EMERSON SUSTAINABILITY SOLUTIONS

Optimizing the Hydrogen Value Chain

EMERSON

BEGIN EXPLORING

AN EFFICIENT HYDROGEN VALUE CHAIN

Driver for Change: Sustainability

As a complement to other technologies, including renewable power and biofuels, hydrogen has the potential to decarbonize industries – such as steel, petrochemicals, fertilizers, heavy-duty mobility (on- and off-road), maritime shipping and aviation – and support flexible power generation (among other applications). (Source: McKinsey 2022)

By 2050, hydrogen has the potential to achieve over 20% of annual global emissions reductions. (Source: McKinsey 2022)

Yet today, we celebrate several milestones:

In February 2022, the world's first shipment of liquefied hydrogen from Australia to Japan was a significant development in the international transport of hydrogen.
(Source: International Energy Agency 2022)

The development of steel projects has accelerated following the start-up of the first demonstration project of using hydrogen in direct iron reduction.
(Source: International Energy Agency 2022)

In Germany, the first fleet of hydrogen fuel cell trains is in operation.
(Source: International Energy Agency 2022)

In September 2023, 100% hydrogen was successfully tested through partnership between Rolls-Royce and easyJet under aircraft take-off conditions at the German Aerospace Center.
(Source: Military Aerospace 2023)

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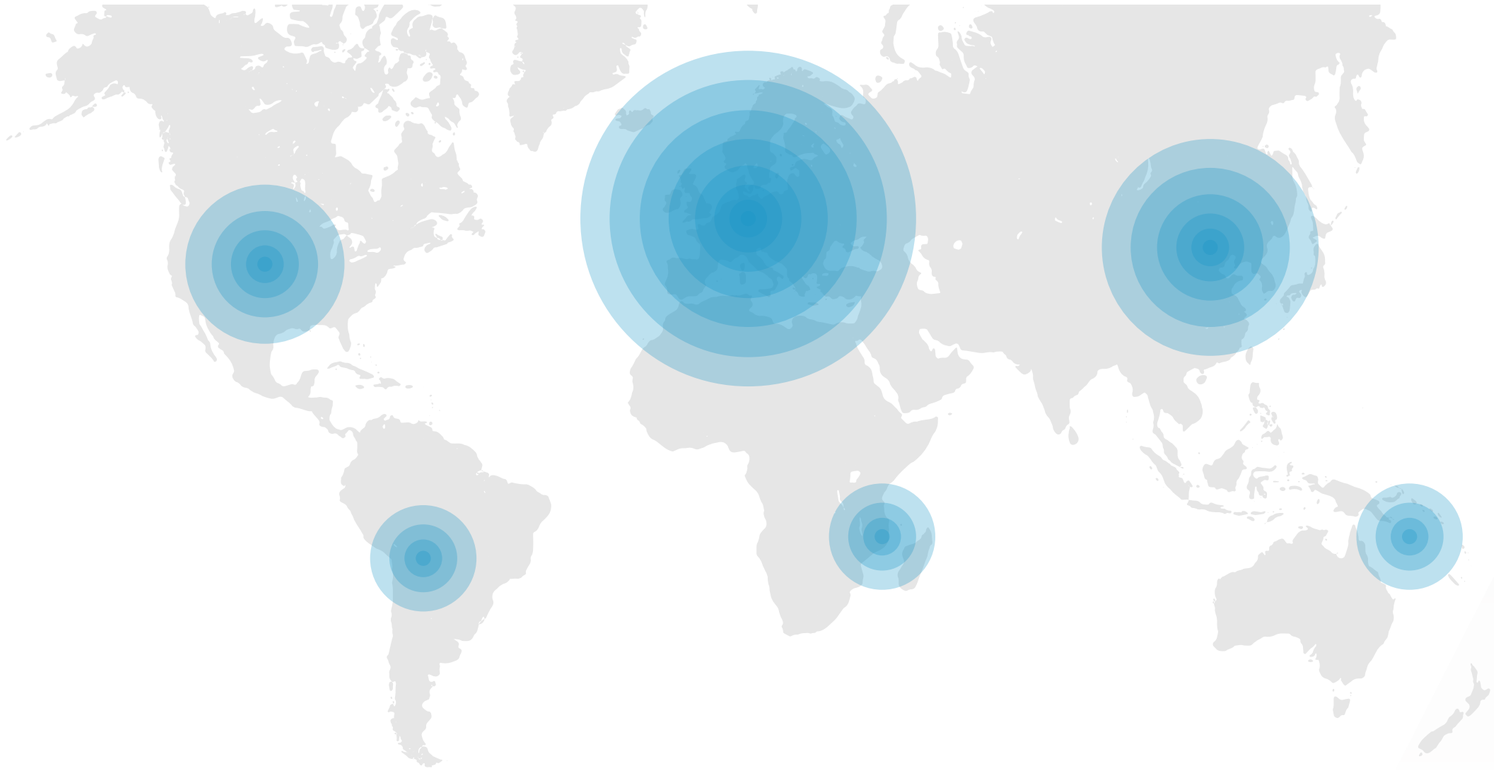
AN EFFICIENT HYDROGEN VALUE CHAIN

H_2 Growth Is Accelerated Through Large-Scale Projects

With over 680 large-scale hydrogen projects in motion worldwide, now is the right opportunity for operators to scale operations and build smarter plants leveraging proven industry H_2 technologies and expertise.

(Source: McKinsey 2022)



To scale and streamline an efficient hydrogen value chain, smart automation must be implemented across production, transportation and distribution.

AN EFFICIENT HYDROGEN VALUE CHAIN

Digital Transformation of Hydrogen Operations Is Empowering Customers to Achieve Ultimate Performance

From production to distribution, Emerson is advancing hydrogen projects and adoption of hydrogen as a clean fuel source through automation solutions. Right now, the combination of Emerson's extensive industry perspective and comprehensive portfolio is enabling the automation, safety and reliability of hydrogen production and refueling in Canada, Korea and more.

As the global automation leader with over 100 years of experience, Emerson innovates for and with customers, working together to reimagine a safer, smarter and more sustainable world.

Air Liquide

Empowering the world's largest PEM electrolyzer in Canada

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KOHYGEN
KOrea HYdrogen Green Energy Network | 코하이젠(주)

Accelerating decarbonization of the hydrogen refueling infrastructure with the world's largest hydrogen refueling station in Korea

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An Efficient Hydrogen Value Chain Innovates, Accelerates Execution and Scales Up New Technologies While Reducing Cost, Risk and Time-to-Market

Advanced software is accelerating innovation and commercialization, optimizing production and storage and facilitating continued innovation of end use with digital twin technology and analytics. By employing the end-to-end project viability and production optimization, this enables:

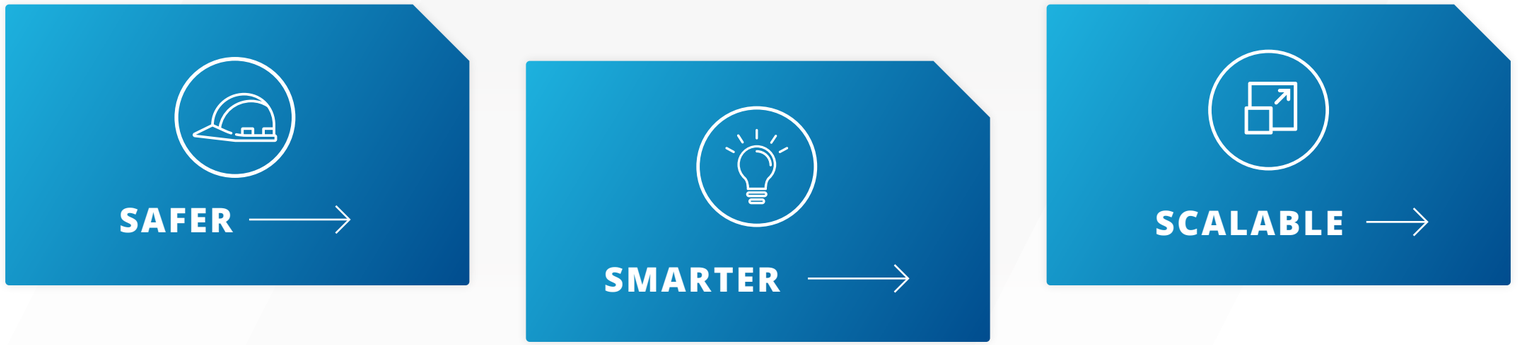
- New technology adoption, reducing costs and time-to-market
- Investment and financial decisions by evaluating risks and costs across lifecycle
- Project designs review, accelerating delivery and execution
- Scalable operation and optimization, maximizing load factor

Integrated with the AspenTech portfolio and decades of innovation, expertise and leadership, Emerson's ecosystem is advancing and providing digital solutions to support and optimize your low-carbon hydrogen project design to economic feasibility.

Hydrogen is becoming increasingly adopted in the global energy transition and as a primary fuel source for meeting the demand for clean energy.

Managing the complexity of the hydrogen value chain with efficiency is more important than ever.

With leading and versatile technologies, experts and solution services, Emerson can help to ensure your hydrogen operations are safer, smarter and scalable from design to operations.



Safer

Throughout the value chain, instrumentation and automation technologies protect and ensure operational integrity. Selecting the right technologies helps to adhere to safety standards and ensures safe and efficient operation of hydrogen-handling facilities.

SAFER PRODUCTION

To Safely Meet Evolving Demands Across the Hydrogen Market, Standards Must be Fortified with Supervisory Systems and Mitigation Technologies

Considering pressures up to 15,000 psi throughout the hydrogen value chain, processes must be monitored and controlled with diagnostic and prescriptive solutions.

As a flammable gas and the smallest of molecules, hydrogen must be handled with extreme caution throughout the facility infrastructure to avoid potential challenges:

- Leaks
- Overpressure
- Fires

OUR SOLUTION

Emerson works with your storage, maintenance and transportation teams to activate vigilant hydrogen solutions designed to perform in hazardous conditions and keep personnel and the environment safe while optimizing product control and mobility.

Challenge: Maintaining Safety and Integrity of Infrastructure and Operations

Solution: Maintain control quality and process safety with reinforced caution and productivity.

These control and safety systems are engineered to mitigate and reduce risk of damage through detection and control equipment and preventative measures.

Protection of Equipment Against Overpressurization

Emerson's pressure and safety relief valves are critical for protection of downstream equipment and upstream fluid pressure against overpressurization in harsh environments.

LEARN MORE

Flame Detection In Case of Hydrogen Fires

With high accuracy and immunity to false alarms, Rosemount™ flame detectors detect various sources of hydrocarbon flames and invisible hydrogen fires using UV, UV/IR and multi-spectrum infrared-based technologies.

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aspentech

Project Design Validation for On-Time and On-Budget Success

Aspen Fidelis™ reduces risk and optimizes plant performance through by enabling risk quantification, asset performance simulation and system analysis.

LEARN MORE

Steady and Precise Pressure Regulation

TESCOM™ back pressure regulators and pressure control valves provide steady, precise and consistent pressure control, minimizing the risk of overpressure. Electropneumatic pressure regulators communicate system and device performance for analysis and decision making.

LEARN MORE

Safety Management in Hazardous Conditions

LED lighting technology ensures proper and safe illumination, eliminating slips and trips while minimizing energy usage. Flameproof and explosion-proof enclosures and junction boxes ensure safety standards are met.

LEARN MORE

Challenge: Maintaining Safety and Integrity of Infrastructure and Operations

Solution: Enhance hydrogen transportation stability through persistent monitoring, advanced diagnostics and precise regulatory measures.

Automated safety systems and asset management tools are paramount in managing critical instrumentation and assets through remote 24/7 inspection and readiness for response.

Reliable Pressure Regulation and Management

Emerson's pressure regulators enable precise and stable pressure management for a range of fluids and provide protection against overpressure.

LEARN MORE

Flame Detection In Case of Hydrogen Fires

With high accuracy and immunity to false alarms, Rosemount™ flame detectors detect various sources of hydrocarbon flames and invisible hydrogen fires using UV, UV/IR and multi-spectrum infrared-based technologies.

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Actuation for Emergency Shutdown With Comprehensive Diagnostics

Bettis™ Smart Electro-Hydraulic Operators (EHO) provide fail-safe actuation for emergency shutdown valves and offer advanced diagnostic capabilities with available connection to DCMlink software for remote monitoring.

LEARN MORE

Optimized Measurements in Hydrogen Transportation Processes

Micro Motion™ High-Pressure Coriolis flow meters are engineered to deliver highly accurate, reliable measurements for hydrogen dispensing applications in high-pressure environments.

LEARN MORE

Product Quality Control and Enhanced Performance

Emerson's control valves, such as the Fisher™ GX control valve, provide a variety of applications in severe circumstances, optimizing product quality during transportation and plant efficiency with improved reliability and performance.

LEARN MORE

Challenge: Maintaining Safety and Integrity of Infrastructure and Operations

Solution: Instate measurement and control tools for reliable distribution operations.

Digital detection and mitigation solutions are crucial for preventing and resolving incidents and addressing a wide range of operational challenges.

Optimized Measurements in Hydogen Transportation Processes

Micro Motion™ High-Pressure Coriolis flow meters are engineered to deliver highly accurate, reliable measurements for hydrogen dispensing applications in high-pressure environments.

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Product Loss Minimization and Emissions Reduction

The Anderson Greenwood Type 81 Spring-Loaded Safety Valves are agile and built for minimizing product loss and emissions.

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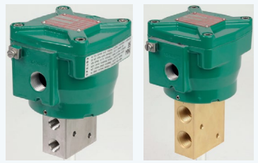

Fuel Dispensing With Solenoid Valves

ASCO™ solenoid valves are engineered for maintenance of highly precise, safe and reliable high flow control, as well as rapid and dependable isolation of hydrogen, in dispensing applications.

LEARN MORE ↗

Gas Leak Detection Through Holistic Monitoring

The Rosemount™ Incus Ultrasonic Gas Leak Detector offers continuous monitoring of wide areas for ultrasound generated from the release of pressurized gas in harsh environments, enabling instantaneous response.

LEARN MORE ↗

High Pressure Control With On/Off Valves

Air operated on/off valves are capable of controlling 15000-psi hydrogen storage tank activity and isolating key components in the high-pressure system within dispensers.

LEARN MORE ↗

Smarter

Automation solutions stabilize and accelerate hydrogen production with increased reliability and efficiency. Edge-to-enterprise solutions offer an integrated system that connects to business outcomes across the hydrogen facility lifecycle.

Smarter Production >

Smarter Transportation >

Smarter Distribution >

SMARTER PRODUCTION

Integration of Automation Technologies and Solutions is Required to Elevate Energy Efficiency and Hydrogen Production with Speed and Quality

To meet local and global production goals, several factors must be maintained and improved.

- Safe management of flow control and reliable operation of equipment
- Efficiency of equipment, from valves to edge controllers
- Efficiency of hydrogen production
- Energy efficiency and emissions intensity
- High-precision pressure regulation at a wide range of pressures

OUR SOLUTION

Emerson works to implement the latest, emerging solutions to help you mitigate risk while achieving optimal production of hydrogen and capitalize on competitive and sustainable opportunities around the growth of hydrogen fuel.

Challenge: Optimize the Hydrogen Value Chain by Streamlining the Journey from Research & Development to Seamless Commercial Production

Solution: Maximize productivity through seamless, strategic integration of smart instrumentation and systems.

These solutions are engineered to optimize operations to meet shifting market demands and trends.

DeltaV™ Automation Platform

The DeltaV™ Automation Platform, which includes systems like DCS, SIS and MES, removes complexities and project risks while driving flexibility, scalability and productivity along the value chain.

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Installation Cost Minimization Through Remote Analysis

The Rosemount™ gas analyzers and integrated systems are designed to meet measurement and monitoring requirements, reducing installation costs with remote support and analytics.

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Faster Execution With Concurrent Engineering Enabling Repeatable Design

Aspen Capital Cost Estimator™ streamlines project design and execution with greater visibility, reliability and evaluation for fast decision-making and change management agility. It enables scaling with speed with reduced CAPEX cost and OPEX risk.

LEARN MORE ↗

Wireless Connectivity for Safe, Sustainable Operations

The addition of industrial wireless networks and sensors, such as Rosemount™ wireless pressure transmitters and temperature instrumentation, improves operations and safety while reducing energy usage.

LEARN MORE ↗

Smart Pneumatics and Control

Passing data from pneumatic sensors, through edge devices and up into an on or off premise cloud provides information that enables better and faster decision-making.

LEARN MORE ↗

Challenge: Optimize the Hydrogen Value Chain by Streamlining the Journey from Research & Development to Seamless Commercial Production

Solution: Ensure safer H_2 transport and storage with mindful compliance of safety regulations.

These solutions are designed to increase visibility and reduce leaks in H_2 transport.

Repeatability of Zero-Leakage Protection

The Anderson Greenwood Type 200 pilot-operated relief valves are engineered to reduce installation and maintenance costs, improve reliability and safety and enhance performance through protection against overpressurization.

LEARN MORE

Simulation and Analytics Platform

Through modeling and simulation capabilities, OSI's Continua™ applications enable advanced insights with improved visibility, designed to improve performance and reduce costs with ease of data transfer.

LEARN MORE

Product Loss Minimization

Vanessa Series 30,000 triple offset valves (TOV) are designed to reduce fugitive emissions with zero-leakage performance.

LEARN MORE

Robust, Optimized Connectivity

With highly secure and scalable architecture, OSI's Monarch™-based SCADA platform provides real-time scheduling and monitoring through enhanced visualization for detecting issues early.

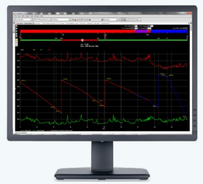
LEARN MORE

Low-Emission, Low-Maintenance Stem Sealing

Fisher™ ENVIRO-SEAL™ Control Valve Packing Systems are reliable packing solutions that offer exceptional stem sealing while reducing operational costs and enhancing operator safety.

LEARN MORE

Challenge: Optimize the Hydrogen Value Chain by Streamlining the Journey from Research & Development to Seamless Commercial Production



Real-Time Pipeline Monitoring

PipelineManager™ supports real-time monitoring of energy pipelines through generation of a digital twin of operations, providing leak detection, automated predictive capabilities and batch tracking.

LEARN MORE ↗

Wireless Corrosion & Erosion Monitoring

Improving pipe maintenance, Rosemount™ Wireless Permasense Ultrasonic Thickness (UT) Sensors offer visibility into corrosion trends through continuous measurement of pipe wall thickness.

LEARN MORE ↗

Challenge: Optimize the Hydrogen Value Chain by Streamlining the Journey from Research & Development to Seamless Commercial Production

Solution: Employ smart technologies that collect data to improve productivity and ensure high operational yields.

These solutions are designed to provide reliable fuel dispensing & storage solutions for fuel transporters and downstream suppliers.

Intelligent Automation of Fueling Processes

Emerson's programmable logic controller (PLC) exerts complete control of the fuel dispensing process through integrated edge capabilities – including dynamic visualization of data. And with Movicon, a modular, scalable and secure industrial platform can help you optimize operations and efficiency from any location and any device.

LEARN MORE

Accurate Temperature Monitoring

Eliminating the need for thermowell assembly or process penetrations, Rosemount™ X-well Technology is the go-to solution for accurate process temperature monitoring. This technology removes the potential for leak points and reduces installation time and overall lifetime costs associated with thermowells.

LEARN MORE

Fuel Dispensing Efficiency

TESCOM™ pressure regulators ensure precise, leakage-free and reliable control for fuel dispensing certainty.

LEARN MORE

Flow Management

Designed for hydrogen dispensing applications, Emerson's Micro Motion™ Coriolis flow meters enable highly accurate and reliable mass flow measurements of hydrogen in various states – gas, liquid or slurry.

LEARN MORE

Advanced Pressure Diagnostics and Insights

Providing critical, ready-to-install solutions to unique hydrogen challenges, Rosemount™ pressure transmitters are protected against hydrogen permeation with high pressure capabilities and deliver high accuracy, reliability and ease-of-use with advanced diagnostics and insights for maintenance.

LEARN MORE

Scalable

A low-carbon, energy-efficient future is optimized through sustainable adaptability and scaling of hydrogen operations, requiring investment, innovation and collaboration across the value chain. Leveraging automation technologies is enabling connectivity and scalability across the hydrogen value chain.

Scalable Production

Scalable Distribution Through H_2 Hubs

SCALABLE PRODUCTION

Integrating the Right Technologies Will Scale Industrial Adoption and Production of Clean Hydrogen, Solve Cost, Infrastructure and Market Challenges and Drive Emerging Small-Scale Applications

To ensure continuous progress in meeting fluctuating demands and trends, agile automation solutions must be implemented to address challenges that are subject to change.

- Energy supply variability
- Design and project feasibility
- Product quality and purity

OUR SOLUTION

Offering flexible, industry-leading support across services, Emerson is empowering customers to achieve high value, performance and productivity through implementation of energy-efficient measurement and control technologies and engineered solutions designed for driving hydrogen fuel applications.

LEARN MORE ↗

Challenge: Enabling H_2 Adoption Through Faster Scale-Up

Solution: Enable quick startup and eliminate H_2 project commercialization risks through advanced software and time-tested hardware.

These solutions are designed to accelerate the adoption of innovation and scale-up operations.

Smart Commissioning by DeltaV and DeltaV Electronic Marshalling with Distributed CHARMs

Emerson's DeltaV™ Automation Platform reduces operations complexity and lowers project risk, improving speed, performance and scalability of power-to-gas megawatt electrolyzers.

LEARN MORE

Flexible, Scalable Industrial Control

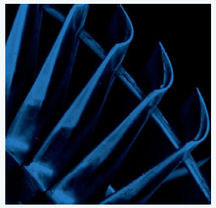
Emerson's PACSystems™ portfolio, including the RX3i Controller and CPL410 Edge Controller, equips customers with advanced, scalable automation solutions engineered for all aspects of hydrogen production and distribution.

LEARN MORE

Project Risk Reduction and Acceleration of Delivery and Execution

Implementing the AspenTech™ Sustainability Pathway reduces time-to-market, as well as costs and risks along the value chain, by enabling effective decision-making for scaling low-carbon hydrogen projects.

LEARN MORE



Dynamic Simulation for Smooth Operations

Aspen HYSYS® Dynamics optimizes interfacing throughout green hydrogen processes with virtual commissioning and startup, providing dynamic simulation modeling for reducing costs and late design changes.

LEARN MORE

Optimal Design and Operations for Engineering Lifecycle

Aspen Performance Engineering, integrated with scalable Digital Twin Solutions, can help customers reduce OPEX and improve safety and profitability through optimal design.

LEARN MORE

SCALABLE PRODUCTION

Challenge: Enabling H_2 Adoption Through Faster Scale-Up

Easy Maintenance, Low Lifetime Costs and High Accuracy

The Fisher™ HP series Control Valves are designed for high-pressure applications in process control industries, maintaining stable output pressure.

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Tight Shut-Off Repeatability

Emerson's extensive portfolio of on/off isolation valves delivers isolation capabilities to ensure operations run safely, including tight shut-off across a wide pressure and temperature range with minimal emissions.

LEARN MORE ↗

Flexible, Scalable Industrial Control

The Fisher™ MR95 Series Pressure Regulators are large-capacity pressure regulators primed for scaled pressure control across applications such as test fixtures, process chemicals and fuel lines.

LEARN MORE ↗

Timeless Reliability in Gaseous Hydrogen

With a LOW-E fugitive emission certification, KTM Series EB1 OM-2 is a high-performance reliable ball valve designed to handle gaseous hydrogen.

LEARN MORE ↗

SCALABLE DISTRIBUTION THROUGH H_2 HUBS

Hydrogen Hubs, Also Known as Industrial Clusters, Are Playing a Crucial Role in the Development and Deployment of Hydrogen in the Effort to Accelerate the Transition to a Low-Carbon Future

When produced at scale, renewable hydrogen, or green hydrogen, can reduce global CO2 emissions by up to 25%.
(Source: U.S. Department of Energy)

The success and scalability of a hydrogen hub ultimately depend on the following considerations:

- Requirement of significant investments
- Scaling risks from research & development to commercial production
- Technology costs and differing levels of efficiencies
- Validation of scenarios and operational strategies
- Increased risk from integration of multiple systems across the value chain

OUR SOLUTION

Through proven automation expertise across the H_2 value chain, Emerson is a solution partner ensuring technologies are connected and project design is validated. This is bringing the highest level of operation efficiency and safety across applications – from electrolyzers to transportation to refueling stations and fuel cells.

SCALABLE DISTRIBUTION THROUGH H_2 HUBS

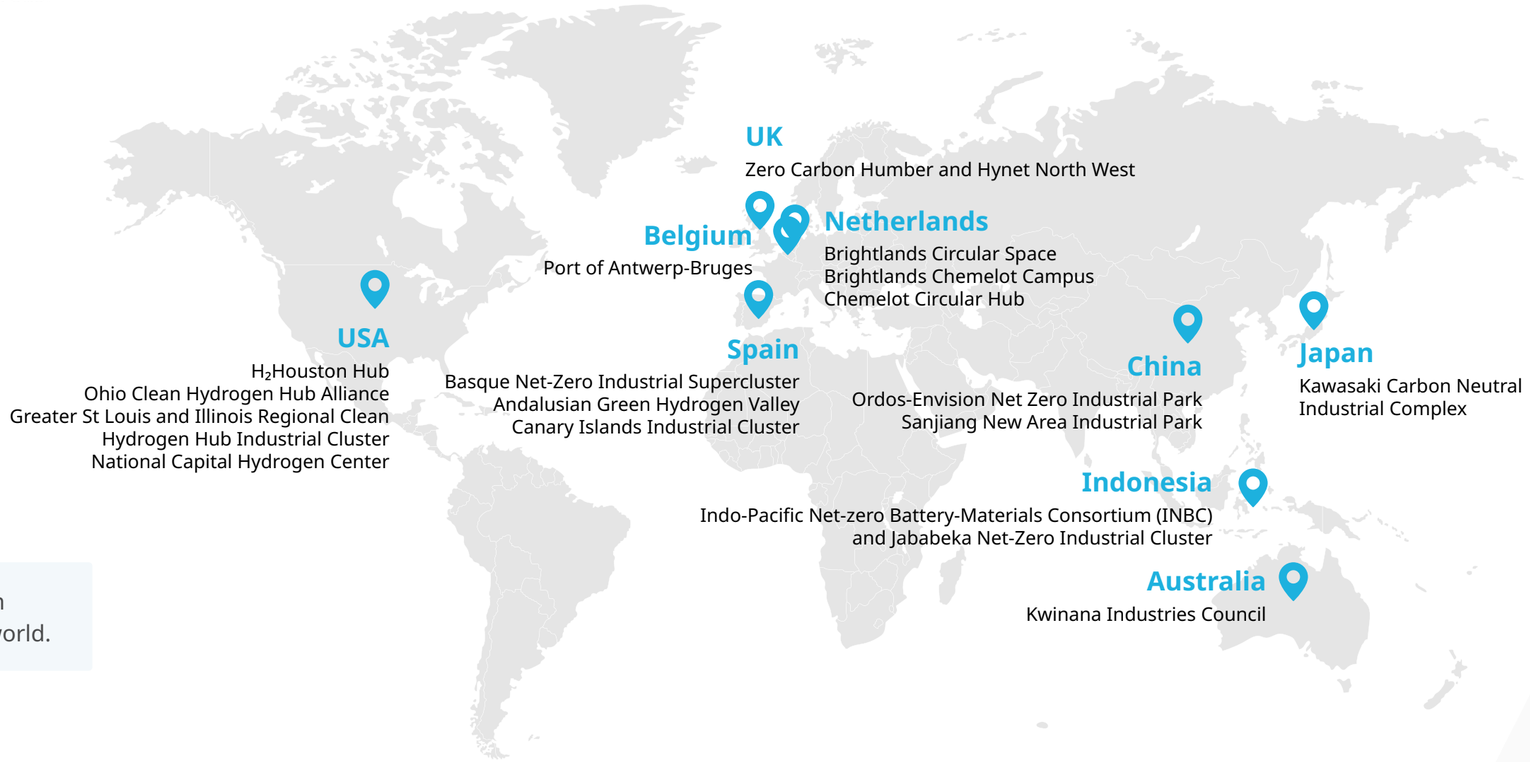
Hydrogen Hubs Are Connecting the Hydrogen Value Chain While Driving Decarbonization Efforts Across Industries Globally

According to the World Economic Forum, new industrial clusters are forming globally to support cross-industry decarbonization efforts in strategic global areas.

To optimize hub adoption, holistic strategies must be developed to accelerate decarbonization journeys and address challenges:

- Partnerships building trust across supply and demand
- Financing
- Policy enablement for accelerating emissions reductions
- Technology that is versatile and applicable across all clusters

With the aim of eliminating carbon dioxide emissions and producing clean hydrogen, these are some of the industrial cluster initiatives around the world.



SCALABLE DISTRIBUTION THROUGH H_2 HUBS

Helping H_2 Hubs Implement Seamless, Enterprise-Wide Performance Improvement

The right partner can ensure safety remains a top priority, including technologies for emergency shutdown and safety instrumented systems, which are important in hydrogen facilities.

The right partner would also be able to provide:

Advanced process control solutions, including asset optimization software, because combining advanced process control with basic process control systems will **improve performance and efficiency** by optimizing operations.

Instrumentation and measurement solutions, which, in the context of hydrogen production, are needed for **monitoring and controlling process variables**, such as pressure, temperature, flow, level and other parameters.

Control valves and accessories for use in hydrogen production and distribution systems to **control flows and ensure optimal performance**.

Energy management solutions to help end users **optimize energy usage** in hydrogen production facilities, contributing to overall efficiency and sustainability.

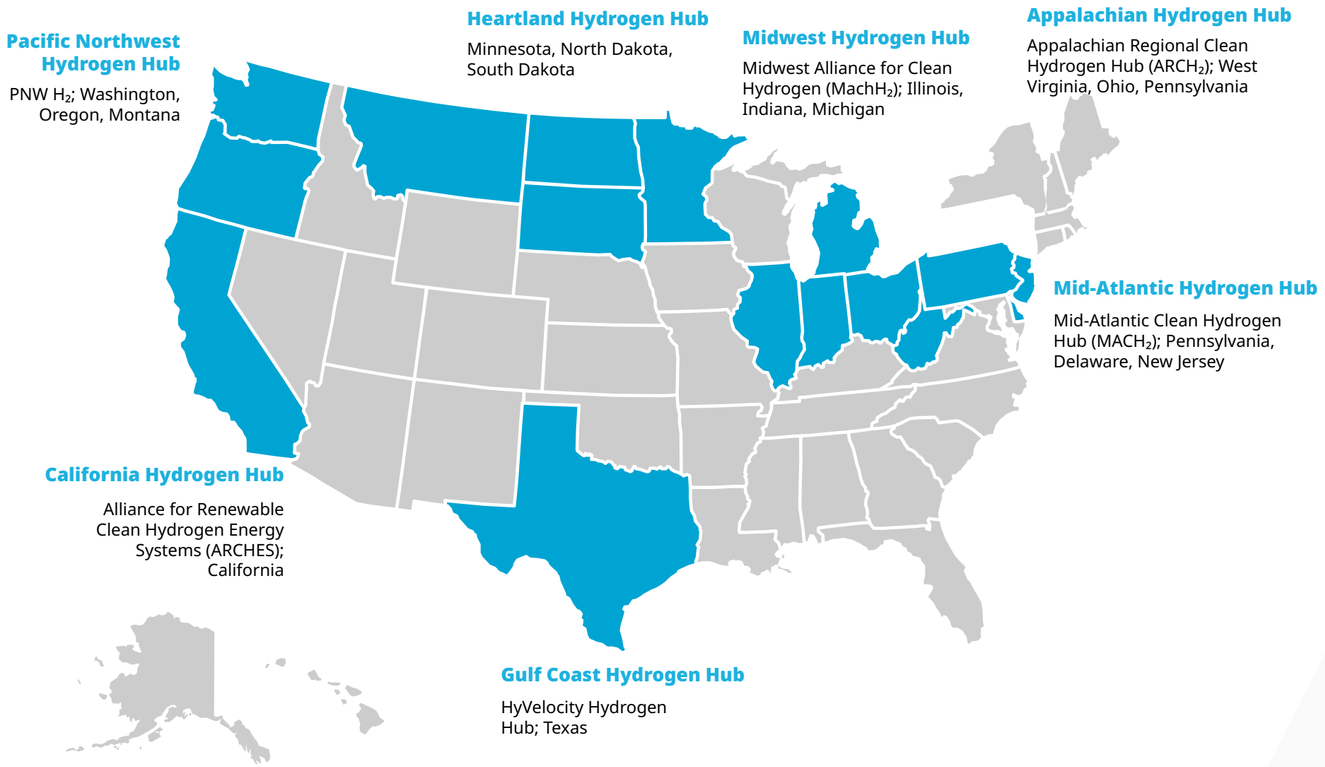
An integrated ecosystem of solutions helps to drive operational excellence, reduce production variability and ensure planning for both plant and production expansion.

With the right automation solutions, operations can accelerate the development of the hydrogen value chain across all sectors and increase the efficiency of massive hydrogen production plants.

Hydrogen Hubs Are Designed to Accelerate the Build-Out of Integrated Systems, from Production and Storage to Transportation and Consumption

Hydrogen valleys, or hubs, are expanding worldwide, quickly becoming the first regional "hydrogen economies." (Source: Clean Hydrogen Partnership 2022)

- As of September 2022, 38 European hydrogen valleys are in development as part of the Mission Innovation Hydrogen Valleys Platform. (Source: Clean Hydrogen Partnership 2022)
- Recently, the United Nations Industrial Development Organization (UNIDO) released the first edition of Green Hydrogen Industrial Clusters Guidelines to enable policymakers and industry leaders to cultivate environmental stewardship and global decarbonization efforts across industries. (Source: United Nations Industrial Development Organization 2023)
- In 2023, the Biden Administration announced seven regional hydrogen hubs that will eliminate 25 million metric tons of carbon dioxide emissions from end uses each year – the equivalent of 5.5 million gasoline-powered cars. (Source: The White House)
- Approximately two-thirds of project investment are associated with green hydrogen production within the hubs, which are projected to produce over three million metric tons of clean hydrogen per year. (Source: The White House)
- About one-third of the 2030 U.S. clean hydrogen production goal can be met within the production within these seven hubs. (Source: The White House)
- From the U.S. to the E.U., these key milestones over the past two years are significant steps forward as various sectors look to initiate and accelerate new large-scale hydrogen projects around the world.



Ensuring the highest level of operational efficiency calls for strategic collaboration with the right partner. Emerson is uniquely positioned to equip customers with industry-leading technologies and deep expertise throughout the hydrogen value chain.

Optimizing the Hydrogen Value Chain

GO BOLDLY ↗

BACK