



# Solutions for hydrogen





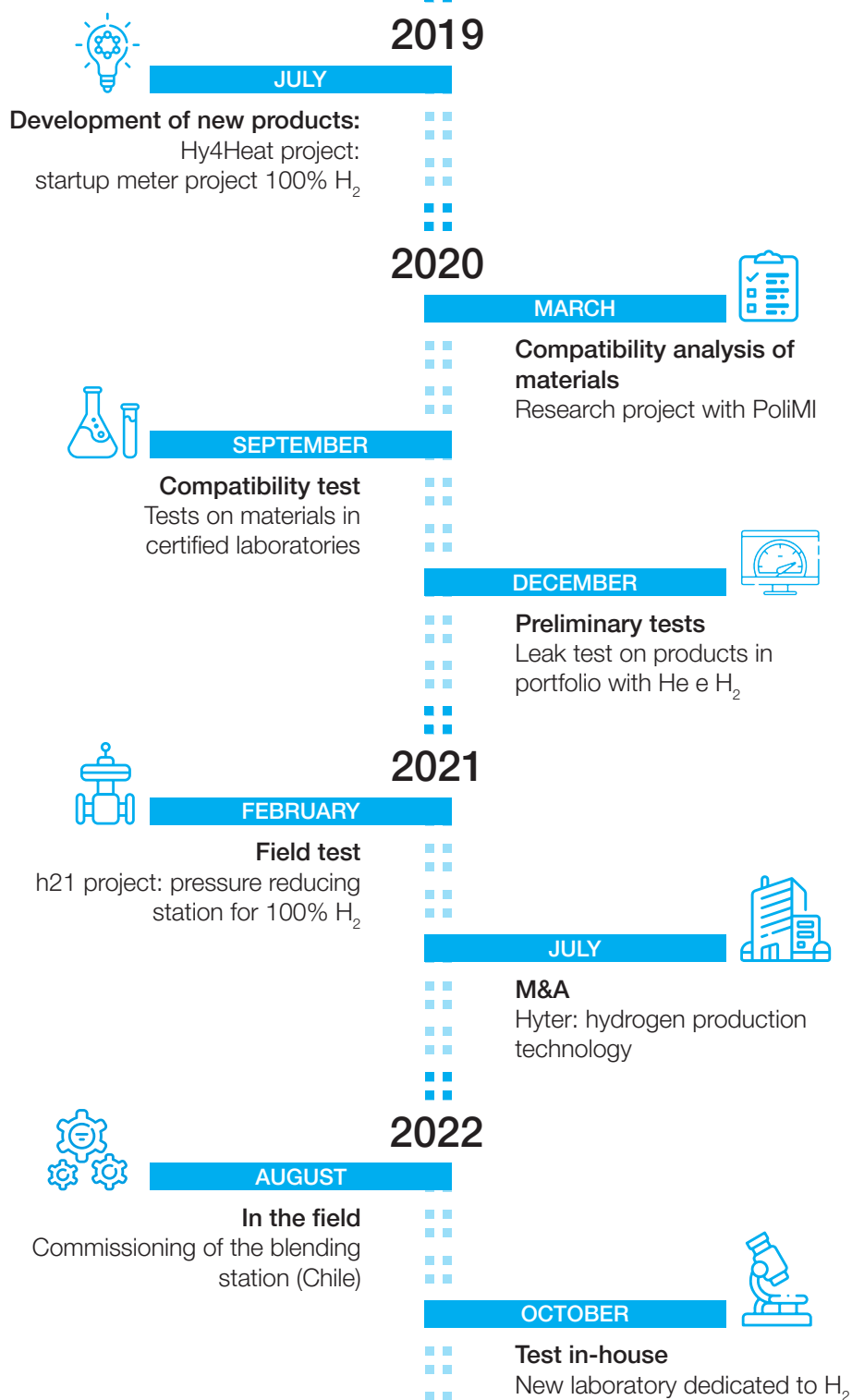
# Hydrogen: the ideal ally for the energy transition



The energy transition is based on using a clean energy mixture, including hydrogen. Our solutions are designed to enable new production technologies and exploit the existing gas networks for its transport and distribution.



# Pietro Fiorentini Group **hydrogen journey**



# Hydrogen Innovation Lab

On October 20, 2022, the virtual grand opening event of the Hydrogen Innovation Lab was held. This project saw the building of a multifunctional facility where **hydrogen can be produced** by electrolysis and used, where **blending of hydrogen and natural gas** can be done, and the **readiness of devices** used along existing networks **can be tested**.



[Click here](#) or scan the QR code to see our hydrogen laboratory video presentation.



## At the heart of the Hydrogen Innovation Lab

The **Hydrogen Innovation Lab is designed to work** with hydrogen gas from the generator, located upstream of the facility, and with normal gas coming from gas network mixing them in varying percentages (**hydrogen blending**), including working **exclusively with hydrogen**. Once the desired mixture is set, the control system precisely adjusts the opening of the valves to ensure the correct flow rates on the two branches of the circuit and **keep the final mixture balanced**.

The Hydrogen Innovation Lab was **also created to evaluate the readiness of the instruments** used along the network, that is, their ability to handle different mixtures of hydrogen and natural gas. Within the laboratory, various flow tests are carried out on regulators and meters with pure hydrogen or mixtures whose quality is verified in real time by **gas chromatographic analysis**. The test bench for testing the meters follows the indications reported in a [recently published scientific article](#), with Pietro Fiorentini Group among the authors.

# An innovation centre for the community

The purpose of Hydrogen Innovation Lab is not only to be a simple testing area for the Group's products: the main objective of building the laboratory is to make it a true **development accelerator**, a **catalyst** for the creation of **new technologies** that can generate comparison and innovative solutions together with other entities and companies in the sector, creating a hub of **excellence for Italy**.



In addition to this comparison, it is also necessary to **interface with the final consumer**, since the energy transition necessarily starts with the users who must see new technologies as an opportunity and not a threat: that is why the Hydrogen Innovation Lab also wants to be an educational and informative **centre for the community**.

## In numbers...

Inside our laboratory we are able to test our products with pure hydrogen and with natural gas **blends from 0 to 100%**, with a blend volume up to 4 Sm<sup>3</sup> accumulation, 0.2 m<sup>3</sup> at 2 MPa | 20 bar.

We are able to test with flow rates up to 40 Sm<sup>3</sup>/h in closed loop and up to 25 Sm<sup>3</sup>/h in continuous discharge, with a pressure up to 10 MPa | 100 bar static. To test our residential meters we apply a pressure variation from 2 to 50 kPa | 20 to 500 mbar, while 400 to 600 kPa | 4 to 6 bar to test our regulators. The **purity** of the **hydrogen** produced by our electrolyzers reaches up to **99.95%**.



**99.95%**

Hydrogen purity



**Up to 10 MPa | 100 bar**

Max static test pressure



**40 Sm<sup>3</sup>/h**

Flow rate in closed loop



**25 Sm<sup>3</sup>/h**

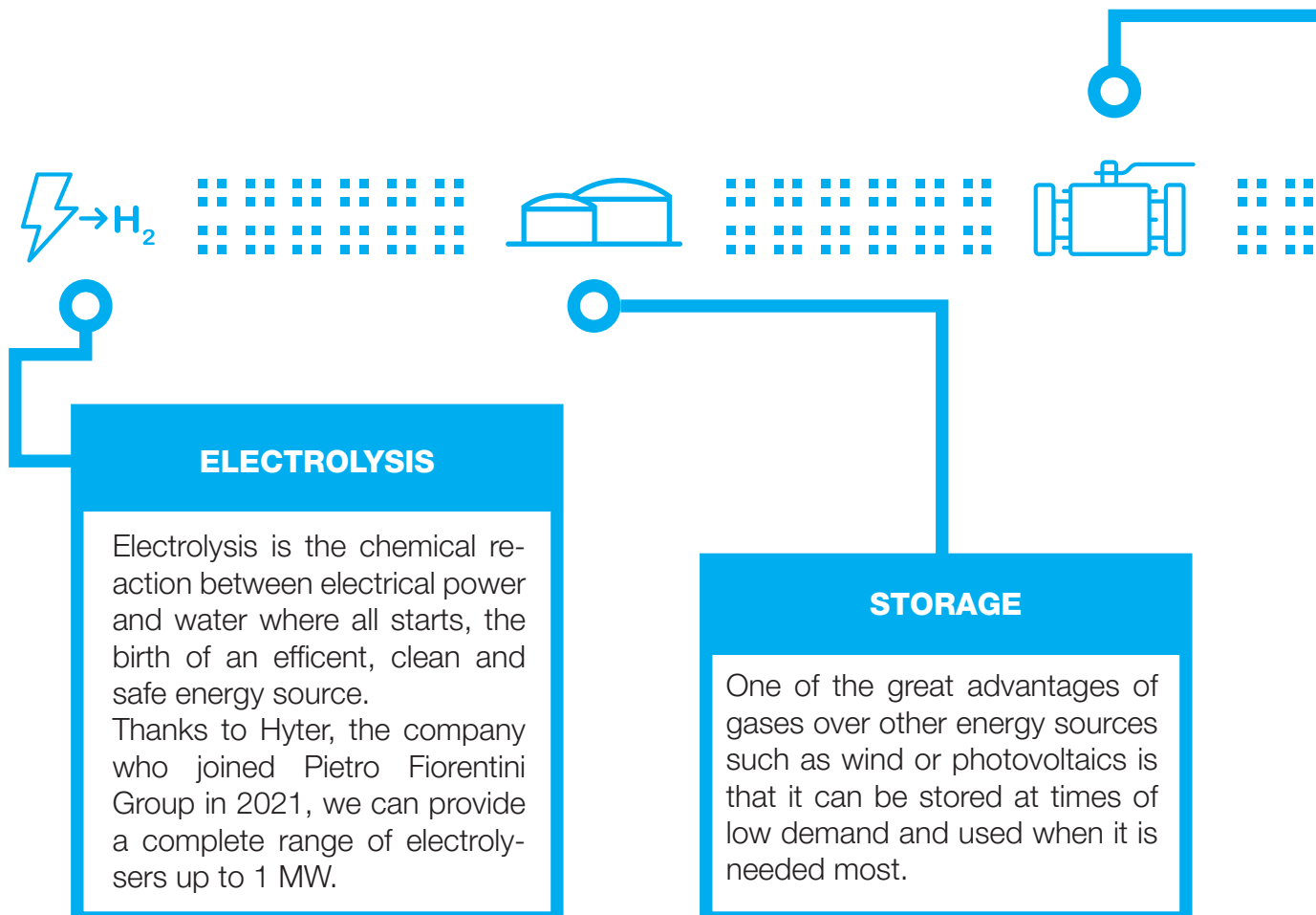
Flow rate  
in continuous discharge

# Pietro Fiorentini Group

## hydrogen value stream

The need of a large scale use of hydrogen is pushing gas infrastructure to drastically evolve. We are applying our international 80 years experience on gas networks to face this exciting challenge: from designing and testing hydrogen ready solutions up to developing new hydrogen blending stations, our purpose is to **exploit the full potential of existing gas networks to accept and deliver hydrogen.**

Our set of solutions spans from hydrogen generation through electrolysis up to the end users metering, passing through storage, pressure control and blending with natural gas.



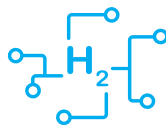
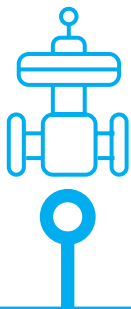
## VALVES

Valves are a fundamental element of any transport and distribution pipeline. We provide a range of valves for every need in the hydrogen value stream: from customized ball valves designed for special uses, to slam shut and butterfly valves for a safe and reliable distribution.

## BLENDING AND INJECTION

Hydrogen networks are on the rise, and especially in the first part of their path, they will have to work together with traditional natural gas transmission and distribution grids.

Depending on various factors, end users may need several degrees of blending, from 20% up to pure hydrogen.



## PRESSURE CONTROL

We define the standard of the pressure regulator with the main purpose of allowing the gas to flow smoothly to the utilisation point, always in total safety. We are bringing our decades long experience with natural gas in the hydrogen field to provide a complete range of reliable pressure regulators.

## METERING

Accurate gas metering is a primary requirement for the energy sector. We provide a complete range of gas meters for residential, commercial and industrial applications.

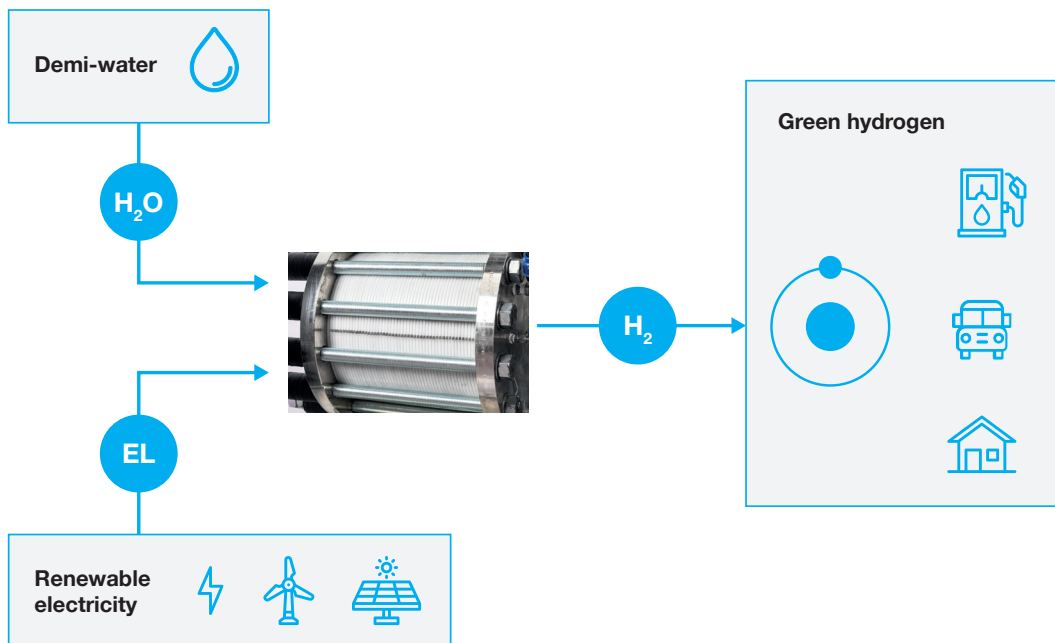


# AEMWE electrolyzers

Hyter is a company operating in the hydrogen sector since 2011. It joined Pietro Fiorentini Group in July 2021. The company develops **solutions to generate green hydrogen through the electrolysis of water**, using a process based on anionic exchange membrane technology (AEMWE).

Using these technologies satisfies multiple needs in the energy transition process. For example, it enables **storing and consuming the hydrogen produced**, thus stabilising the variability of the production of electricity from renewable sources, very often not aligned with consumption. There are also umpteen potential applications, like sustainable mobility, sector coupling or solutions to satisfy residential uses.

## Hyter | How it works







Scope	Size	Main features	Time to market
<b>Rigel</b> Small scale electrolyser	Up to 12 stacks of 10 kW each (solutions up to 120kW)	<ul style="list-style-type: none"> <li>Few rare metals</li> <li>Efficiency 85%</li> <li>Up to 2.5 MPa   25 bar output pressure</li> <li>H<sub>2</sub> purity 99.95%</li> <li>3% of electrolyte</li> <li>Process water: demi water</li> </ul>	Available
<b>Sirius</b> Large scale electrolyser	Multiple stacks in parallel from 166 to 250kW each (solutions up to 1MW)		Q4 2024

## Hyter | Main features

- Working with direct renewable source
- Compression up to 70 MPa | 700 bar
- Demi water in the process
- Purification up to 99.999%
- Using 3% of electrolyte
- Minimum usage of rare metal
- Modular solution
- 85% of efficiency
- Fuel cell integration
- Easy maintenance

## Hyter | Reference list

Scope	Size	Customer	Country	Year
Refueling station	0.5 m <sup>3</sup> /h	Redam Srl	Italy	2014
Storage PV	1.5 m <sup>3</sup> /h	Aquacell GMBH	Germany	2015
Refueling station	1.5 m <sup>3</sup> /h	Caldoa GMBH	Germany	2020
Laboratory	0.25 m <sup>3</sup> /h	Enea	Italy	2018
Laboratory	0.5 m <sup>3</sup> /h	Edison Spa	Italy	2019
Pilot	0.5 m <sup>3</sup> /h	Electrohydro BV	Netherlands	2020
Pilot	0.5 m <sup>3</sup> /h	Bareau BV	Netherlands	2020
Storage PV	2 m <sup>3</sup> /h	Enphos Srl	Italy	2021
Biomethanation plant	4 m <sup>3</sup> /h	Micropyros GMBH	Germany	2021
Micro-grid	2 m <sup>3</sup> /h	PLT energia	Italy	2021
Refueling station	6 m <sup>3</sup> /h	SERA GMBH	Germany	2021
Biomethanation Plant	200 m <sup>3</sup> /h	HERA SpA	Italy	2023
3x Storage PV	8 m <sup>3</sup> /h	H2X	France	2023



# Pressure vessel tanks

## for hydrogen storage

One of the great advantages of gases over other energy sources such as wind or photovoltaics is that it can be stored at times of low demand and used when it is needed most. Moreover, it allows the transportation of gas without expensive pipeline interventions.

Thanks to the expertise of our team, all these traditional advantages of natural gas are applicable to hydrogen on a wide range of pressure vessel tanks, tailored on every customer's need.



Features	Values
Individual vessel capacity	Up to 30 m <sup>3</sup>
Material	Stainless steel or carbon steel
Design pressure*	8 MPa 80 bar
Design temperature*	from -20° C to +50° C from -4° F to +122° F

**(\*) NOTE: Different functional features and/or extended temperature ranges available on request. Stated temperature ranges are the maximum for which the equipment's full performance are fulfilled. Standard product may have a narrower range.**

## Vessel tanks certifications



EN13445



ASME VIII  
Div. 1



CE-PED



# Valves



TIV Valves, part of Pietro Fiorentini Group since 2019, is an Italian manufacturer of high quality ball valves striving to be your most valuable partner for oil and gas, sustainable energy, green and industrial applications, offering on-time delivery of engineered technical solutions thanks to its specialized team of experienced managers and engineers and the 25,000 m<sup>2</sup> production area.

**Pietro Fiorentini Group guarantees the all the current manufactured natural gas valves in the following range are suitable for 20% hydrogen blending service.**



Sizes: 1" to 48"



Pressure class: up to ANSI 900



Design temperature: from -29° C to +150° C | from -20.2° F to +302° F

Upon request all valves can be manufactured for **100% hydrogen service**



Custom engineered product to fit process conditions



Material selection and valves design based on operating pressure, temperature and fluid composition



Class 600# valve for 100% Hydrogen service (h21 project)



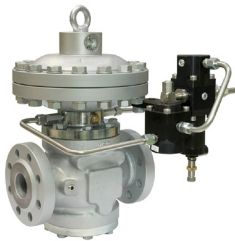
# Pressure control

## for hydrogen networks

We define the standard of the pressure regulators with the main purpose of allowing the gas to flow smoothly to the utilisation point, always in total safety. Thanks to our many decades of experience in the natural gas field, we can provide a complete range gas pressure regulators suitable for all applications, from transmission to residential.

These devices are now being tested to work with hydrogen blends and pure hydrogen, in order to be ready for the future of gas networks. **Pietro Fiorentini Group guarantees the all the current manufactured pressure control products are suitable for 20% hydrogen blending service.**

### Hydrogen ready pressure control devices range



Pilot operated regulators



Direct action regulators



Double stage regulators



Governors



Slam shut valves



## Main application field covered

- Compression / booster stations
- H<sub>2</sub> storage
- H<sub>2</sub> liquefaction plants
- Electrolyzer plant
- Compressed hydrogen tube trailers
- Electrolyzers downstream applications
- City gates
- Heavy industries
- Regasification plants
- District stations
- Commercial users
- Power generation
- Gas reverse-flow
- Blending units
- Medium/small industry
- Residential users

## Pressure regulators available for 100% hydrogen service and typical applications

Range	Model	Main applications
Transmission	Reflux 819 H	
Transmission	Reflux 819/FO H	
Transmission	Staflux 187 H	
Distribution MP	Reval 182 H	
Distribution MP	Norval H	
Distribution MP	Dival 600 H series	
Distribution LP	Dival 500 H series	
Distribution LP	FE H	
Distribution LP	Governors H	

**NOTE: All optionals available with each pressure regulator (i.e. monitors, slam shut valves, silencers) have the same compatibility degree of the device they are equipped to.**

## Slam shut valve available for 100% hydrogen service and typical applications

Range	Model	Main applications
Transmission	SBC 782 H	
Transmission	SBC 187 H	
Distribution MP	Dilock H	
Distribution MP	SCN H	

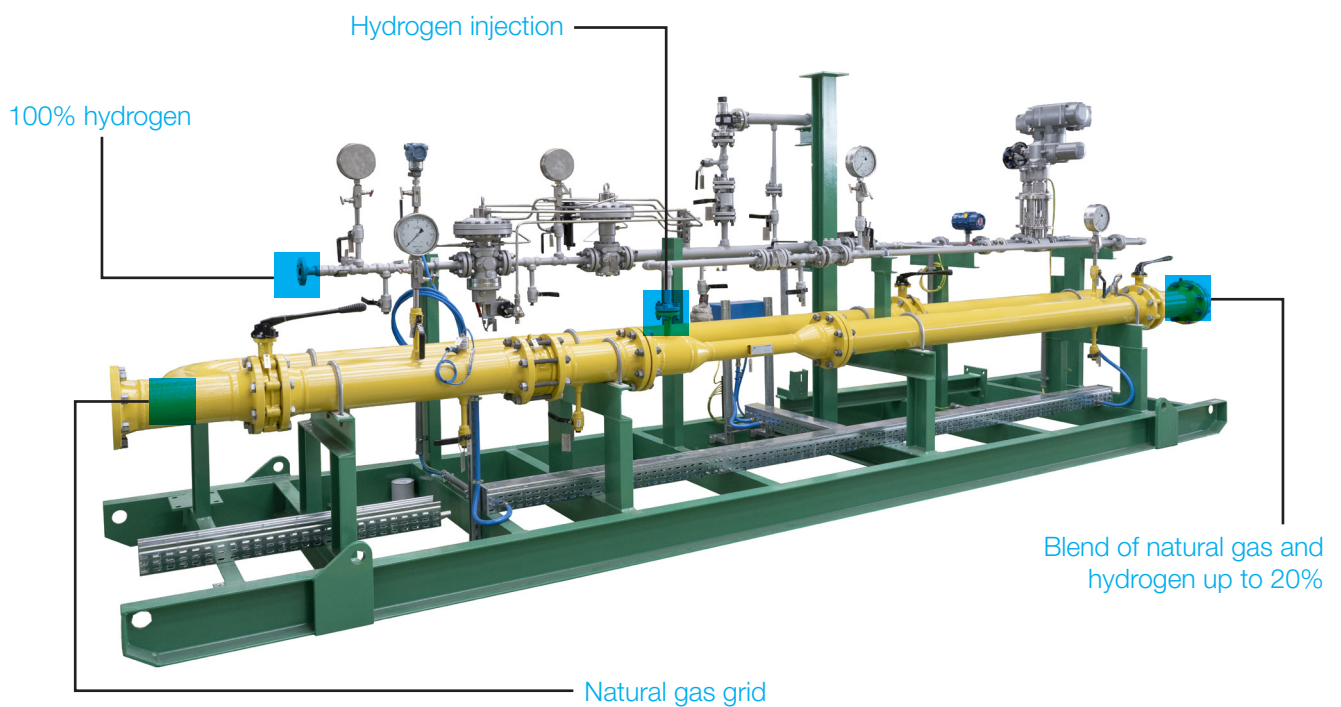


# Blending & Injection

## Hydrogen stations

Hydrogen networks are on the rise, and especially in the first part of their path, they will have to work together with traditional natural gas transmission and distribution grids.

Depending on various factors, end users may need several degrees of blending - up to 20% hydrogen. This means that a reliable, fast-responding system is needed to blend, analyse and control hydrogen flow in the grid.



We provide tailor designed station for blending & injection, featuring a full scale industrial design that can be easily adapted from low pressure districts up to high pressure transmission networks and industrial applications.



## Inaugurated the first hydrogen blending station by Pietro Fiorentini Group

On the 15th of December 2022, the **first hydrogen blending station** built and installed by Pietro Fiorentini Group was officially inaugurated. Commissioned by **Gasvalpo**, the oldest gas distribution company of Chile and one of the most important in South America, the station is part of a **plant that produces and injects green hydrogen into the natural gas distribution** networks of the Coquimbo region, reaching more than 2.000 homes.



Thanks to the **hydrogen blending stations** by Pietro Fiorentini Group, **natural gas** from local distribution networks **can be mixed with up to 20% hydrogen**. Within these plants, the green hydrogen (i.e. produced from renewable sources) undergoes a reduction treatment – using special **Reflux 819** for hydrogen applications – until it reaches the correct mixing pressure to be injected into the network through PLC-controlled control valves, programmable control systems that allow the selection of the percentage of hydrogen to inject (from 0 to 20% with incremental steps of 1%).

For the development of the **H2GN**, the **pilot project** by Gasvalpo to reduce carbon dioxide emissions generated by the use of gas in the domestic sector (e.g. for heating and cooking), we have been at the side of the Chilean distribution company once again, following a partnership that for years has seen the supply of a wide range of products, including high and medium pressure regulators and residential and commercial meters.

The station is one of the solutions at the service of renewables by Pietro Fiorentini Group. Regarding the hydrogen sector, the Group is now committed to taking a leading role through products and technologies that enable traditional infrastructures to receive increasing percentages of this energy vector.



# Metering

## for hydrogen networks

Accurate gas metering is a primary requirement for the energy sector. Pietro Fiorentini Group provides a complete range of gas meters for residential, commercial and industrial applications.

**Pietro Fiorentini Group guarantees that all the current manufactured gas meters are suitable for 20% hydrogen blending service.**

### Hydrogen ready meters range



Turbine meters



Rotary meters



Ultrasonic meters



Ultrasonic smart meters



Full hydrogen smart meters

### Main application field covered



Compression / booster stations



Power generation



Medium/small industry



H<sub>2</sub> storage



Heavy industries



Commercial users



City gates



District stations






Residential users





## Meters available for 100% hydrogen service and typical applications

Range	Model	Main applications
Turbine	IM-TM H	
Rotary	IM-RM H	
Ultrasonic	H2-SSM-iCON	

## Zero emissions target in the United Kingdom with H2-SSM

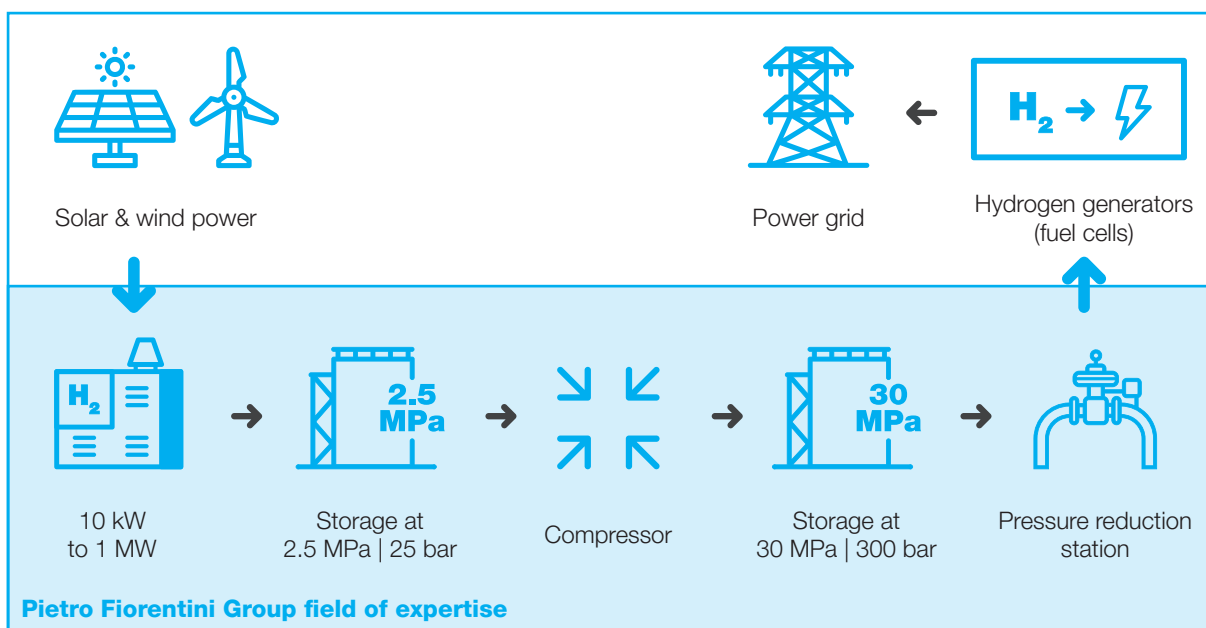
Our first step in the hydrogen world was taken in the **Hy4Heat** project, wanted by the United Kingdom to achieve the target of being a **zero emissions Country by 2050**. More specifically, the project aims to check the safety and technical-economic feasibility of **replacing methane gas with 100% hydrogen** in the domestic/industrial networks. Working packages were assigned to us in the Hy4Heat project. These include the supply of a **residential meter** and all the upstream and downstream components. The result is **H2-SSM**, the first static, ultrasonic meter developed to measure up to 100% of hydrogen, currently in its preliminary test phase with the Hydrogen Home in the United Kingdom.



[Click here](#) or scan the QR code to take a tour of Hydrogen Home (Northern Gas Networks project).

# Power-to-Power

“Power-to-Power” refers to a technology that involves converting **excess renewable electric energy into hydrogen**, which can then be stored and used as an energy source when needed. This is one of the solutions to address the problems of intermittency and availability of renewable energy, such as solar and wind power.



1

**Hydrogen production:** during periods when renewable energy production exceeds demand, instead of dispersing excess energy, it is used to electrolyze water, separating hydrogen from oxygen.

2

**Storage:** the hydrogen produced in this way can be stored in special tanks.

3

**Energy production:** when there is a shortage of renewable energy, such as overnight or when there is no wind, the stored hydrogen can be converted back into electricity using fuel cells or generators. During the reaction, separation of electrons and ions takes place, generating electricity and producing water as a byproduct. **Fuel cells** offer high energy efficiency and are considered a clean technology.

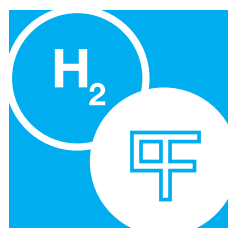




[www.fiorentini.com](http://www.fiorentini.com)



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