

A decorative graphic consisting of a grid of white squares on a green background. The grid is composed of several rows and columns of squares, some of which are missing, creating a stepped or fragmented appearance. The squares are arranged in a way that they frame the central text.

ROCKFIN HyVentive

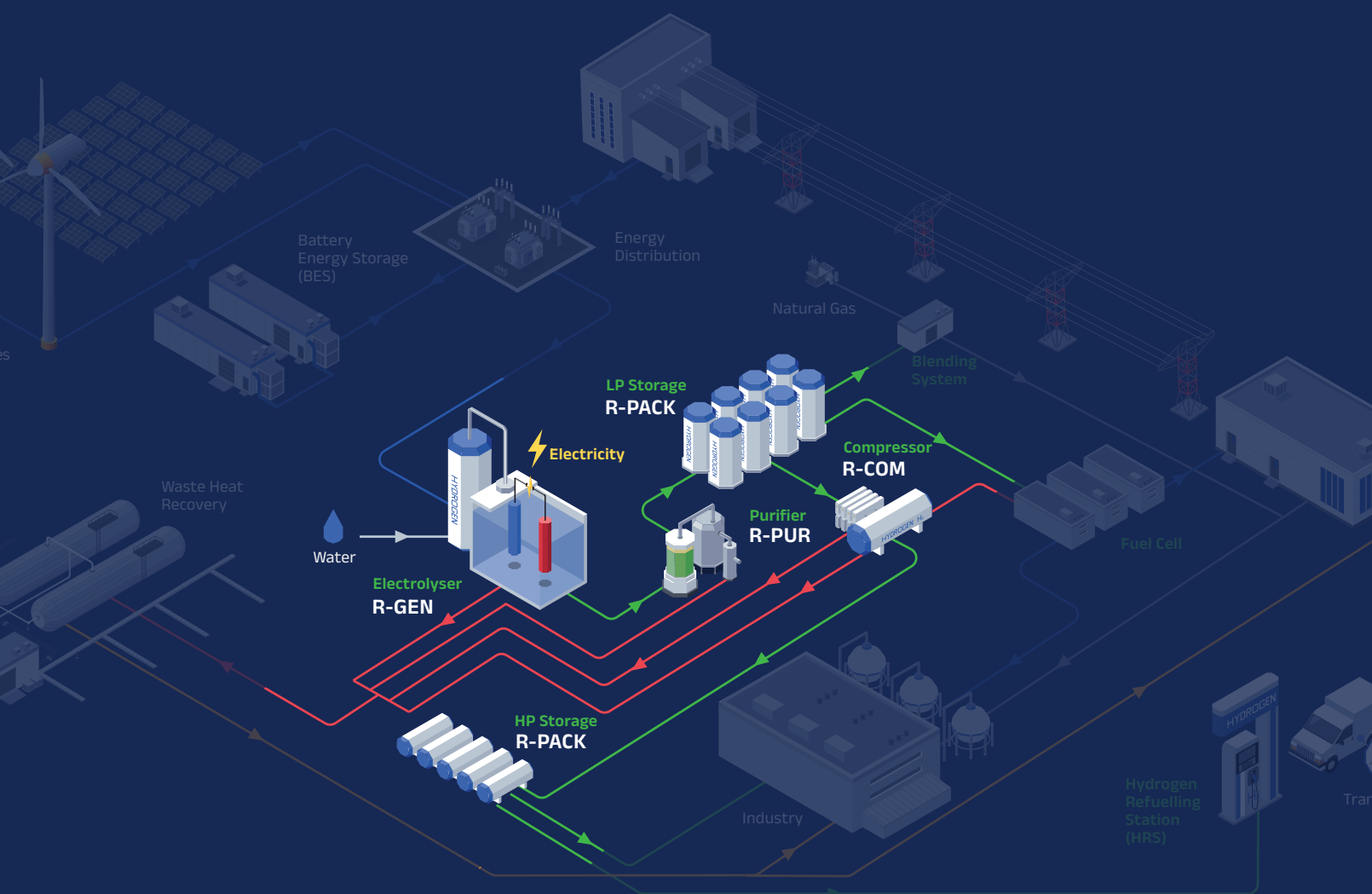
By Developing Hydrogen Technologies, We Invest in Energy Independence and Security of Tomorrow.

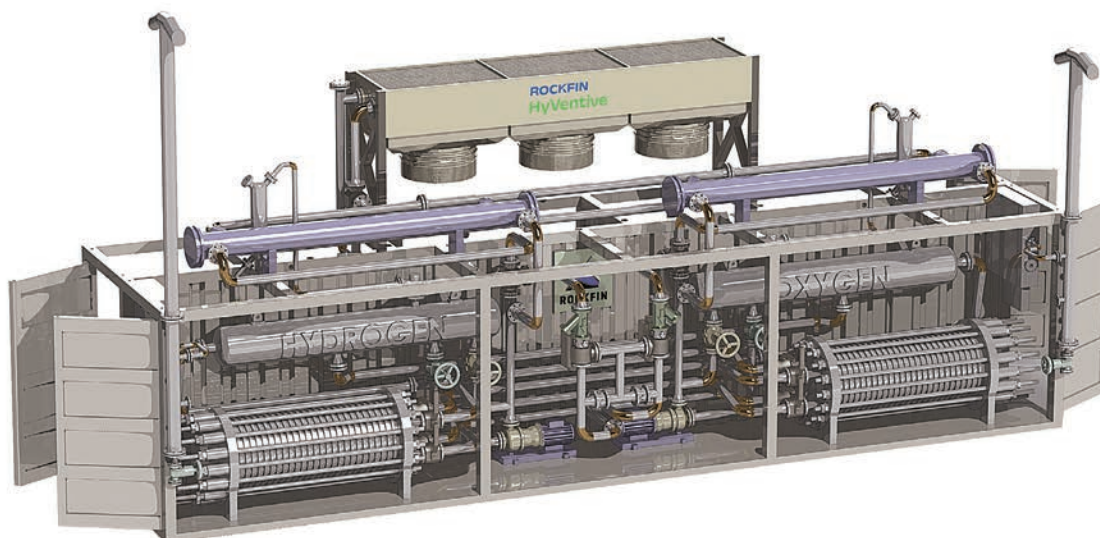
Where are HyVentive products used?

The HyVentive product portfolio facilitates both the generation of hydrogen via electrolysis and the subsequent conditioning and storage of hydrogen for process integration. Our R-GEN series hydrogen generators offer production utilising either alkaline, proton exchange membrane (PEM) or solid-oxide (SOE) technologies. R-PUR purification systems enable the attainment of high-purity hydrogen streams, whilst our R-COM compression systems, R-FLOW distribution networks, and R-PACK storage solutions are designed for hydrogen containment and delivery. These systems exhibit operational flexibility;

they can be integrated to form a comprehensive, turnkey installation or deployed as standalone units to fulfil specific functional requirements.

HyVentive product lines can be applied across all industries where hydrogen is currently prevalent, including the refining, chemical, and food processing industries. Furthermore, they are strategically positioned to support emerging hydrogen applications with significant growth potential, such as transportation, the metallurgical and cement industries, and the power generation sector.



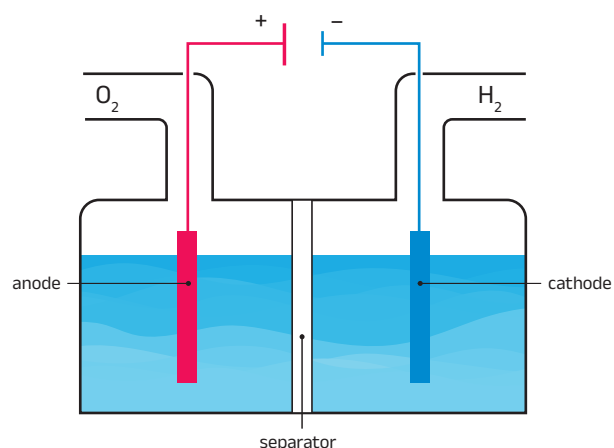


ALKALINE HYDROGEN GENERATOR

R-GEN.A SERIES

How the R-GEN.A Hydrogen Generator Works

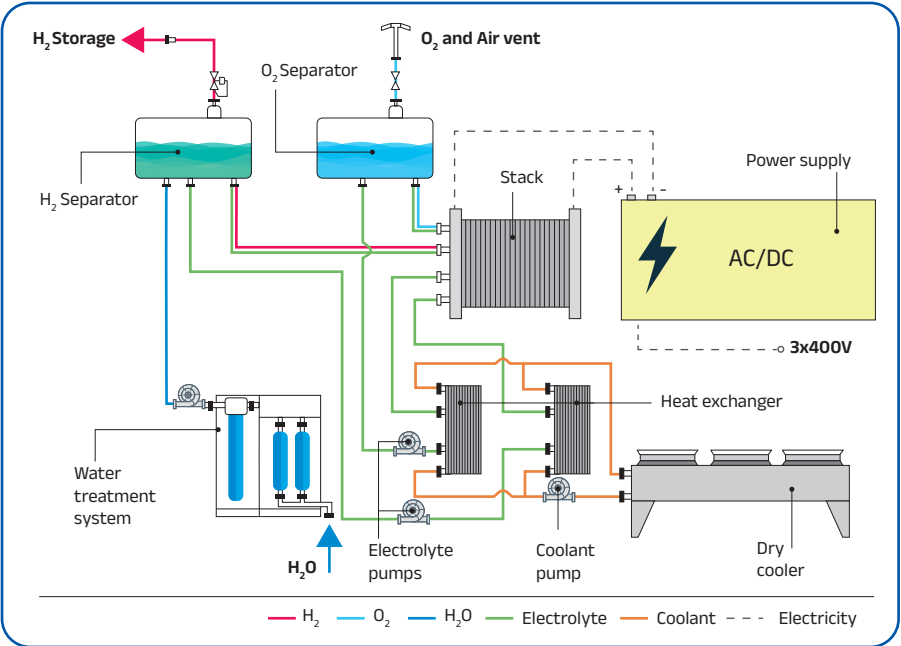
The operation of R-GEN.A hydrogen generators is based on the most mature and proven method of hydrogen production from water – alkaline electrolysis. Alkaline water electrolysis is a process that decomposes water (H_2O) into hydrogen (H_2) and oxygen (O_2) using an electric current passed through an aqueous alkaline solution (electrolyte) between two electrodes: the anode (positive) and the cathode (negative), both housed within an electrolyser stack. During this process, hydrogen is released at the cathode and oxygen at the anode. A membrane separates the electrodes, effectively isolating the hydrogen and oxygen gases. This not only enhances the purity of the resulting gases, but also significantly improves the safety of the entire process. Water from the electrolyte is gradually consumed and continuously replenished during operation. To produce 1 kg of hydrogen, approximately 9 litres of water are required. Consequently, the production of 1 tonne of hydrogen – an energy equivalent to about 2,100 litres of E10 petrol – requires as much water as an average Polish household consumes in one month. In addition to water, the production of 1 kg of hydrogen necessitates the input of approximately 51 kWh of electrical energy into the electrolyser stack.



R-GEN.A Design

At the heart of the R-GEN.A series hydrogen generator is at least one stack where the electrolysis process takes place. Electrolyte flows constantly through the stack, which has 3 very important functions:

- 1. First of all, it consists of 70% water, which is essential for the process itself.
- 2. As the electrolyte flows through the stack, it takes with it the bubbles of the gases produced, which increases the efficiency of the process.
- 3. It also cools the stack by taking away excess heat from it.



To ensure that the process runs safely and the purity of the hydrogen produced is high, the electrolyte circuits that flow through the cathode and anode chambers have been separated. As a result, the electrolyte in the cathode circuit contains only hydrogen bubbles, and the electrolyte in the anode circuit, only oxygen. Both streams of gassed electrolyte go into different separation tanks, where the gas is separated from the electrolyte. The hydrogen undergoes preliminary drying and is directed to further processes such as purification and compression. Oxygen is released into the atmosphere. The electrolyte, on the other hand, is cooled in heat exchangers and directed back to the stack.

Since water is lost from the system during electrolysis, it is necessary to constantly replenish it. Also as all impurities introduced with the refilled water would be concentrated, it is necessary to carefully ensure that the refilled water is chemically pure. The water preparation system supplied with the generator is responsible for the proper water quality. The electrolysis process requires a specialized power supply. A direct current of high amperage and relatively low voltage has to be supplied to the stack. In addition, its source is required to have very low ripple and high efficiency. Such power supplies are standard equipment for any R-GEN hydrogen generator.

Delivery Scope of Hydrogen Generators R-GEN.A

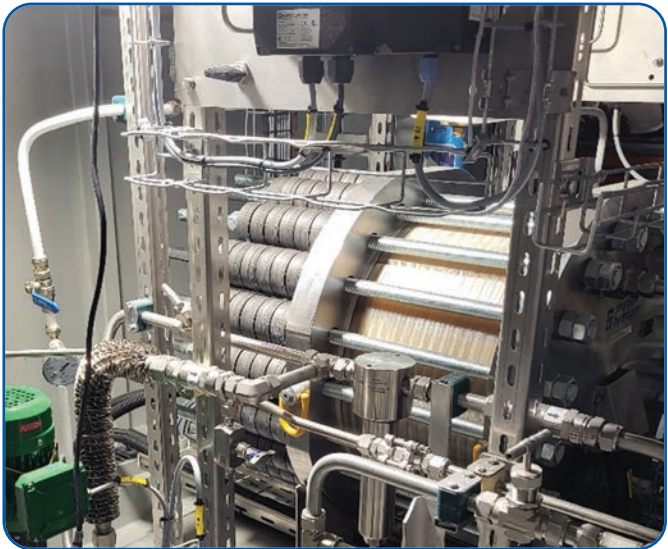
Standard Equipment	Additional Equipment
Electrolyser	LV/MV transformer
Cooling system	Heat recovery system
Rectifier	Hydrogen purification system
Water treatment system	Hydrogen compressor (> 30bar)
Container	Hydrogen storage R-PACK
Preliminary gas dryer	Certified gas analyser
Nitrogen purge system	Certified gas flowmeter
Control system including touch control panel and communication interface	Low temperature insulation (below -20°C)
Safety systems	Mobile application enabling remote monitoring of process parameters from any location

Services and Maintenance
Transport and unloading at site
Additional maintenance during storage
Making connections between system components
Connecting the system to utilities
Participation in commissioning
Training of personnel
Periodic maintenance and servicing

Main Advantages of R-GEN.A

- Durability:**
The design based on proven components and high standards of project implementation at Rockfin are a guarantee of long-term reliability of R-GEN generators.
- Proven Technology:**
Decades of use of alkaline electrolyzers are hard evidence, not just a declaration, of their efficiency and reliability.
- Scalability:**
R-GEN.A hydrogen generators are suitable for both small laboratory installations as well as megawatt industrial installations.

- High Energy Efficiency:**
Alkaline electrolyzers achieve efficiency levels comparable to other technologies while operating efficiently over a wide power range.
- Cost-Effectiveness:**
Alkaline electrolyzers use readily available and inexpensive materials such as nickel-based catalysts and stainless-steel electrodes, avoiding the costly rare earth and platinum required in other types of electrolyzers.



Compliance with EU Directives and Industry Standards

R-GEN generators are CE marked and manufactured in accordance with the following industry directives and standards:

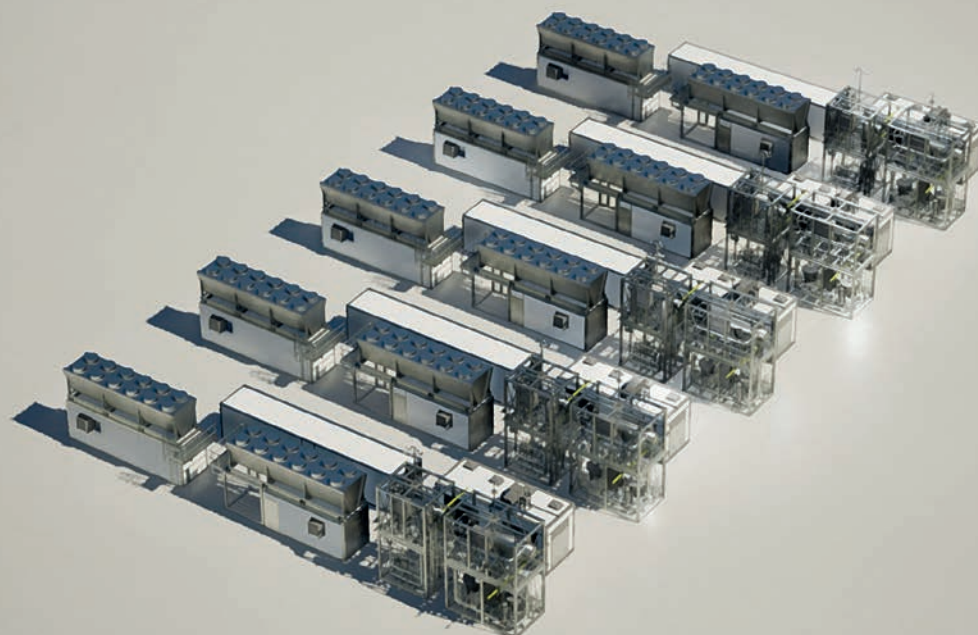
- MD 2006/42/EC – Machinery Directive,
- PED 2014/68/EU – Pressure Directive,
- EN 61508 – Functional safety of electrical/electronic/programmable electronic safety-related systems,
- EN 61511 – Functional safety – Safety instrumented systems for the process industry sector,
- EN 12100 – Safety of machinery - General design principles - Risk assessment and risk reduction,
- EN 60204-1 – Safety of machinery - Electrical equipment of machinery,
- EN 1127-1 – Explosive atmospheres - Explosion prevention and protection,

- EN 60079 – Series of standards for the safety of electrical equipment used in explosive atmospheres,
- EN 1090 – Construction of steel and aluminium structures,
- EN 764-7 – Pressure equipment – Safety systems for unfired pressure equipment,
- EN 13445 – Unfired pressure vessels,
- ASME BPVC VIII – Rules for Construction of Pressure Vessels Section VIII,
- ISO 22734 – Hydrogen generators using water electrolysis,
- ASME B31.12 – Hydrogen piping and pipelines,
- EIGA DOC 15 – Hydrogen systems,
- EIGA DOC 211 – Hydrogen vent systems for commercial applications,
- EIGA DOC 121 – Hydrogen pipelines,
- ISO 14687 – Hydrogen fuel quality.

Hydrogen Generator Examples - R-GEN.A

Type	Nominal Power [kW]	Capacity [Nm³/h]	Nominal Pressure [bar(g)]	LHV Stack Efficiency (BoL) [%]	Capacity Control Range [%]
R-GEN.A.10.1.28	10	2	28	65.2	50-100
R-GEN.AM.100.1.15	100	20	15	68.5	10-100
R-GEN.A.500.1.30	500	100	30	65.2	50-100
R-GEN.A.1000.2.30	1000	200	30	65.2	25-100
R-GEN.A.2500.1.16	2500	500	16	65.2	50-100
R-GEN.A.5000.2.16	5000	1000	16	65.2	25-100
R-GEN.A.5000.10.30	5000	1000	30	65.2	10-100

For more information, please visit our website:
<https://www.rockfin.pl/hyventive>

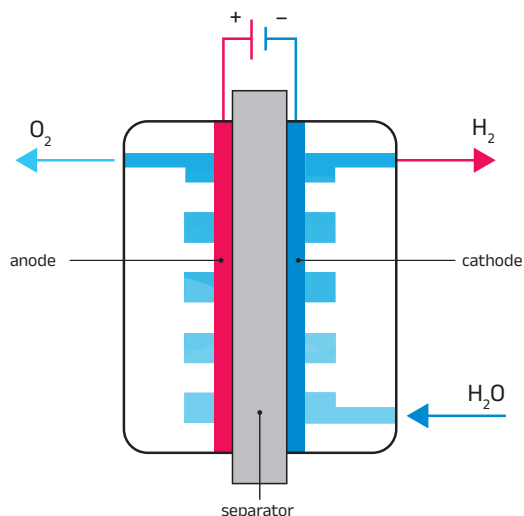


PEM TYPE HYDROGEN GENERATORS

R-GEN.P SERIES

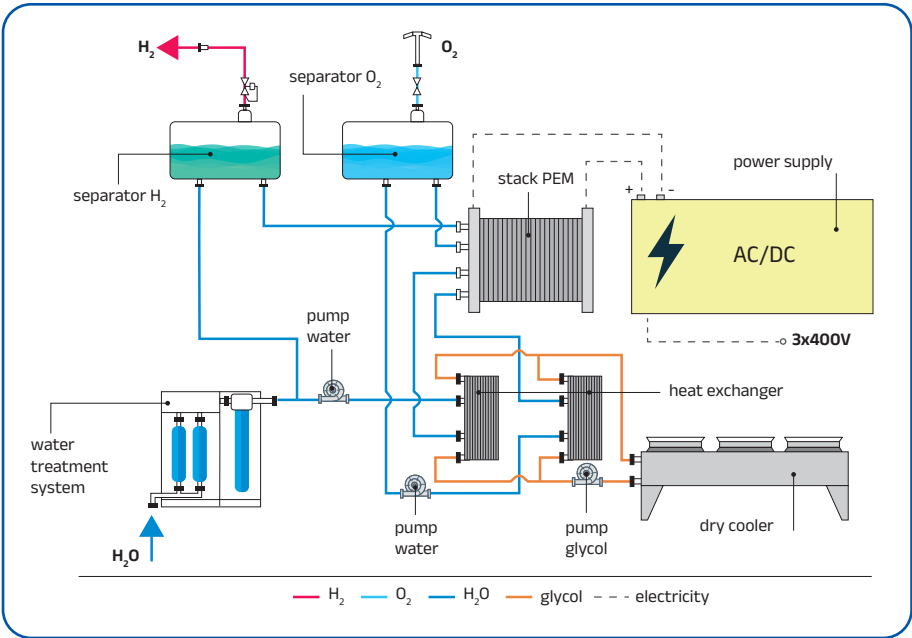
How the R-GEN.P Hydrogen Generator Works

The operation of hydrogen generators R-GEN.P is based on high-performance PEM (Proton Exchange Membrane) electrolysis technology. Electrolysis of water is the process of decomposing water (H_2O) into hydrogen (H_2) and oxygen (O_2) using an electric current. PEM technology is distinguished by the fact that the production of hydrogen does not use hazardous substances as in alkaline technology, but only ultrapure water. The role of the electrolyte in the PEM electrolyser is performed by an ion-exchange membrane combined with electrodes: anode (positive) and cathode (negative) placed in a stack. On the cathode there is hydrogen evolution, while on the anode there is oxygen evolution. Thanks to the use of a gas-impermeable membrane tightly separating the electrodes, hydrogen and oxygen do not mix with each other, which guarantees very high hydrogen purity and increases the safety of the entire process. To produce 1 kg of hydrogen, about 9 litres of ultrapure water and only 54 kWh of electricity are required.



R-GEN.P Design

The proven system concept is based on the Modulyser solution developed by Elogen, a leading French supplier of high-performance PEM stacks for electrolyzers. The hydrogen generator R-GEN.P uses the PEM-type stack to perform water electrolysis. Ultrapure water is pumped through the stack. It serves not only as an essential component of the electrochemical reaction, but also as a transport medium and coolant. The water circulates in two separate loops: anodic and cathodic, carrying the produced gases and removing heat from the stack. Oxygen and hydrogen are separated from the water in dedicated separators and directed to the rest of the system, for example to a compressor or low-pressure storage. The degassed water is cooled and reused in the electrolysis process. The system may include one or more stacks, which ensures excellent scalability and dynamic operation.



Delivery Scope of Hydrogen Generators R-GEN.P

Standard Equipment	Additional Equipment
Electrolyser	LV/MV transformer
Cooling system	Heat recovery system
Rectifier	Hydrogen purification system
Water treatment system	Hydrogen compressor (> 30bar)
Container	Hydrogen storage R-PACK
Preliminary gas dryer	Certified gas analyser
Nitrogen purge system	Certified gas flowmeter
Control system including touch control panel and communication interface	Low temperature insulation (below -20°C)
Safety systems	Mobile application enabling remote monitoring of process parameters from any location

Services and Maintenance
Transport and unloading at site
Additional maintenance during storage
Making connections between system components
Connecting the system to utilities
Participation in commissioning
Training of personnel
Periodic maintenance and servicing

The Main Advantages of R-GEN.P Hydrogen Generators

Durability:

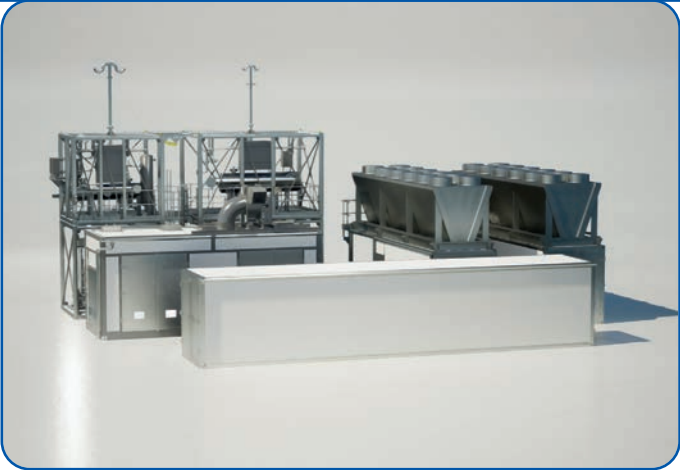
Design based on proven components and high standards of project implementation at Rockfin are a guarantee of long-term reliability of R-GEN.P generators.

Fast Response:

The device is one of the few on the market that allows for a rapid change in performance in just a few seconds.

Flexibility:

The output of R-GEN.P hydrogen generators is adjustable in a range of 10–100%, with the possibility of short-term overload up to 110%.



High efficiency:

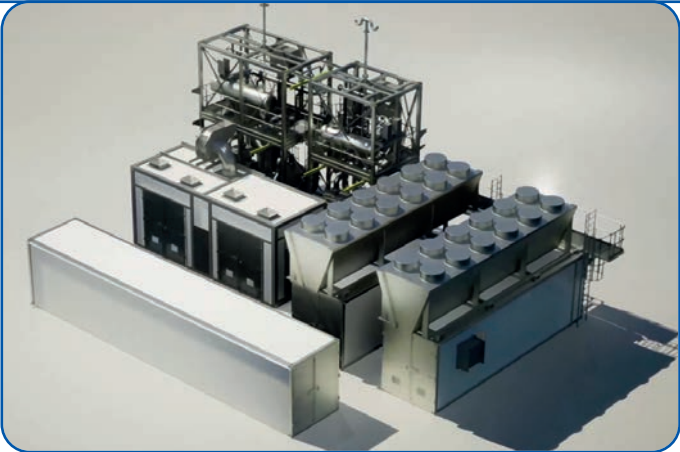
Electrolysers in the R-GEN.P series achieve one of the highest efficiencies available on the market. To generate 1 kg of hydrogen from water, only 54 kWh of electrical energy is used.

High purity of hydrogen:

R-GEN.P generators offer significantly higher hydrogen purity than alkaline electrolysers, which translates into a higher level of safety and lower costs of preparing hydrogen for use in fuel cells, for example.

Modularity:

The modular design enables flexible system expansion and seamless scalability, allowing the infrastructure to be adapted efficiently to changing operational demands and future development needs.



Compliance with EU Directives and Industry Standards

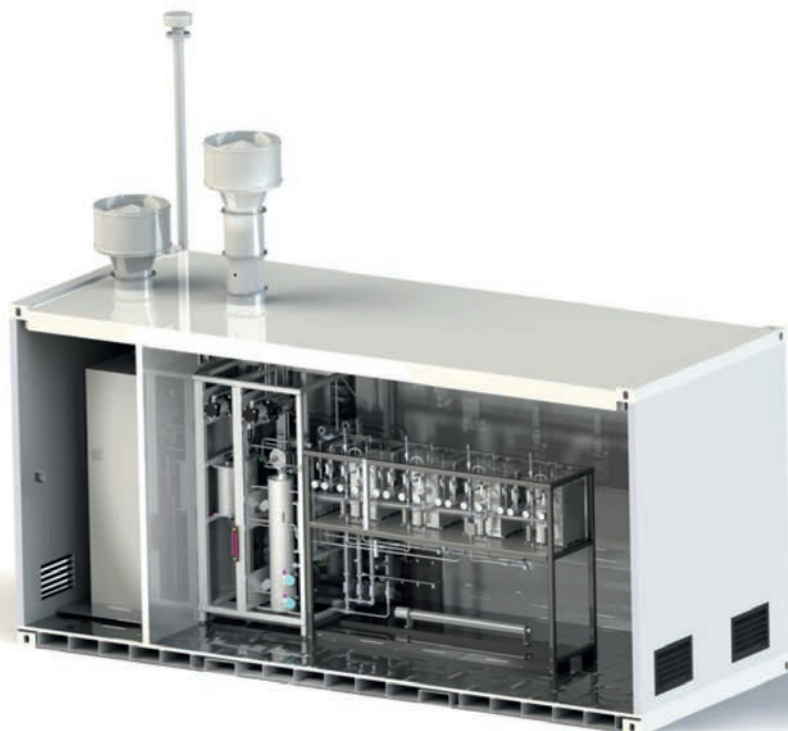
R-GEN generators are CE marked and manufactured in accordance with the following industry directives and standards:

- MD 2006/42/EC - Machinery Directive,
- PED 2014/68/EU – Pressure Directive,
- EN 61508 - Functional safety of electrical/electronic/programmable electronic safety-related systems,
- EN 61511 - Functional safety – Safety instrumented systems for the process industry sector,
- EN 12100 – Safety of machinery – General design principles – Risk assessment and risk reduction,
- EN 60204-1 - Safety of machinery – Electrical equipment of machinery,
- EN 1127-1 - Explosive atmospheres – Explosion prevention and protection,
- EN 60079 – Series of standards for the safety of electrical equipment used in explosive atmospheres,
- EN 1090 – Construction of steel and aluminium structures,
- EN 764-7 - Pressure equipment – Safety systems for unfired pressure equipment,
- EN 13445 – Unfired pressure vessels,
- ASME BPVC VIII – Rules for Construction of Pressure Vessels Section VIII,
- ISO 22734 – Hydrogen generators using water electrolysis,
- ASME B31.12 – Hydrogen piping and pipelines,
- EIGA DOC 15 – Hydrogen systems,
- EIGA DOC 211 – Hydrogen vent systems for commercial applications,
- EIGA DOC 121 – Hydrogen pipelines,
- ISO 14687 – Hydrogen fuel quality.

Hydrogen Generator Examples - R-GEN.P

Type	Nominal Power [kW]	Capacity [Nm³/h]	Nominal Pressure [bar(g)]	LHV Stack Efficiency (BoL) [%]	Capacity Control Range [%]
R-GEN.P.5000.8.30	5000	1000	30	68	10-100
R-GEN.P.20000.32.30	20000	4000	30	68	10-100

For more information, please visit our website:
<https://www.rockfin.pl/hyventive>



SOLID-OXIDE HYDROGEN GENERATOR

R-GEN.S SERIES

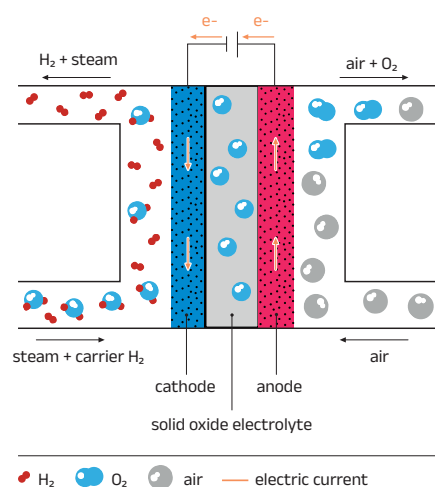
How the R-GEN.S Hydrogen Generator Works

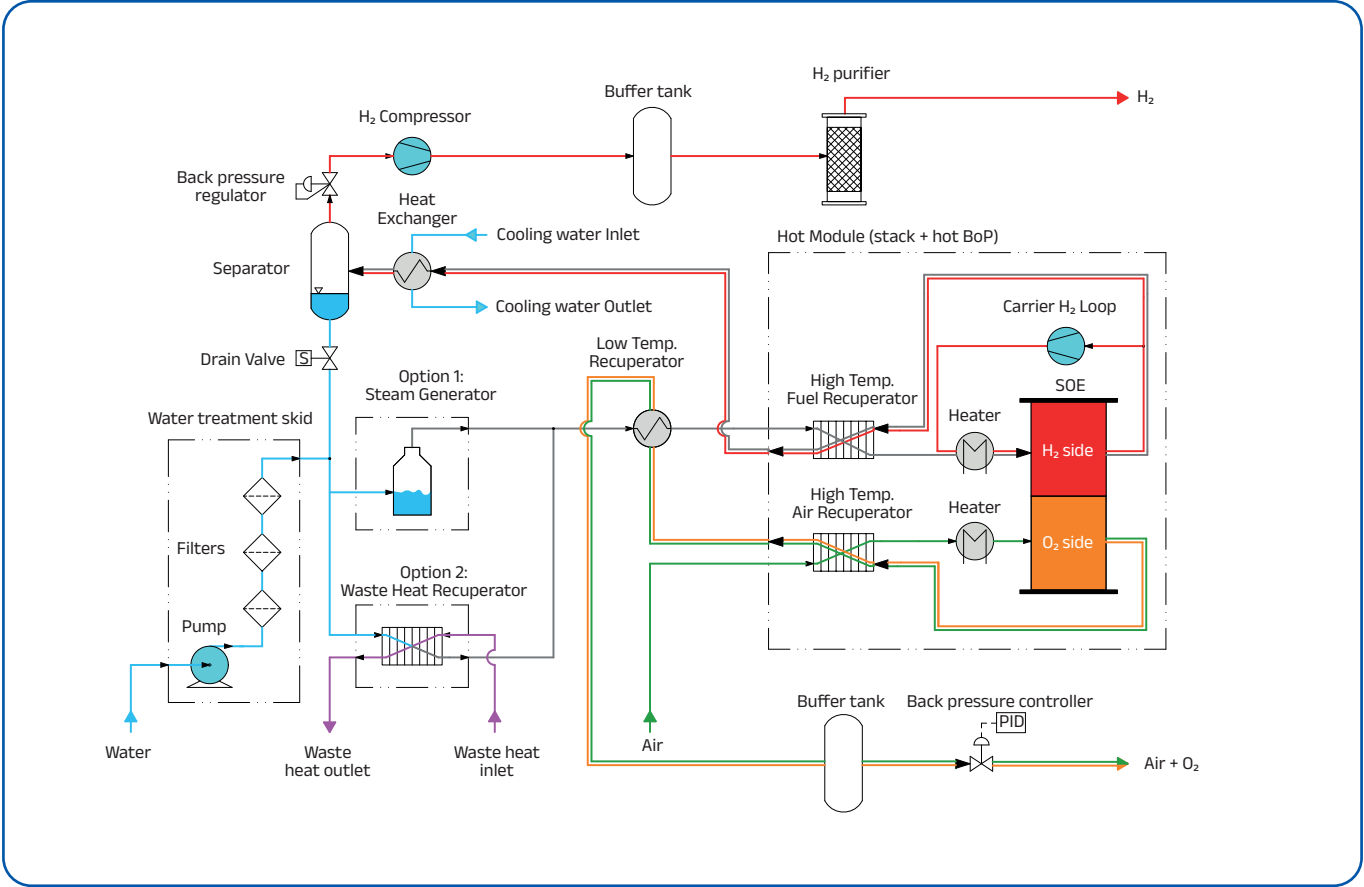
The operation of a Solid Oxide Electrolyser Cell (SOEC) is based on the process of high-temperature steam electrolysis (HTSE).

At elevated operating temperatures, typically in the range of 700°C to 800°C, a portion of the energy required to drive the electrochemical reaction is supplied in the form of heat. This significantly reduces the electrical energy demand compared to low-temperature electrolysis technologies.

At the cathode, steam is reduced to produce hydrogen gas and oxide ions (O^{2-}). These oxide ions subsequently migrate through a dense ceramic electrolyte towards the anode. At the anode, the oxide ions release electrons to the external circuit and are oxidised to form oxygen gas.

The fabrication of SOEC cells relies on advanced ceramic materials technology. Commonly used materials include cermets such as nickel-yttria-stabilised zirconia (Ni-YSZ) for the cathode, yttria-stabilised zirconia (YSZ) as the electrolyte, and perovskite-type materials such as lanthanum strontium manganite (LSM) or lanthanum strontium cobalt ferrite (LSCF) for the anode.





The SOE generator system comprises the following key subsystems:

- **Steam supply and conditioning system** – responsible for the preparation and delivery of water vapour to the electrolyser under the required process conditions.
- **Hot Module** – consisting of interconnected SOEC stacks, thermally insulated to maintain the high operating temperature required for efficient electrolysis.
- **Hot Balance of Plant (Hot BoP)** – a subsystem responsible for heating of the incoming steam to the required operating temperature.
- **Balance of Plant (BoP)** – auxiliary equipment designed to condition feed streams and manage product streams for integration with downstream systems.
- **Power supply system** – providing electrical energy to both the Hot Module and associated auxiliary systems.
- **Control system** – ensuring stable and optimised operation of the entire installation through monitoring and regulation of process parameters.
- **Safety system** – responsible for operational safety, including protection against abnormal operating conditions and system failures.

Delivery Scope of Hydrogen Generators R-GEN.S

Standard Equipment	Additional Equipment
Hot Module	Hydrogen compressor
Hot-BoP	Hydrogen storage system
BoP	Heat recovery system
Power supply module	Gas drying and purification modules
Control and automation system	Monitoring system
Primary safety systems	
Containerised design	

Services and Maintenance
Installation and commissioning
Personnel training
Warranty service
Remote monitoring

The Main Advantages of R-GEN.S Hydrogen Generators

High Efficiency:

Due to the thermodynamics of the process, and with the provision of sufficient waste heat, the electrical efficiency of SOEC systems can approach 90%. This is achieved by partially substituting electrical energy with thermal energy, thereby reducing the overall power consumption.

Minimal Oxygen Content in Hydrogen:

The high gas-tightness of ceramic electrolytes significantly limits oxygen crossover to the cathode side. Any trace amounts of oxygen that do permeate are, at elevated temperatures, subject to spontaneous recombination with hydrogen, forming steam. This mechanism ensures a high purity of the produced hydrogen stream.

Integration with Industrial Processes:

SOE technology is particularly well suited for integration with industrial installations where high-temperature heat is readily available. Typical applications include the chemical, metallurgical, power generation, and refining industries.

Co-electrolysis:

This technology enables the simultaneous electrolysis of steam and carbon dioxide to produce synthesis gas (a mixture of hydrogen and carbon monoxide). Syngas serves as a key feedstock for the production of synthetic fuels and chemicals, supporting pathways towards low-carbon and circular industrial processes.



Compliance with EU Directives and Industry Standards

R-GEN generators are CE marked and manufactured in accordance with the following industry directives and standards:

- MD 2006/42/EC – Machinery Directive,
- PED 2014/68/EU – Pressure Directive,
- EN 12100 – Safety of machinery – General design principles – Risk assessment and risk reduction,
- EN 60204-1 – Safety of machinery – Electrical equipment of machinery,
- ISO 22734 – Hydrogen generators using water electrolysis,
- EN 61508 – Functional safety of electrical/electronic/programmable electronic safety-related systems,
- EN 61511 – Functional safety – Safety instrumented systems for the process industry sector,
- EN 1127-1 – Explosive atmospheres – Explosion prevention and protection,
- EN 60079 – Series of standards for the safety of electrical equipment used in explosive atmospheres,
- EN 13445 – Unfired pressure vessels,
- EN 764-7 – Pressure equipment – Safety systems for unfired pressure equipment,
- EN 1090 – Construction of steel and aluminium structures,
- ASME BPVC VIII – Rules for Construction of Pressure Vessels Section VIII,
- ASME B31.12 – Hydrogen piping and pipelines,
- EIGA DOC 15 – Hydrogen systems,
- EIGA DOC 211 – Hydrogen vent systems for commercial applications,
- EIGA DOC 121 – Hydrogen pipelines,
- ISO 14687 – Hydrogen fuel quality.

Hydrogen Generator Examples - R-GEN.S

Type	Nominal Power [kW]	Capacity [Nm³/h]	Nominal Pressure [bar(g)]	LHV Stack Efficiency (BoL) [%]	Capacity Control Range [%]
R-GEN.S.120.6.0,03	120	40	0.03	85	100

For more information, please visit our website:
<https://www.rockfin.pl/hyventive>



HYDROGEN PURIFICATION SYSTEMS

R-PUR

Features of R-PUR Hydrogen Purification Systems

R-PUR hydrogen purification systems are designed to ensure gas purity at the level of 99.999%. These devices are installed to remove the oxygen and water vapour that are in the hydrogen coming out of the electrolysis process.

Hydrogen coming directly from electrolyzers is characterised by a purity of 99.9%. Hydrogen with a purity of 99.999% is required for use in fuel cells, among other applications.

Thanks to the high purity, the dew point temperature is low enough that there is no risk of condensation in a very wide range of pressures.



How the R-PUR Hydrogen Purification System is Built

The R-PUR hydrogen purification system consists of an oxygen removal unit (Deoxo) and two drying columns.

The oxygen removal unit consists of a pressure vessel filled with a catalyst that induces and intensifies the reaction of combining oxygen with hydrogen. This reaction produces water and releases a significant amount of heat.

The desiccant columns separate the water vapour by means of adsorbents that are located inside these tanks. Water vapour molecules are trapped on the surface of the adsorber. Due to the limited capacity of water vapour accumulation, it is necessary to regenerate adsorbents. For this purpose, the system incorporates two drying columns in the hydrogen purification system. While one of them dries the hydrogen, the other is regenerated.



Scope of Delivery of R-PUR Hydrogen Purification Systems

Basic Equipment	Accessories
Oxygen removal column (Deoxo)	Bodywork in a container
Two water vapour removal columns	Electrically driven shut-off valves
Heaters and coolers for operation	Auxiliary system with air compressor
Shut-off valves with pneumatic drive	
Coalescing filter	
Safety valves	
Frame construction	
Dew Point Sensor	
Necessary measuring devices	
Control for automatic continuous operation	
Blow-off branch	

Services and Maintenance
Transport and unloading at site
Additional maintenance during storage
Making connections between system components
Connecting the system to utilities
Participation in commissioning
Training of personnel
Periodic maintenance and servicing

Main Advantages Of R-PUR Hydrogen Purification Systems

Durability:

The design based on proven components and high standards of project implementation at Rockfin are a guarantee of long-term reliability of R-PUR hydrogen purification systems.

Proven Technology:

Decades of adsorption and catalysis technology guarantee the reliable performance of the treatment systems.

Scalability:

R-PUR hydrogen purification systems are suitable for both small electrolyzers and megawatt industrial installations.



Compliance with EU Directives and Industry Standards

R-PUR hydrogen purification systems are CE marked and manufactured in accordance with the following industry directives and standards:

- MD 2006/42/EC – Machinery Directive,
- PED 2014/68/EU – Pressure Directive,
- EN 61508 – Functional safety of electrical/electronic/programmable electronic safety-related systems,
- EN 61511 – Functional safety – Safety instrumented systems for the process industry sector,
- EN 12100 – Safety of machinery – General design principles – Risk assessment and risk reduction,
- EN 60204-1 – Safety of machinery – Electrical equipment of machinery,
- EN 1127-1 – Explosive atmospheres – Explosion prevention and protection,
- EN 60079 – Series of standards for the safety of electrical equipment used in explosive atmospheres,
- EN 764-7 – Pressure equipment – Safety systems for unfired pressure equipment,
- EN 13445 – Unfired pressure vessels,
- ASME BPVC VIII – Rules for Construction of Pressure Vessels Section VIII,
- ASME B31.12 – Hydrogen piping and pipelines,
- EIGA DOC 15 – Hydrogen systems,
- EIGA DOC 211 – Hydrogen vent systems for commercial applications,
- EIGA DOC 121 – Hydrogen pipelines,
- ISO 14687 – Hydrogen fuel quality,
- ISO 19880-1:2020 – Gaseous hydrogen – Refuelling stations.

Examples of R-PUR Hydrogen Purification Systems

Type	Removal Module Oxygen (Deoxo)	Hydrogen Flow [Nm ³ /h]	Pressure [bar(g)]	Regeneration Circuit
R-PUR.D.20.34.CC	D – includes an oxygen removal module	20	34	CC – Closed Circulation (no hydrogen loss)
R-PUR.X.100.15.OC	X – does not include an oxygen removal module	100	15	OC – Open Circulation
R-PUR.D.500.40.CC	D – includes an oxygen removal module	500	40	CC – Closed Circulation (no hydrogen loss)

Where are HyVentive systems used?

	Chemical and Refining Industry Hydrogen can be successfully used in technological processes in the chemical and refining industries. It is widely used in the production of ammonia, methanol and fertilizers, as well as in a number of production processes in the petrochemical industry.
	Energy-Intensive Industry Hydrogen is an excellent substitute for natural gas, with water being the sole by-product of its combustion. Therefore, blending hydrogen produced using renewable energy sources (RES) with natural gas can effectively reduce CO ₂ emissions.
	Conventional Energy and RES In the context of increasing volatility within the energy market - characterised by a surplus of renewable energy generation during summer months and significant fluctuations in electricity prices - hydrogen production presents a viable solution for energy balancing. Surplus energy can be utilised to produce hydrogen, which may then be stored either as compressed or liquefied gas. This stored hydrogen can subsequently be employed in gas turbines or fuel cells for electricity generation, contributing to a more flexible and resilient energy system.
	Automotive and Alternative Fuels Hydrogen generated using R-GEN generators, following appropriate conditioning via R-PUR purification systems and compression through R-COM compressors, can be stored in R-PACK high-pressure tanks. This hydrogen is then suitable for refuelling and utilisation as a clean energy carrier in vehicles equipped with fuel cells or hydrogen combustion engines.

HYDROGEN COMPRESSION SYSTEMS

R-COM

Concept of the R-COM Product Line

The R-COM product line comprises H₂-compression systems engineered for maximum efficiency, reliability and safety. Our solutions respond directly to the growing demand for technologies that support the energy transition and the advancement of the hydrogen economy.

By integrating an innovative engineering mindset with Rockfin's decades of experience, R-COM delivers fully integrated compression systems tailored to diverse industrial environments. A modular design and flexible configuration options allow R-COM units to serve equally well in R&D projects and in large-scale hydrogen production, storage and distribution facilities.

Types of R-COM

Within the R-COM product line we collaborate with leading component suppliers, integrating their equipment into our own compression systems that meet each customer's specific requirements.

Compressor Type	Pneumatic Booster	Hydraulic Booster	Diaphragm Compressor
Sample Photo ¹			
Flow [kgH ₂ /h]	0.8 - 7	15 - 45	7 - 45
Inlet Pressure [bar(g)]	0.1 - 15	15 - 30	15 - 30
Outlet Pressure [bar(g)]	200 - 400	500 - 950	500
Construction Type	Rack	Container/Skid	Container/Skid
Drive Type	Pneumatic	Hydraulic	Hydraulic
Applications	Small-scale installations	HRS	Trailer refuelling

¹ The photos show products from the following suppliers: MAXIMATOR, HASKEL, PDC.

Our position as an experienced integrator enables us not only to select from the above mentioned components, but also to integrate other types of components, such as pistons or screw compressors.

R-COM Coding - Examples

Product Code	Compressor Type	Inlet Pressure [bar(g)]	Outlet Pressure [bar(g)]	Flow [Nm ³ /h]
R-COM.DC.30.500.500	Diaphragm compressor (DC)	30	500	500
R-COM.HB.500.950.340	Hydraulic booster (HB)	500	950	340
R-COM.PB.1.350.145	Pneumatic booster (PB)	1	350	145

R-COM Scope of Supply

Basic Equipment	Services and Maintenance
Compressor	Transport and unloading at site
Cooling system	Additional maintenance during storage
Containerization	Installation on site
Nitrogen purge system	Connecting the system to utilities
Control unit	Participation in commissioning
Power supply unit	Training of personnel
Safety and monitoring system	Periodic maintenance and servicing

Key Advantages of R-COM Compression Systems

Modularity:

The design of R-COM systems allows for expansion and adaptation to the customer's needs. This enables the optimisation of costs and provides flexibility in system configuration.

Turnkey Solution:

The comprehensive execution includes design, delivery, installation, and commissioning, minimising the client's involvement in the implementation process. Our goal is to ensure the rapid commencement of operation for R-COM systems.

Highest Level of Safety:

All R-COM products undergo a thorough HAZOP analysis with a focus on maximising safety, in compliance with current industry standards. The use of H₂ detectors and the execution of high-pressure leak tests across the entire installation, using process gas, are part of our standard practice.



Compliance with EU Directives and Industry Standards

R-COM compression systems are CE marked and manufactured in accordance with the following industry directives and standards:

- MD 2006/42/EC – Machinery Directive,
- PED 2014/68/EU – Pressure Directive,
- EN 61508 - Functional safety of electrical/electronic/programmable electronic safety-related systems,
- EN 61511 – Functional safety – Safety instrumented systems for the process industry sector,
- EN 12100 – Safety of machinery – General design principles – Risk assessment and risk reduction,
- EN 60204-1 – Safety of machinery – Electrical equipment of machinery,
- EN 1127-1 – Explosive atmospheres – Explosion prevention and protection,
- EN 60079 – Series of standards for the safety of electrical equipment used in explosive atmospheres,

- EN 1090 – Construction of steel and aluminium structures,
- EN 764-7 – Pressure equipment – Safety systems for unfired pressure equipment,
- EN 13445 – Unfired pressure vessels,
- ASME BPVC VIII – Rules for Construction of Pressure Vessels Section VIII,
- ISO 19880-1:2020 – Gaseous hydrogen – Refuelling stations,
- ASME B31.12 – Hydrogen piping and pipelines,
- EIGA DOC 15 – Hydrogen systems,
- EIGA DOC 211 – Hydrogen vent systems for commercial applications,
- EIGA DOC 121 – Hydrogen pipelines,
- ISO 14687 – Hydrogen fuel quality,
- API 618 – Reciprocating compressors.

For more information, please visit our website:
<https://www.rockfin.pl/hyventive>



HYDROGEN STORAGE

R-PACK

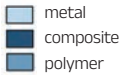
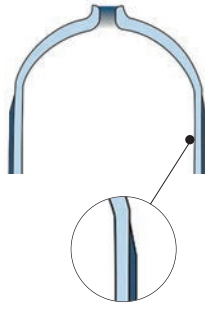
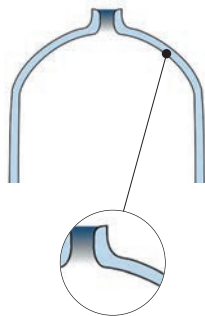
R-PACK Hydrogen Storage

One of the key challenges associated with the use of hydrogen is its safe and efficient storage.

For this purpose, various types of pressure vessels are used, with designs tailored to specific requirements concerning capacity, safety, weight, and cost-efficiency. Hydrogen storage cylinders are generally classified into four main generations, each representing an advancement in materials and engineering, aimed at improving performance and safety.



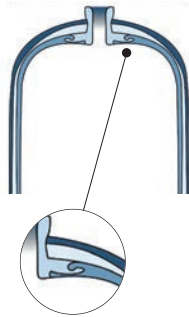
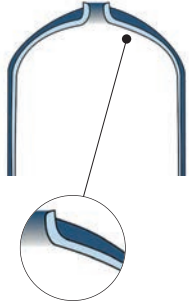
Generations of Hydrogen Storage Cylinders



Generation I – Metallic Cylinders

The earliest type of cylinders used for hydrogen storage is fabricated from carbon steel, stainless steel, or aluminium.

- Material: Carbon steel, stainless steel, or aluminium
- Working pressure: Up to 300 bar
- Mass: High relative to storage capacity
- Applications: Primarily used in industrial settings and laboratories
- Advantages: Low cost and high durability
- Disadvantages: High weight, limited working pressure, susceptibility to corrosion



Generation III – Composite Cylinders with a Thin Metallic Liner

The next stage in the development features cylinders that utilise a thin internal metallic liner combined with a robust external composite structure.

- Material: Thin metallic liner (typically aluminium) reinforced with a carbon fibre composite shell
- Working pressure: 350–700 bar
- Mass: Significantly lighter than Generation I and II cylinders
- Applications: Mobile hydrogen storage systems, hydrogen-powered vehicles (e.g., buses, trucks)
- Advantages: Substantial weight reduction; capable of supporting higher storage pressures
- Disadvantages: High production cost; requires advanced manufacturing technologies

Generation II – Composite Cylinders with a Metallic Liner

Advancements in materials technology enabled the development of lighter hydrogen storage cylinders that combine traditional metals with modern composite reinforcements.

- Material: Metallic liner (steel or aluminium) overwrapped with glass fibre or carbon fibre composite
- Working pressure: 200–300 bar
- Mass: Lighter than steel cylinders, though still relatively heavy
- Applications: Portable hydrogen storage systems, demonstration vehicles
- Advantages: Improved mass-to-capacity ratio compared to Generation I
- Disadvantages: Still relatively heavy; higher manufacturing costs compared to Generation I

Generation IV – Fully Composite Cylinders

The most advanced technology currently available involves cylinders made entirely from composite materials.

- Material: Polymer liner (e.g. plastic) fully encapsulated in a carbon fibre composite shell
- Working pressure: 700 bar and above
- Mass: The lightest cylinder design available on the market
- Applications: Automotive sector (passenger cars, buses, trucks), aviation, hydrogen refuelling stations
- Advantages: Optimal mass-to-capacity ratio, high safety performance, corrosion resistance
- Disadvantages: Very high production cost; more complex recycling process

Each successive generation of hydrogen storage cylinders demonstrates improvements in key technical parameters such as weight, capacity, and safety. As hydrogen technologies continue to evolve, reducing the mass of storage vessels and enhancing their efficiency remains a critical objective. Fully composite Generation IV cylinders currently dominate modern mobile applications. Ongoing advancements in storage technology and reductions in production costs will play a pivotal role in the wider adoption of hydrogen technologies in the future.

Scope of Supply for R-PACK Hydrogen Storage Systems

Installation and Equipment Options	Services and Maintenance
Cylinder pack	Transport and unloading at site
Stationary containerised installation	Additional maintenance during storage
Mobile containerised installation	Making connections between system components
Integrated loading/unloading panel	Connecting the system to utilities
Pressure gauge	Participation in commissioning
Safety valve	Training of personnel
Hydrogen detector	Periodic maintenance and servicing
Compliance with ADR regulations	

Key Advantages of R-PACK Hydrogen Storage Systems

Durability:

The design, based on proven components and high standards of project implementation at Rockfin, ensures long-term reliability and durability of the products.

Mobility and Flexibility:

R-PACK cylinder storage systems are easily transportable, making them ideal for mobile or temporary applications.

Scalability:

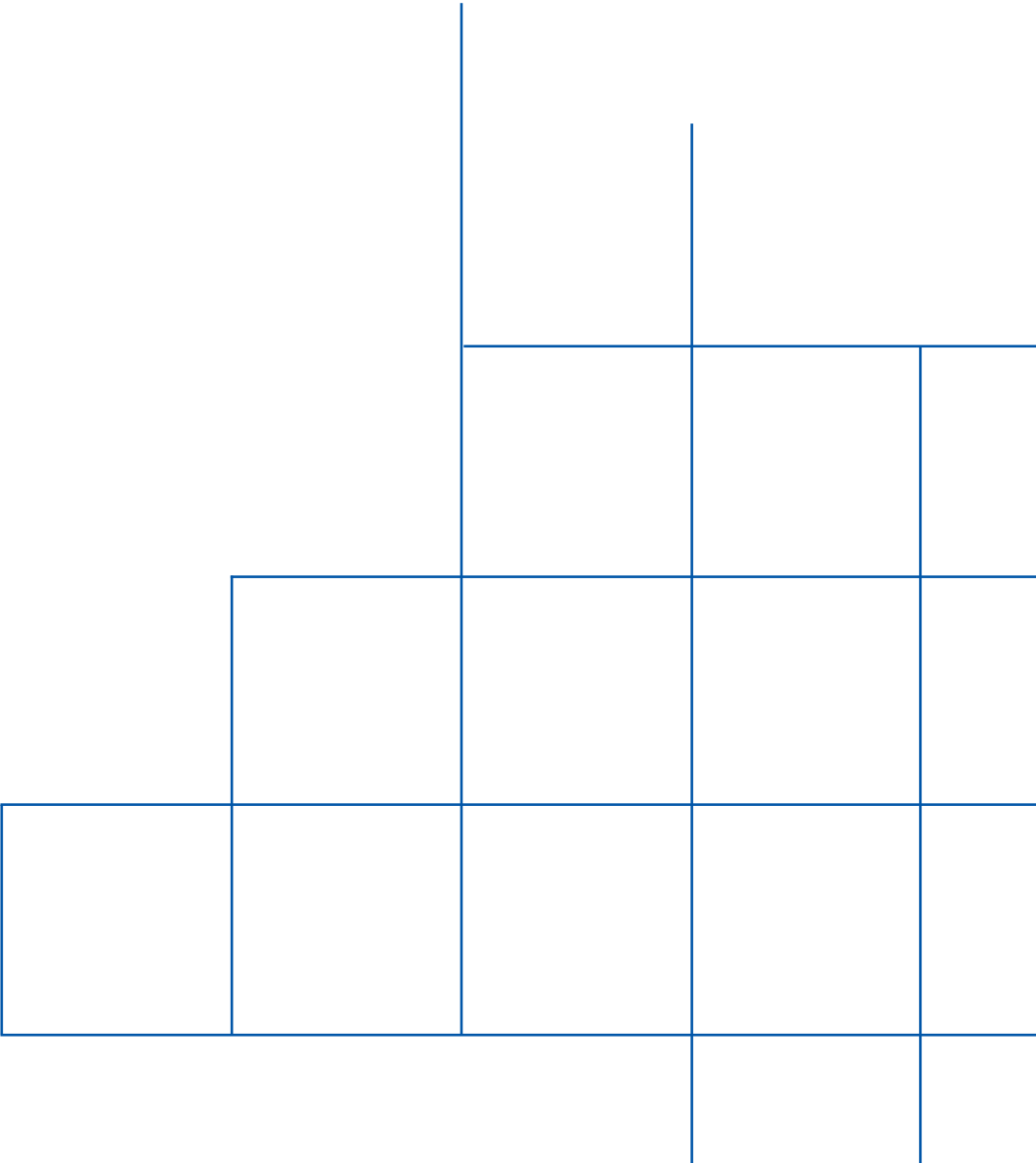
R-PACK hydrogen storage systems are suitable for both small laboratory setups and large industrial installations.

Safety and Durability:

The cylinders are constructed from robust materials that can withstand high pressures. Additionally, safety systems are in place to minimise the risk of leaks or failures.

Cost-Effectiveness:

R-PACK cylinder storage systems are more affordable compared to large cryogenic or underground hydrogen storage tanks. The use of standard components allows for easy integration with existing systems and future expansion.



Example R-PACK Hydrogen Storage Systems

Code	Type	Capacity (Water) [L]	Number of Cylinders/Tanks	Maximum Pressure [bar]	Cylinder Generation
R-PACK. P.600.12.200.CS	P – Pack	600	12	200	CS – Carbon Steel Gen I
R-PACK. V.700.1.40.SS	V – Vessel	700	1	40	SS – Stainless Steel Gen I
R-PACK. C.800.16.300.G2	C – Container	800	16	300	G2 – Composite Gen II
R-PACK. C.1900.6.350.G3	C – Container	1900	6	350	G3 – Composite Gen III
R-PACK. T.1600.9.700.G4	T – Trailer	1600	9	700	G4 – Composite Gen IV

Own Pressure Vessel Manufacturing Facility

Rockfin is a leading Polish manufacturer of energy systems, with its production facility located in Bydgoszcz, specialising in the manufacture of pressure vessels. As part of its operations, the company offers advanced solutions for hydrogen storage and separation, as well as other hydrogen technology applications.

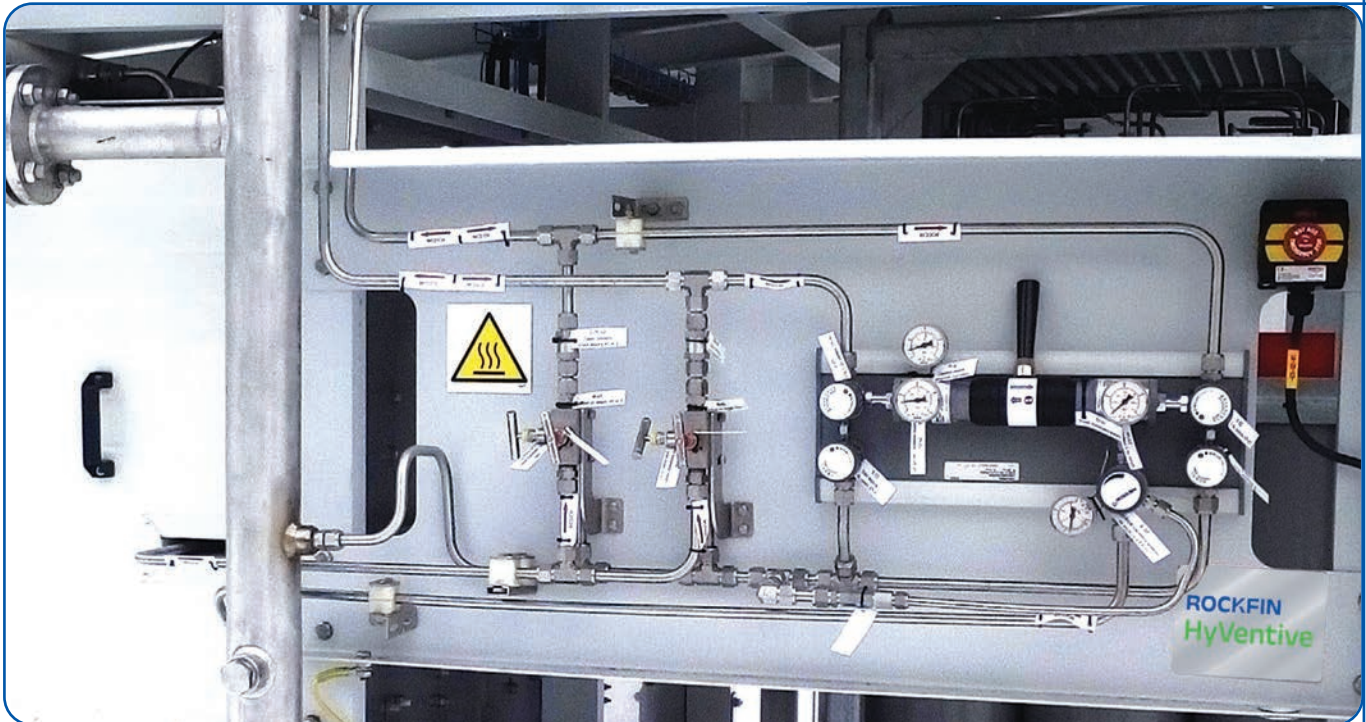
The Rockfin facility is equipped with modern production lines that enable the manufacturing of pressure vessels using both carbon steels and stainless steels. Upon a special request, vessels larger than the standard units presented in the table below can be manufactured.

Technical Parameters of Standard Pressure Vessels	
Design pressure	Up to 400 bar
Design temperature	from -196°C to 490°C
Diameter	Up to 3000 mm
Height	Up to 6000 mm
Length	Up to 12000 mm
Shell thickness	Up to 60 mm
Vessel weight	Up to 30 tonnes

The company ensures product compliance with international quality and safety standards, including ASME and PED (CE) regulations, enabling their use in domestic, European, and global markets. With its in-house

engineering office and many years of experience in design, the company is capable of manufacturing custom pressure vessels, based on client documentation or designed according to specific requirements.

For more information, please visit our website:
<https://www.rockfin.pl/hyventive>



HYDROGEN PANELS

R-FLOW

Functions of R-FLOW Hydrogen Panels

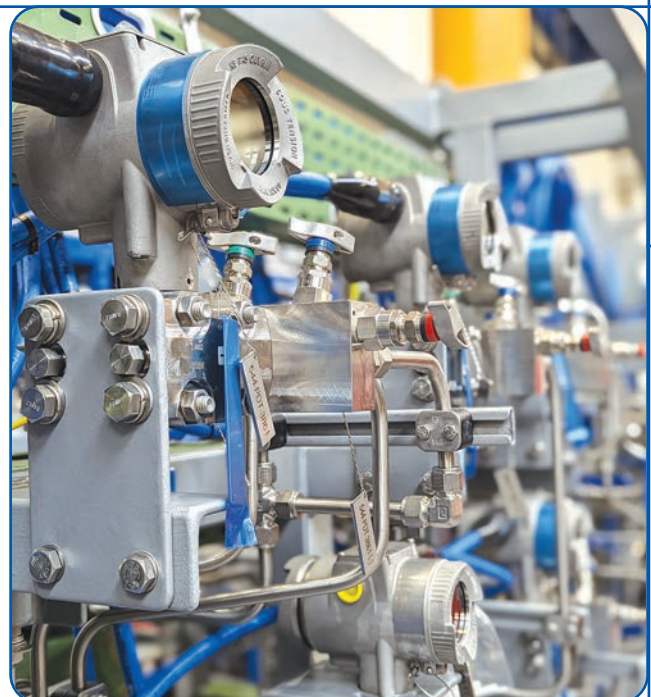
Hydrogen panels can perform various tasks depending on their equipment. Three main functions of the panels are distinguished:

- Supply Panels
- Refuelling Panels
- Distributing Panels

Supply panels are designed to enable the safe connection of the hydrogen trailer, receiving hydrogen without compromising its purity, and then redirecting it to the next module.

Refuelling panels enable the direct filling of vehicle tanks from the hydrogen trailer without the need for any additional components. This is possible when the hydrogen trailer maintains a higher pressure than the vehicle's tank.

Distributing panels can manage the hydrogen flow throughout the entire HUB-type system. This allows for successful integration of modules such as compression systems, hydrogen generators, hydrogen trailers, cooling systems, hydrogen storage, and hydrogen dispensers.



Equipment of R-FLOW Hydrogen Panels

Standard Equipment	Optional Equipment
Safety valve	Mass flow meter
Ventilation / purge	Pressure regulator
Grounding	Control valve
Shut-off valves	Breakaway coupling
Panel type steel structure	Flexible hose
	Pneumatically actuated valves
	Electrically actuated valves
	Containerised construction

How R-FLOW Hydrogen Panels are Constructed

R-FLOW Hydrogen Panels are a set of valves and measuring instruments mounted on a steel structure forming the panel. The panel can be installed either within a container or the individual components can be protected using enclosures or boxes.



Key Advantages of R-FLOW Hydrogen Panels



- Durability:**

The design, based on proven components and high project implementation standards at Rockfin, guarantees long-term reliability of R-FLOW hydrogen panels.
- Tailored to Requirements:**

R-FLOW hydrogen panels are always selected according to the project's specific requirements. Custom design services are also available for these devices when needed.
- Engineering Excellence:**

With many years of experience, Rockfin ensures that R-FLOW hydrogen panels are designed in accordance with best engineering practices, ensuring reliable operation and ease of use.
- Mobility and Flexibility:**

R-FLOW hydrogen panels are easily transportable, making them ideal for mobile or temporary applications.

Additional maintenance during storage

Connecting the system to utilities

Training of personnel	
-----------------------	--

Type	Function	Design Pressure [bar(g)]
R-FLOW.SP.500	SP - Supply Panel	500
R-FLOW.RP.400	RP - Refuelling Panel	400
R-FLOW.DP.900	DP - Distributing Panel	900

ROCKFIN HyVentive

Quality Founded on Experience

For over 20 years Rockfin has been successfully designing and manufacturing advanced hydrogen systems in Poland, delivering high-performance solutions to clients across the globe. With a dedicated workforce of over 1500 employees across four production facilities, we ensure that each system meets the highest standards of quality, reliability, and punctual delivery.

Our client portfolio includes global leaders in the energy and oil & gas sectors—organisations known for placing the most stringent demands on equipment performance and compliance. To consistently meet these expectations, Rockfin Sp. z o.o. has implemented an Integrated Quality Management System aligned with internationally recognised standards:

- PN-EN ISO 9001:2015 – Quality Management Systems
- PN-EN ISO 14001:2015 – Environmental Management Systems
- PN-EN ISO 45001:2018 – Occupational Health and Safety Management Systems

In addition to these core certifications, we also hold the following accreditations and conformity approvals:

- EN 1090 – Construction of steel and aluminium structures,
- PN-EN ISO 17025 – Accreditation of the Non-Destructive Testing Laboratory,
- PN-EN ISO 3834-2 – Quality Requirements for Welding of Metallic Materials,
- PED Module A2 – Conformity of Pipelines and Pressure Equipment with the Pressure Equipment Directive,
- U-Stamp (ASME) – Conformity of Pressure Vessels with ASME Standards,
- AD 2000-Merkblatt – Compliance with the German Welding Standard for Pressure Equipment.

These certifications serve as a testament to our technical competence and a guarantee of the consistent quality of our products. All Rockfin HyVentive systems are manufactured within the European Union and fully comply with applicable European Directives, bearing the CE marking.

This brochure is not a commercial offer within the meaning of the Civil Code.

Rockfin reserves the right to make amendments to the contents of this brochure without prior notice.



Małkowo, 9 Pałacowa street, 83-330 Żukowo, Poland

+48 58 728 29 00 hydrogen@rockfin.pl www.rockfin.pl/hyventive