



**OPTIMIZING
THE HYDROGEN
VALUE CHAIN:
EFFECTIVE
SOLUTIONS
FOR ENHANCED
SAFETY,
RELIABILITY,
AND EFFICIENCY**

Honeywell

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HYDROGEN IS THE FUEL OF THE FUTURE

Hydrogen is the fuel of the future. As a carrier of clean renewable energy, it will be essential to meeting global goals to decarbonize the economy. Governments in more than a dozen countries worldwide have already adopted formal hydrogen strategies. Dozens more are preparing theirs or are in policy discussions.

For powering heavy transport, as a feedstock for industrial processes, and, in future, heating homes and buildings, hydrogen is versatile and could be plentiful. It can power combustion processes, provide energy via fuel cells, or be blended into natural gas. Across industrial and domestic markets, it offers potential to transform the energy value chain, and promises to vastly accelerate the move to low carbon and no-carbon economies. Hydrogen can further be transformed into Ammonia or Methanol, both as proxies for Green Hydrogen, for practical and logistical reasons. It also presents significant challenges for safety, measurement and storage, requiring new processes, technologies, materials and expertise to facilitate massive and rapid change across a complex value chain:

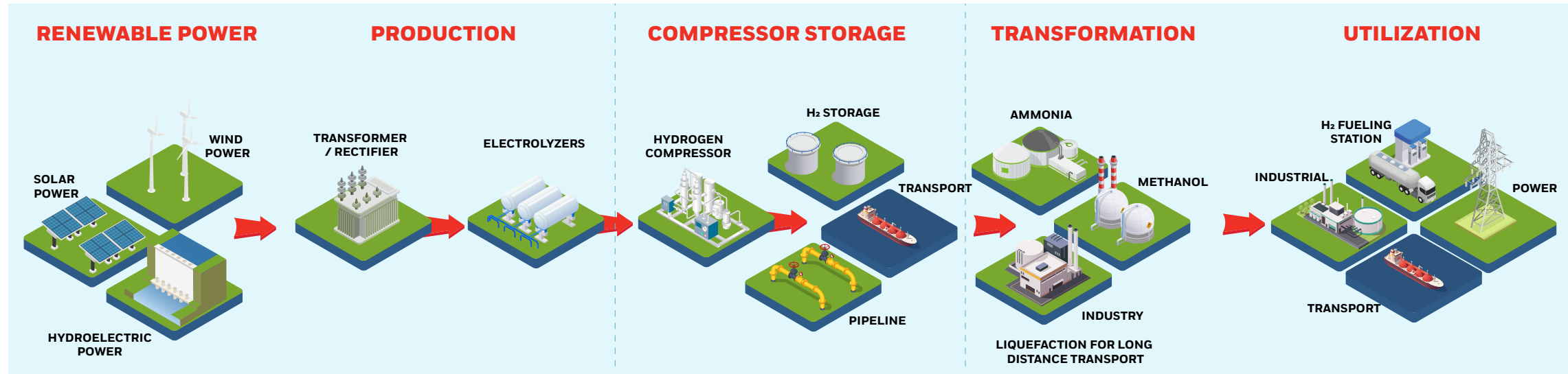
- From renewable sources such as wind, solar, hydroelectric and tidal energy with intermittent and fluctuating energy production

- To electrolyzers and ancillary processing with requirements to quickly scale hydrogen production as demand increases
- Through to high pressure storage, cryogenic liquid product movements and grid injection and blending
- To end users, ensuring safe storage, fueling, and utilization. Across the new and traditional energy infrastructure, industries and transport, operators require hydrogen-ready solutions and partners to operate safely, scale effectively and operate efficiently



WE'RE READY. ARE YOU?

Honeywell's solutions and expertise cover the entire hydrogen value chain. Across production and conversion, transmission and storage, and distribution and use, our solutions can help operators and OEMs operate more safely and profitably.



Offering	Value Chain				
	Renewable power production	Hydrogen Production	Conversion	Storage and Distribution	End Use
Flow Meters		✓		✓	✓
Pressure Regulators /Safety Valves		✓	✓	✓	✓
Hydrogen Grid Injection				✓	
Hydrogen Blending					✓
Gas Trains					✓
Gas Analyzers		✓	✓	✓	✓
Flow Computers		✓		✓	✓
SmartLine Transmitters		✓	✓	✓	✓
Terminal Automation Solutions				✓	
Gas and Fire Detection	✓	✓	✓	✓	✓
Sense Point Detectors		✓	✓	✓	✓
Connected OEM	✓	✓		✓	✓
ControlEdge™ PLC	✓	✓	✓	✓	✓
ControlEdge™ RTU	✓	✓	✓	✓	✓
Safety Manager SC		✓	✓	✓	✓
ControlEdge HC900		✓	✓	✓	✓
Experion HS	✓	✓	✓	✓	✓
Experion PPC	✓	✓	✓	✓	✓
Versatilis Sensors		✓	✓	✓	✓



WHY HONEYWELL

At Honeywell, we combine market-leading technology with global expertise and relevant experience to provide the support operators and OEMs need in a fast changing market.

We don't just offer a broad and growing portfolio of hydrogen ready solutions; we draw on real experience and from our wider group to provide confident answers to your challenges.

- Honeywell UOP is a leader in hydrogen process technology, with a track record of over 1,000 successful purification projects worldwide. It's an expert in Blue hydrogen production via SMR, ATR, POX, or gasification with UOP CO2 capture, Hydrogen purification, and Callidus burners. It also has a full portfolio of solvent, [membrane](#), adsorbent, and cryogenic process technologies for CO2 capture.
- We're the market leaders in biomethane injection with more than 450 Honeywell renewable injection systems operating across Europe. That includes more than 350 of our compact [biomethane injection](#) systems for GRDF, the leading distributor of natural gas in France and the continent.
- Honeywell solutions have cybersecurity as standard. Honeywell Experion DCS, Safety Manager and ControlEdge PLC have embedded cybersecurity

capabilities that are ISASecure certified. We enable users to enjoy the benefits of remote connectivity, the industrial Internet of things and the Cloud while retaining the security they need when dealing with sensitive data, hazardous process and connections to critical infrastructure.

- Honeywell's has extensive experience in large-scale and multi-phase projects as a main automation contractor. Our remote solutions capability means projects are engineered in the Cloud, implemented with an onsite presence, and supported in real time in operation from remote control centres or remote engineering excellence centres. Our leading virtualization capability, Universal IO and marshalling and Experion HIVE technology accelerate engineering and make it easy to adapt to changes.

When looking to your hydrogen future, consider our past. Honeywell brings decades of experience in gas and liquid automation, control and metering, and proven solutions that are relied on for critical and complex applications worldwide. We offer global scale and a network of local support to combine market-leading technology with strong execution capabilities and unrivalled service. To discuss your needs, contact us today.



Problem: Natural gas pipeline operators anticipate the future integration of hydrogen into their systems. Both existing and new infrastructure must be prepared for hydrogen compatibility. Besides that, hydrogen blending into the grid needs to happen safely and reliably.

Solution: Honeywell's gas portfolio has been released for use with natural gas with up to 30% hydrogen content for most of the products. Furthermore, Honeywell has engineered comprehensive solutions for safely injecting hydrogen into natural gas pipelines and for blending hydrogen with natural gas in industrial applications.



GAS METERING AND CONTROL PORTFOLIO

Honeywell has a long history in gas flow measurement and control. With our [Elster product line](#) we build decades of experience in the natural gas- and other industries.

Our gas products portfolio is traditionally used mainly in the natural gas industry. With the increasing importance of hydrogen our gas metering and control portfolio has been investigated and confirmed suitable for blends of natural gas and hydrogen. Several products are suitable for 100% hydrogen as well. For an overview of the product portfolio compliance, you can check our [white paper](#) which gives the latest status of product compliance.



Gas Flow meters

- Ultrasonic flow meters suitable for natural gas containing up to 30% hydrogen.
- Turbine meters ready for use with 100% hydrogen
- Maintenance free metering with the Rabo Compact significantly reducing cost of ownership.



Pressure Regulators / Safety valves

- Full range portfolio of gas pressure regulators and safety valves for distribution, transmission and industrial applications
- More than 20+ years of experience in hydrogen applications
- Rugged design for reliable and safe operation
- Modular design to fulfill needs in modern gas industry as well as electronic automation capabilities



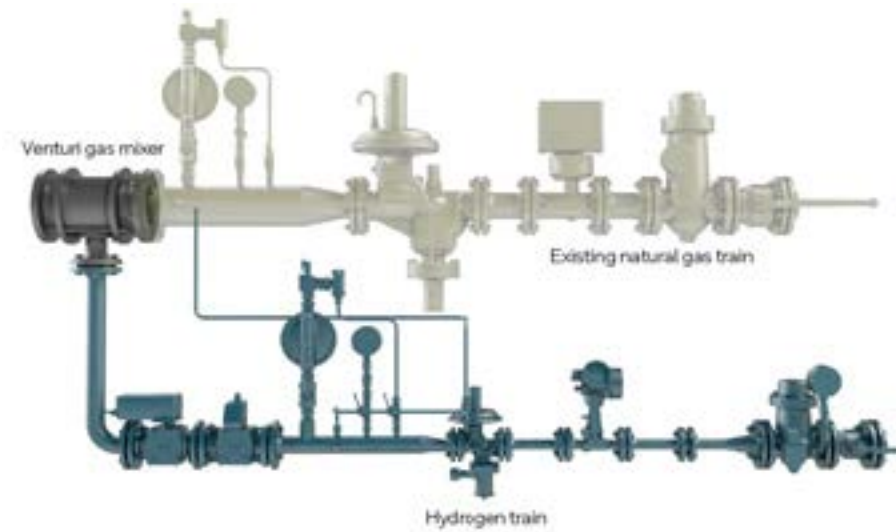
Volume Correctors

- Full range battery operated field mounted volume correctors as well as full continuous flow computers.
- Suitable for hydrogen application applying AGA9-92DC or SGERG-mod-H2 algorithms
- MID approved for applications with up to 100% hydrogen



Gas Analyzers

- C6+ analysis including hydrogen assuring correct measurement of blended gases.
- Low carrier gas consumption results in OPEX savings and minimal He-cylinder changes.
- Impurities measurement in hydrogen
- Highly accurate and fast hydrogen analysis



Gas Trains

- Gas mixing solutions for hydrogen / Natural gas fuel supply to gas engines
- Retrofitting & solutions for existing fuel supply systems
- Gas trains for pure hydrogen for low flow rates (test bench) to high flow rates (large combustion engines or burners)
- Fully-automated blending & mixing including control system



Grid Injection System

- Enabling safe and [reliable injection](#) of hydrogen into distribution and transmission gas grids
- Pre-packaged solution for fast project execution and reduced engineering and system cost.
- Complete control with remote monitoring system “Connected OEM”



Hydrogen Blending

- Standardize solution to blend hydrogen with natural gas to reduce your process’ carbon footprint
- Accurate blending with full blend control based on highly accurate rotary flow meters
- Gas Chromatograph controlled blending delivering full and accurate gas composition data to optimize your process

Problem: Improve production performance and efficiency, reduce maintenance while maintaining highest levels of safety.

Solution: Hydrogen ready SmartLine Field Instruments with industry leading performance with factory integration and leak testing, maximizes process uptime to optimize production and achieve desired product quality.



SMARTLINE TRANSMITTERS: MAKE YOUR HYDROGEN JOURNEY SMOOTHER

[SmartLine Transmitters](#) provide unparalleled value across the entire Hydrogen value chain. From enhancing efficiency in production and purification to ensuring safe storage and transportation, all the way to optimizing consumption and utilization, our transmitters are the go-to solution for hydrogen management.

- Innovative modular design for reduced maintenance and operating cost.
- Industry leading total performance for improved quality
- Highest degree of safety with SIL2 certified/SIL3 capable devices.
- Dual certifications for reduced inventory
- Intuitive cloud based SmartLine Application and Validation tool for error free instrument selection and application validation.
- Extended and Lifetime warranty for peace of mind

Pressure Transmitters

- Proven in use, hydrogen compatible transmitters for improved reliability and uptime.
- Enhanced safety with factory leak tested, dual seal design and SIL capable transmitters.
- Integrated solution with SmartLine manifolds.
- Draft range to high pressure measurement for complete value chain.
- Global installed base of thousands of transmitters on hydrogen service.





Temperature Transmitters

- Comprehensive portfolio caters to application needs across Hydrogen value chain.
- Enhance safety and efficiency with accurate temperature measurement and SIL transmitters.
- Maximize uptime and reduce maintenance with industry leading performance specifications.
- Factory pre-tested, pre-calibrated and certified temperature probe assembly for out of box installation.
- Advanced diagnostics to gain visibility into the process, reduce variations and optimize energy.



Level Transmitters

- Eliminate poor production quality and false off-process trips in with obstacle immunity and dynamic false echo suppression algorithms.
- Eliminate off-process measurement and enable production under highly dynamic processes and change-over conditions with advanced correlation algorithm.



Flow Meters

- Multiple low technologies to suit application needs; Coriolis, Multivariable, Vortex, Mag, Differential Pressure.
- Hydrogen permeation resistant diaphragm materials, dual seal design and SIL capable Multivariable low meters for dynamically compensated mass flow
- High performance, cryogenic, high pressure, and high temperature Coriolis meters.
- Enhanced safety with fully welded, non-wearing SS construction of Vortex meters.

Problem: Unplanned downtime of assets result in lost production. Operating assets in large geographically distributed locations often lead to high maintenance cost.

Solution: Honeywell Versatilis Transmitters enables predictive equipment health monitoring. Versatilis transmitters communicate through Open Wireless LoRAWAN Protocol that offer lowest CAPEX and Negligible OPEX.

Remote Monitoring of Equipment health using Honeywell Versatilis Transmitters and Experion Equipment Health Monitoring System helps to reduce maintenance cost of your distributed assets.



HONEYWELL VERSATILIS

[Honeywell Versatilis™ Transmitter](#) is a multi-variant sensing offering based on the latest LoRaWAN® protocol communication technology. Its inherently low power compact design coupled with quick and easy installation and commissioning help manufacturers to deploy them at scale with the lowest CAPEX and negligible OPEX.

The transmitter is capable of multi-variant sensing including 3 axis vibration, surface temperature, acoustics and ambient parameters.

Electrolyzers are at the heart of hydrogen production. The reliability of rotating equipment such as feed pumps that are used to pump water as well as caustic chemicals are critical for uninterrupted operation of electrolyzers and so hydrogen production.

Honeywell Versatilis EHM offering enables this through end-to-end solution and help customers remotely monitor the asset performance saving OPEX while improving the availability



Honeywell Versatilis Transmitter

- Digitizing assets and ambient conditions
- Automating field data collection
- Reducing unplanned downtime through predictive maintenance of rotating equipment's in hydrogen plants and feed pumps for electrolyzers
- Remote monitoring of asset performance

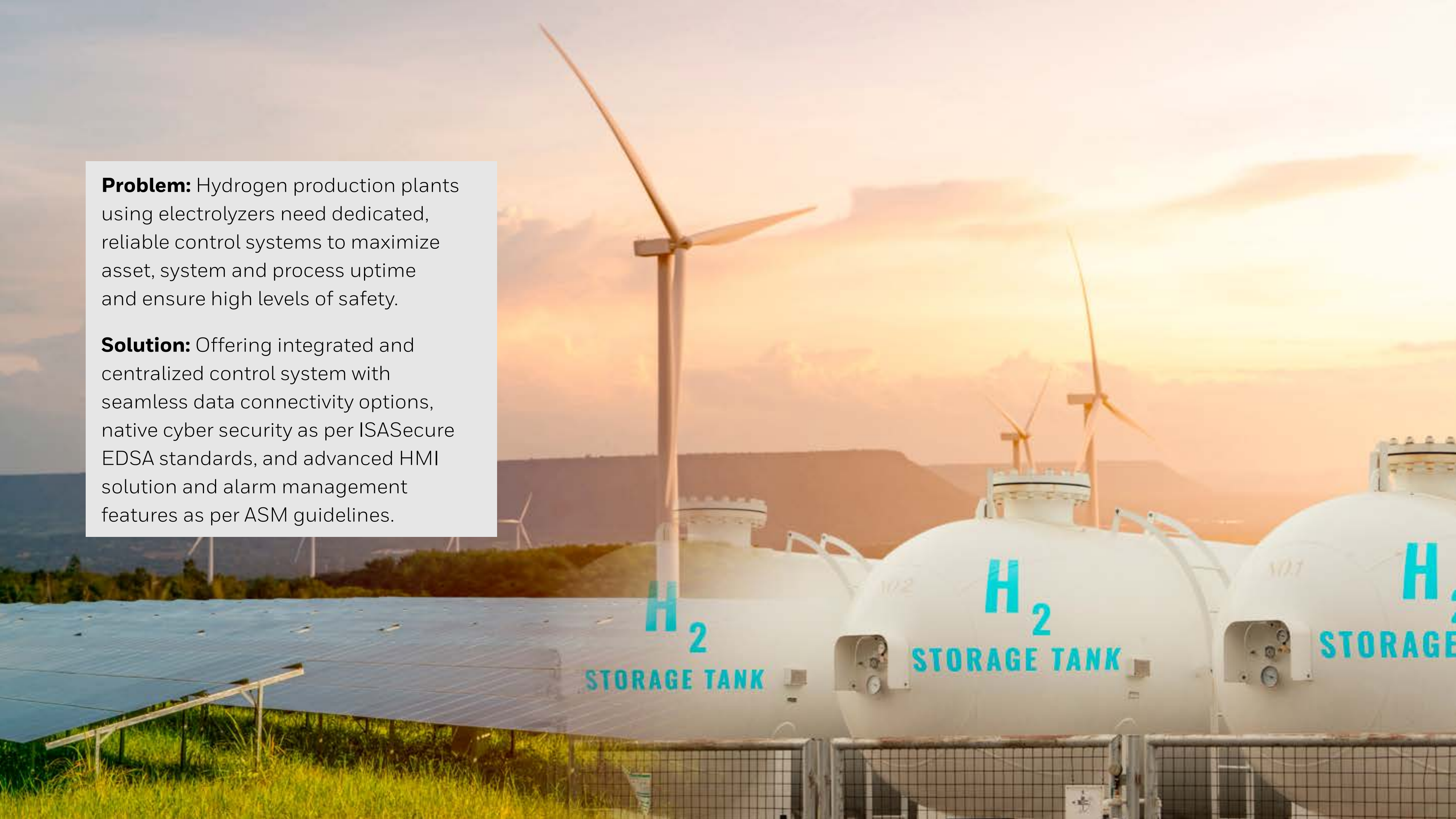


Honeywell Versatilis Configurator

- 30% less time to complete tasks with a larger display
- 80% faster navigation through menus
- Basic configuration in under 30 seconds
- Configures devices from a safe distance
- A single tool for multiple protocols
- Up to 60% lower cost of additional units (interfaces compared with a full handheld

Problem: Hydrogen production plants using electrolyzers need dedicated, reliable control systems to maximize asset, system and process uptime and ensure high levels of safety.

Solution: Offering integrated and centralized control system with seamless data connectivity options, native cyber security as per ISA Secure EDSA standards, and advanced HMI solution and alarm management features as per ASM guidelines.



MODULAR SYSTEMS

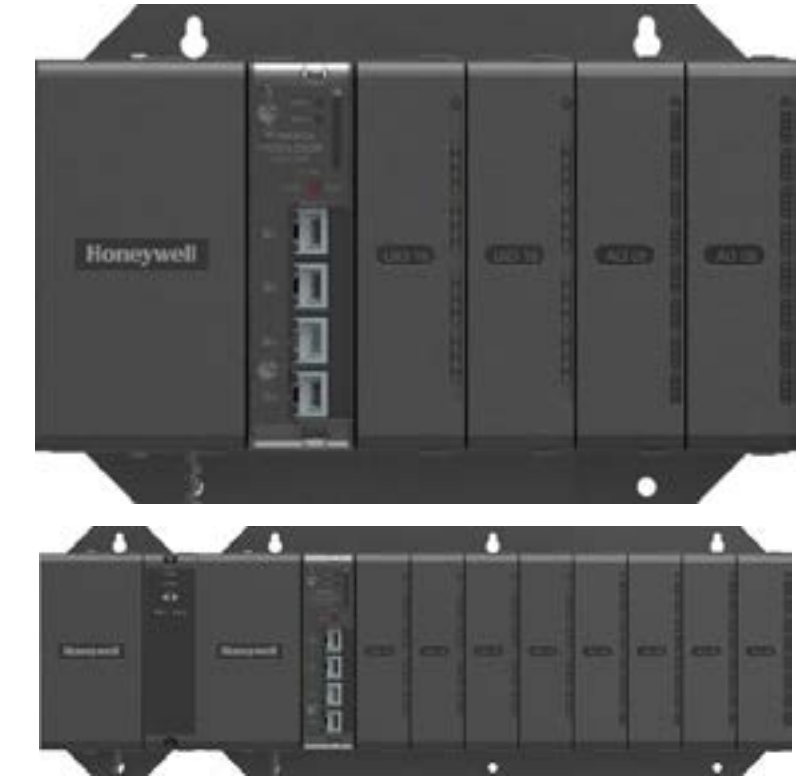
Honeywell's [modular systems](#) provide the perfect modular, flexible solutions for small and medium-scale hydrogen production, distribution and use. Whether for water treatment, electrolyzers, compressors, fueling stations or hydrogen turbines, we help lower costs and improve control. Our range of flexible solutions meets the needs of any-sized operation and includes:

- Experion® HS, a powerful software platform incorporating innovative applications for HMI and SCADA
- ControlEdge™ PLC, providing secure connectivity and tight integration to devices from multiple vendors
- MasterLogic PLC, a compact and versatile PLC solution optimized for high-speed logic applications
- ControlEdge™ HC900 SIL2, ideal for unit process applications that require a combination of analog process control functions and safety critical control actions
- Experion Panel PC, industrial grade touch panel PC that extends the proven Experion user experience to local field operations.
- Honeywell VFD, wide range of Low voltage variable frequency drives with advanced control capabilities for improved asset performance and energy savings.



Connected OEM

- Connected OEM combines Honeywell's industrial Internet of things platform, Cloud historian, visualizations and analytics in one simple, subscription-based service for remote asset monitoring across dispersed sites.
- Enhanced visibility, enables better support to your customers. Quickly resolve issues, and eliminate the need for on-site visits.
- Get access to crucial data that helps maintain optimal performance, reduce maintenance and service expenses, and extend the lifespan of equipment.
- Drive up overall equipment effectiveness, and improve operational efficiency of your assets in the field



ControlEdge PLC

- Seamless integration across the hydrogen value chain, minimizing hardware requirements
- Built-in Cybersecurity protection with ISASecure EDSA Level 2 certified platform
- Versatile connectivity to devices and HMI via open protocols like Modbus, Profinet, EtherNet/IP, OPC-UA, MQTT
- Universal IO with HART compatibility and integrated Asset management for enhanced operational efficiency
- Reliability with a redundant architecture and certifications for critical Hydrogen applications- ATEX, IECEx, and Marine



Safety Manager SC

- Modular and multi-fault tolerant safety system for demanding applications, such as Emergency Shutdown (ESD) and Safety Instrumented System (SIS) requirements.
- TUV Rheinland-certified for SIL3 applications, ensuring compliance and reliable performance e.g. in hydrogen production and transportation processes.
- Universal IO structure allowing electrolyzer manufacturers to design systems with maximum flexibility, facilitating seamless integration within the hydrogen value chain.



Experion HS and PPC

- Allows operators in various industries to monitor and control plant environments using real-time data, leading to improved efficiency and productivity.
- Features an onboard historian that archives valuable plant data for analysis and decision-making purposes.
- Experion PPC is an industrial-grade Touch Panel PC based on a robust and easy-to-maintain hardware platform.
- Eliminates the need for proprietary, embedded Panel HMI mix, reducing maintenance overheads and simplifying data integration.
- Improves process data flow within the plant, enhancing operational efficiency and facilitating effective decision-making.



Experion LX

- Based on Honeywell's proven Experion PKS technology and designed to efficiently meet the control system needs of Hydrogen manufacturing process applications.
- Integrated platform with comprehensive connectivity, advanced HMI and tools, and software-enabled solutions that deliver operational efficiencies and new business outcomes.
- Extend your scope from process control and management to include personnel, assets and even the resources of your entire business operation



[Variable Frequency Drives create](#)

- Precise control of speed and torque for both single-phase and three-phase induction motors by adjusting input frequency and voltage.
- Enhances system performance, management, and energy efficiency, while seamlessly integrating with Honeywell's Experion® and ControlEdge™ platforms.
- Offers a diverse and dependable portfolio of motor control and power solutions for various industrial applications and environments.
- Provides highly reliable motor control capabilities, contributing to improved productivity and operational effectiveness.



Problem: Terminal operators need accurate, reliable, and legal metrology compliant data for storage of hydrogen in form of liquid ammonia.

Solution: Honeywell Enraf tank gauging systems combine the proven servo measurement technology with advanced software algorithms for an unrivaled solution to help ammonia terminals across the world create safer, more reliable, and more efficient operations.



TERMINAL AUTOMATION SOLUTIONS FOR LH2 STORAGE IN FORM OF AMMONIA

Honeywell's decades of experience in terminal automation solutions make it the perfect partner for [ammonia storage and distribution solutions](#). Honeywell Enraf tank gauging systems combine the proven measurement technology with advanced software algorithms for an unrivaled solution to help ammonia terminals across the world create safer, more reliable, and more efficient operations.

Honeywell Enraf Servo tank gauges, including special O-rings for demanding chemical applications, such as ammonia, provide accurate, reliable, and stable gauging for custody transfer and inventory control, including in SIL-2/SIL-3 loops to prevent spillage. Servo technology is particularly important because ammonia levels cannot be measured with the required accuracy using radar gauges

Honeywell's Terminal Manager software integrates with the Experion® Process Knowledge System (PKS) platform to provide a complete terminal automation solution and managing product loading and unloading logistics. It increases efficiency, productivity and safety through greater automation and offers users the flexibility to scale as required.



Enraf Smart Servo 954

- Improve safety and drive efficiency with industry's best servo gauge for highly demanding liquid ammonia storage applications.
- Most accurate and reliable level measurement complying with legal metrology requirements.
- Integration of liquid level, density, and free water interface measurements for comprehensive tank gauging.
- Exceptional performance in critical ammonia storage operations.



Enraf Communication Interface Unit (CIU888)

- Reliable and accurate real-time tank inventory data 24 x7 for improving operational efficiency of tank farm with improved decision-making.
- Internationally standardized calculation methods (API, ASTM, GPA, etc.) to ensure accurate tank inventory data for custody transfer and inventory monitoring.
- Advanced ammonia tank calculations library for reliable monitoring even in demanding process situations.
- Enhanced connectivity with multi-protocol support for range of instruments and host systems



ENTIS inventory System

- Increase operator efficiency, reduce inventory uncertainties and product losses.
- Accurate and secure inventory data for custody transfer, inventory management, and tank movement.
- Ensures real-time inventory information for safe and efficient operations.
- The ENTIS Inventory system is built on the Experion® platform to improve performance and drive down costs.



Enraf Vito Temperature

- Enhances accuracy and reliability in temperature measurement for custody transfer processes.
- Enables effective monitoring and control of temperature parameters during custody transfer operations.
- Measures average product and vapor temperature, temperature profiles, and free water level.
- Provides precise temperature data crucial for custody transfer applications.



Terminal Manager

- Cloud-enabled solution for bulk terminal control, monitoring, and optimization.
- Integrates tightly with Experion PKS platform, leveraging Honeywell's expertise in DCS automation and terminal technology.
- Enables efficient distribution management, thereby enhancing operational efficiency and maximizing terminal performance.
- Comprehensive functionality for tank gauging, additive management, blending, and proving solutions.

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To learn more about Safety Solutions,
visit process.honeywell.com or contact the
Honeywell account manager in your country/region.

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