this evolving landscape, enhanced technology, deeper expertise and a stronger commitment to value-creating solutions guarantees a market advantage. With automation technology at the heart of most equipment and process designs, manufacturers across the entire hydrogen fuel value chain will benefit from partnering with expert automation technology providers who can elevate their offering and to help them achieve production efficiency.

Emerson's project execution approach delivers solutions that eliminate costs, reduces complexity, and accommodates change to improve capital efficiency and deliver more reliable project schedules.



Production Equipment Solutions

Advanced automation technology providers are helping to meet production challenges, with digital twin technology helping to prove new designs, and site-wide integrated control and safety systems, measurement and machinery health solutions, designed specifically for hydrogen applications, improving safety and reliability. Implementing smart technologies also helps to reduce operational complexity, decrease risk and improve the performance of both electrolyzers and balance of plant.

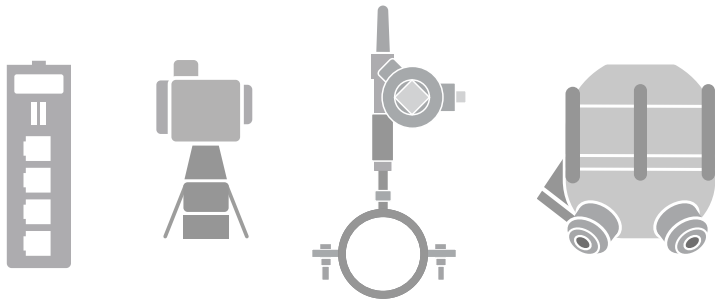


The impact of implementing the latest automation solutions:

- Increased scale to drive unit costs
- Appropriate levels of process control redundancy and safety
- Compliance with latest regulations, protocols and norms
- Increased electrolyzer system efficiency and lifespan
- Increased adaptability to fluctuating power supplies
- Greater power density and stack size
- Lower material costs and increase flexibility

Distribution Network Solutions

Automation solutions not only ensure correct delivery of fuels but increase visibility into the performance of a fleet of assets, leading to improved availability of equipment, productivity and profitability. Effective management of disparate and remote operations can be achieved by adopting a discovery, design, development and deployment approach that aligns organizations around priority metrics and uses KPIs to drive profitability.



The impact of implementing this approach and the latest automation solutions is:

- Dependable flow rates and pressure control
- Actionable data available to support operational performance improvements
- Detect leaks and irregularities with real-time notifications
- Prevention of under or overfilling
- Predictive maintenance to avoid unplanned disruptions
- Lower maintenance costs
- Compliance with regulations and certifications including regional differences

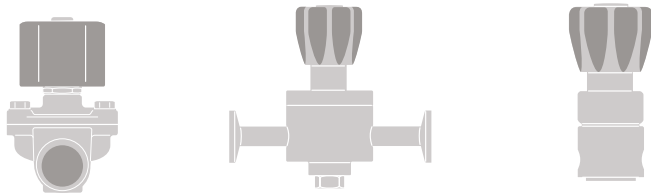
Fuel Cell Application Solutions

The latest automation solutions offer greater reliability, while compact solutions offering comparable or improved performance provide the end user with a critical advantage.

The reliable and safe operation of fuel cell types including PEMFC, PAFC, SOFC and MCFC is achieved through stable pressure regulation, safe distribution and connection between conducts and equipment. This is enhanced further by robust and extremely reliable products designed for cold environments that ensure longer life and reduced downtime.

Impact:

- Reduced risk of fuel cell system failure
- Reduced failure points enhances reliability and safety
- Increased accuracy of flow regulation with varied output power capacity
- Compact and lightweight designs permit creation of high-power density systems
- Greater fuel efficiency and power distribution



Choosing a Technology Partner

In an increasingly competitive market, relationships with reliable experts and partners become critical for your success. When selecting an automation technology partner, some of the key considerations are whether they have products designed for this demanding application that meet the industry standards and provide the required reliability.

Does the company have the necessary experience and understanding of the specific challenges of safely producing and transporting hydrogen, and a broad range of fuel cell applications? Can they provide the product and project support globally in line with your expected growth?

The right partner will offer:

- Product suitability and reliability
- A comprehensive portfolio to reduce complexity
- Solutions that increase and optimize operational performance and safety
- Engineered solutions for specific applications
- Collaborative design engineering capability
- Project execution capability
- In-house implementation services
- Global scale and responsive local support





Achieving Environmental Sustainability Goals

Emerson supports decarbonization journeys, with technology and project execution capability that impact all areas of the energy system. This includes optimizing the production of low-carbon power and low-carbon fuels, reducing the energy use of buildings and industrial sites, minimizing waste generation and material use, preventing emissions leakage, capturing and storing CO₂ and electrifying end-uses.



Hydrogen Fuel Chain Automation Expert

Emerson has supported hydrogen production for decades and has established full capabilities across the hydrogen fuel value chain. A strong partnership with an automation expert, such as Emerson, strengthens your position and long-lasting competitive advantage.



Comprehensive Support

Selecting a supplier able to provide a complete portfolio of automation solutions can simplify the supply chain, freeing manufacturers to focus on developing their products.

Our comprehensive portfolio of products, designed specifically for hydrogen applications, reduces complexity, while our industry experts are available globally to support the design and build of your machines and processes.

With the hydrogen fuel industry evolving rapidly, we continue to develop innovative solutions to meet the challenges of expanding operations, including the need for efficient production, safe and lower-cost distribution, and reliable fuel cell operation.

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