



# Pietro Fiorentini

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Technology and solutions for a digital and sustainable world



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Hydrogen Laboratory Capabilities

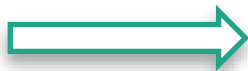
**04**

## **Complete Package for Hydrogen**

Injection & Pressure Control

# 1. Hydrogen Value Chain Sustainability

## HYDROGEN



## GREEN GAS NETWORKS TEAM



Systems for  
Green Gas  
Acceptance



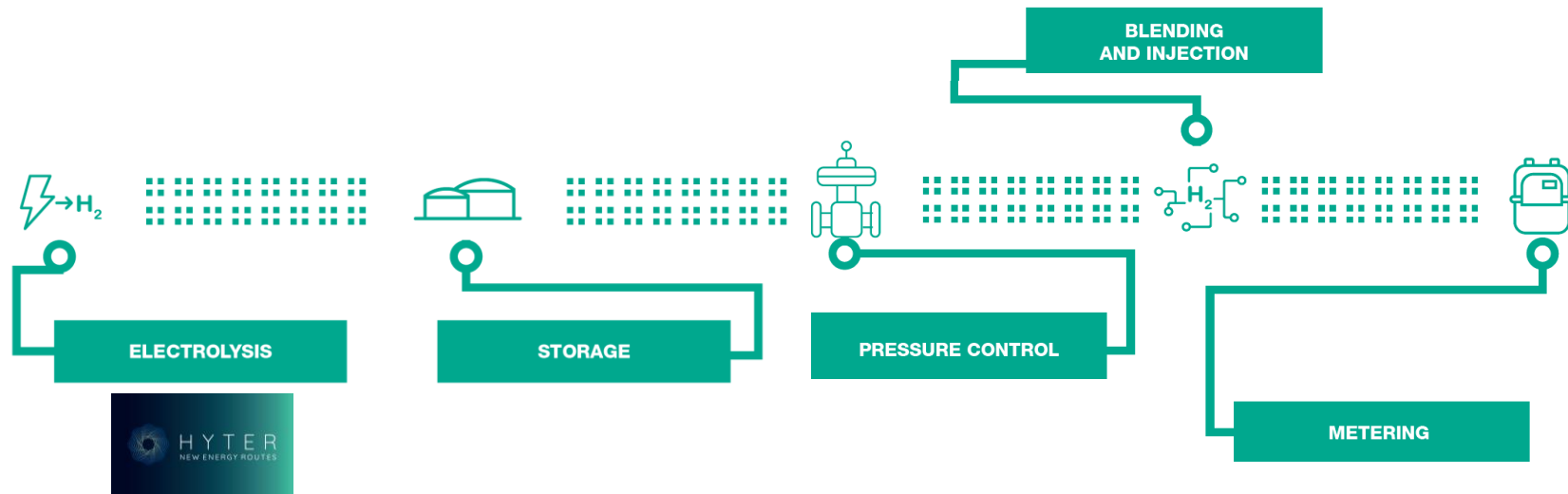
Grid  
readiness to  
Green Gases



Gas Grid  
Efficiency



# 1. The Hydrogen Package Concept





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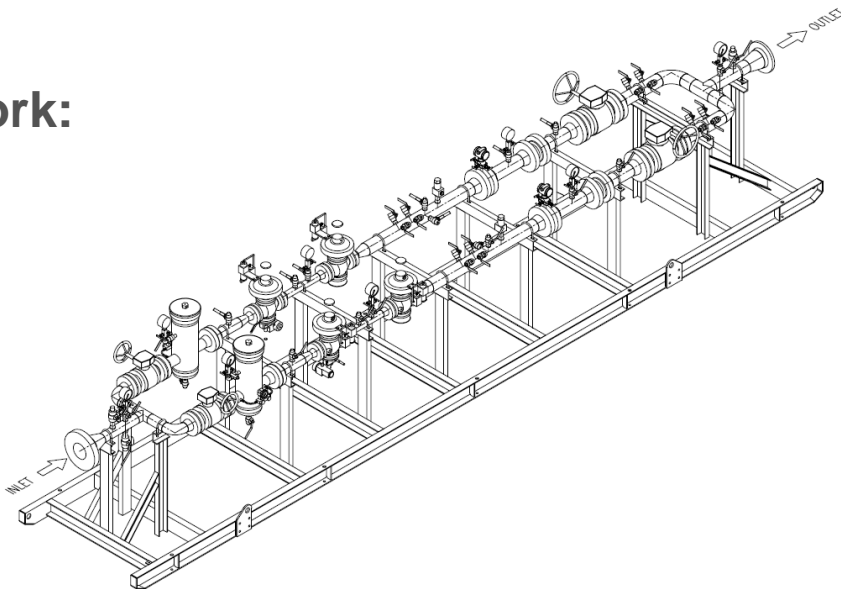
# 2. H<sub>2</sub> gas networks readiness

## Pietro Fiorentini mission:

- Explore the entire gas network to understand the impacts of hydrogen injection into the grid, to ensure customers safety with technical solutions **up to 100% hydrogen** ready.

## The main topics through the gas network:

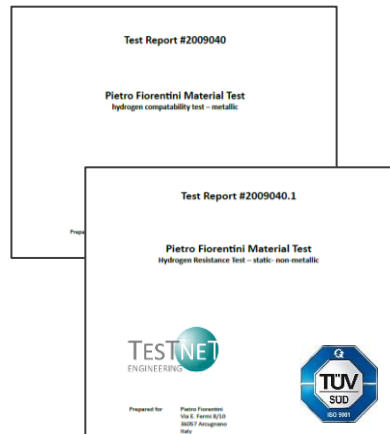
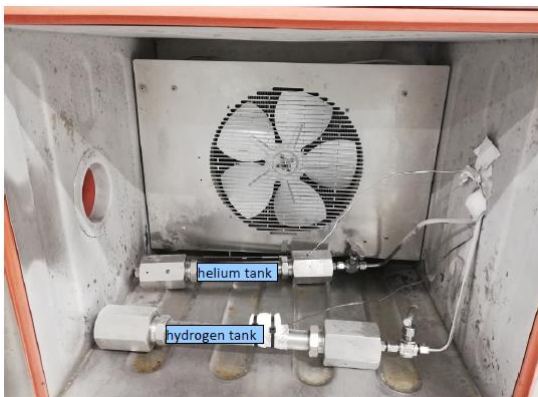
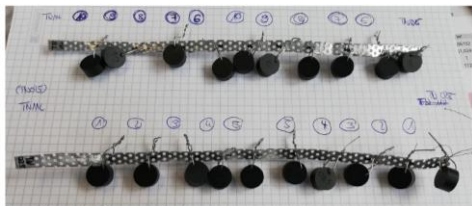
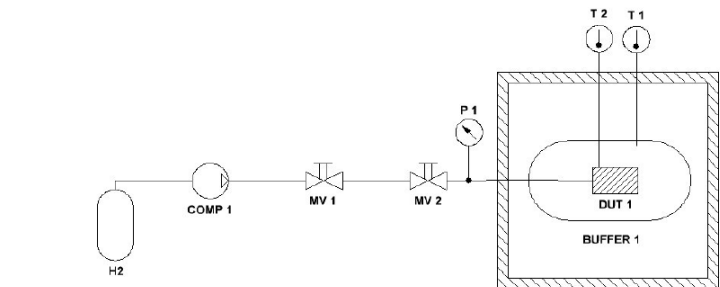
- Rubbers behaviours (Aging, Permeability)
- Metals (Hydrogen Embrittlement)
- Gaskets (Tightness)
- Metering (HHV Vs. Flow Rate)
- ATEX compatibility
- Field installation procedure
- Commissioning procedure
- Maintenance
- De-commissioning procedure



# 2. Materials testing in laboratory

## Metallic & Rubbers Materials

- **Tensile strenght test** on mechanical resistance of **metallic materials** under hydrogen environment.
- **Permeability and aging test** for **rubbers materials** under hydrogen environment.




# 2. Materials testing in-house

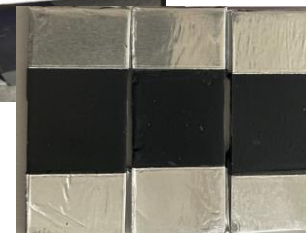
## H<sub>2</sub> exposure test



**Metallic springs** to evaluate strenght performance after exposure in **100% H<sub>2</sub>**



 **Reinforced gasket** to evaluate adesive performance after exposure in **100% H<sub>2</sub>**





# 2. Test on Gas Pressure Regulators

## With Helium

In-house tightness test with 100% He to analyze performances with actual standard.















































































































## With Hydrogen

Test with hydrogen up to 100%.  
Applied for direct operated and pilot operated gas pressure regulators to evaluate long-term effects.



# 2. Regulators Portfolio Readiness

Range	Regulator	Compatibility		Main applications
		0-20%	100%	
Transmission	Reflux 819	✓	✓	           
Transmission	Aperfux 851	✓	✓	           
Transmission	Staflux 187	✓	✓	           
Distribution MP	Reval 182	✓	✓	           
Distribution MP	Norval	✓	✓	           
Distribution MP	Dival 600	✓	✓	           
Distribution LP	Dival 500	✓	✓	           
Distribution LP	FE	✓	✓	           
Distribution LP	Governors	✓	✓	           
<p><b>NOTE:</b> 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.</p>				

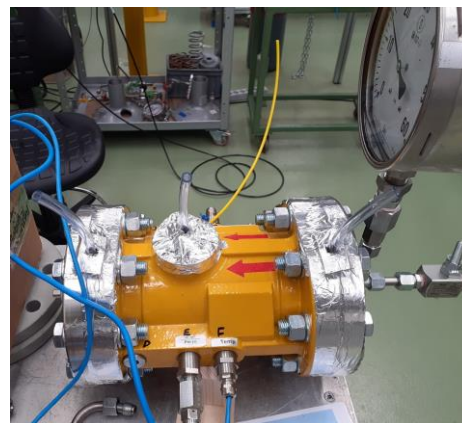
✓ Already available

✓ Upon request

## 2. Test on rotary & turbine meters

### With Helium

In-house tightness test with 100% He to compare performances with actual standard.



### With Hydrogen

Test with hydrogen up to 100%.  
To evaluate long-term effects.

# 2. Laboratory Meter Test

## Joint Industry Project | Groningen (NL)

Evaluate performances of gas flow meters in renewable gas conditions up to 1.000 Sm<sup>3</sup>/hr and up to 32 barg

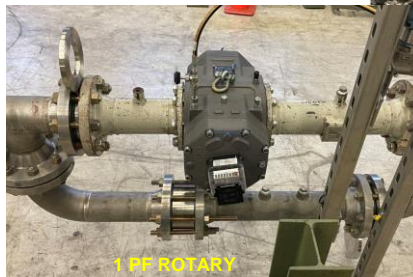
**FioSonic (Ultrasonic Flow Meter)**, turbine meter and rotary meter tested up to 30% H<sub>2</sub> in the flow loop with a reference system to cross-check the meter accuracy performances.



Gas	Test points
N2 ~100%	12
CH4 ~100%	12
Groningen-gas (G-gas)	12
G-gas + 5% H2	8
G-gas + 10% H2	8
G-gas + 15% H2	8
G-gas + 20% H2	8
G-gas + 10% CO2	8
G-gas + 20% CO2	8



1 PF USM



1 PF ROTARY



1 PF TURBINE



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## Pietro Fiorentini HyLab Dedicated for testing H<sub>2</sub> solutions

### Main features:

- Blending NG-H<sub>2</sub> from 0 to 100%;
- Electrolyzers for H<sub>2</sub> production & testing;
- P2Hy testing opportunities;
- Test up to 100 bar;
- Meters and regulators test bench;
- Loop test up to 40 Sm<sup>3</sup>/h;
- Safe proof protection system with BMS.










## Construction Progress

Fully connection: February 2022

Final authorization: March 2022

### Milestones:

- Fire-fighters pre-authorization 
- Building construction 
- Utilities available on-site 
- Alkaline Electrolyzer on-site 
- Piping construction 
- Electronic connection 
- Fire-fighters final authorization 

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# 4. H<sub>2</sub> Pressure Reduction Station



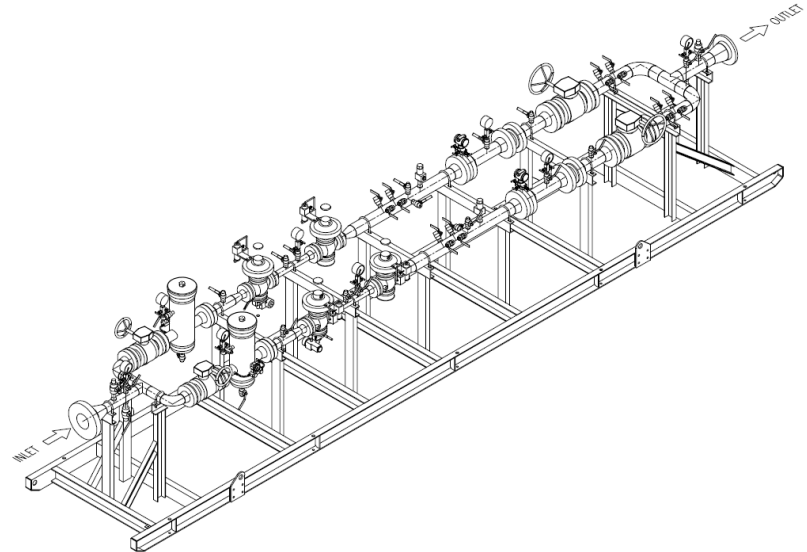
Pressure Reduction Station for **100% H<sub>2</sub>** properly working @Spadedam Test Site (UK) since February 2021.

- Inlet Pressure: 90 barg
- Outlet Pressure: 7 barg
- Max Flow rate: 4.000 Sm<sup>3</sup>/hr

*Pilot operated gas pressure regulators, slamshut valves, ball valves, filters and piping are engineered and manufactured by Pietro Fiorentini.*



PRS installed on site in Spadedam: <https://news.sky.com/story/fuel-of-the-future-inside-the-uks-first-hydrogen-powered-homes-12287892>



# 4. H<sub>2</sub> Pressure Reduction Station

Pressure Reduction Station for **100% H<sub>2</sub>**  
for **KIWA Laboratory** in UK delivered in  
November 2021.



Operating conditions:

- Inlet Pressure: 7 barg
- Outlet Pressure: 75 mbarg
- Max Flow rate: 150 Nm<sup>3</sup>/hr

*Direct operated gas pressure regulators, slamshut valves, filters  
and piping are engineered and manufactured by Pietro Fiorentini.*



# H<sub>2</sub> New Hydrogen Products



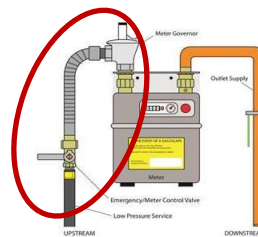
**Hy4Heat Project Target:** Establish if it is technically possible, safe and convenient to replace natural gas with 100% hydrogen in residential and commercial buildings and gas appliances.

## WP10 : Residential solid state meter



- Measures natural gas & up to 100% hydrogen
- Gas Meter specification for hydrogen:
  - Ultrasonic flow sensor able to cover large flow range span

## WP4b : Ancillary system components



# H<sub>2</sub> New Hydrogen Products



Compliance to standard for  
Hydrogen Piping and Pipelines



Fugitive emission



Quarter turn valve – Intrinsically  
lower stem emission compared to  
linear shaft valves



Customized engineering based on  
application and blending



# 4. Hydrogen Grid Injection Unit\*

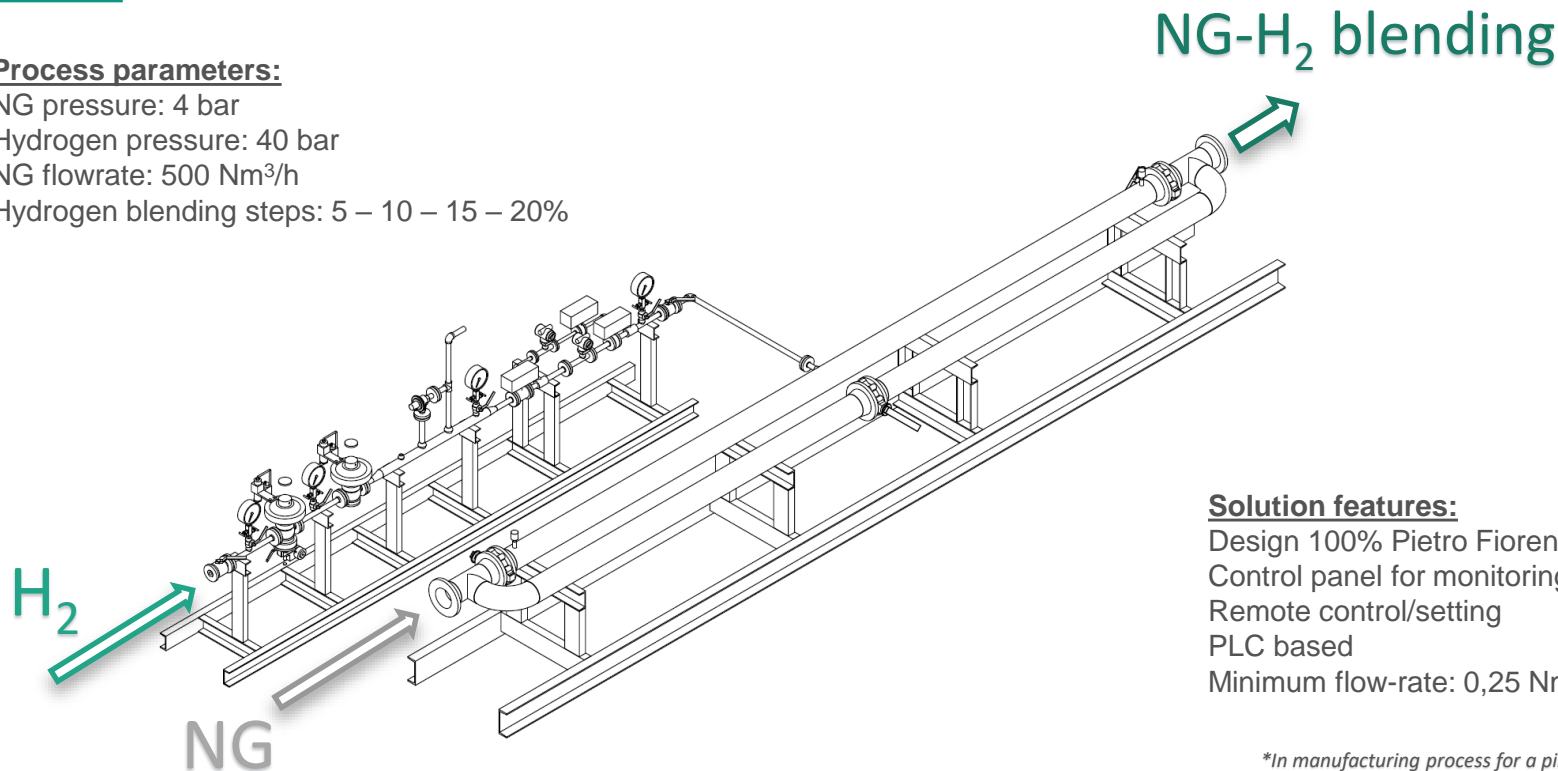
## Process parameters:

NG pressure: 4 bar

Hydrogen pressure: 40 bar

NG flowrate: 500 Nm<sup>3</sup>/h

Hydrogen blending steps: 5 – 10 – 15 – 20%



## Solution features:

Design 100% Pietro Fiorentini

Control panel for monitoring & control

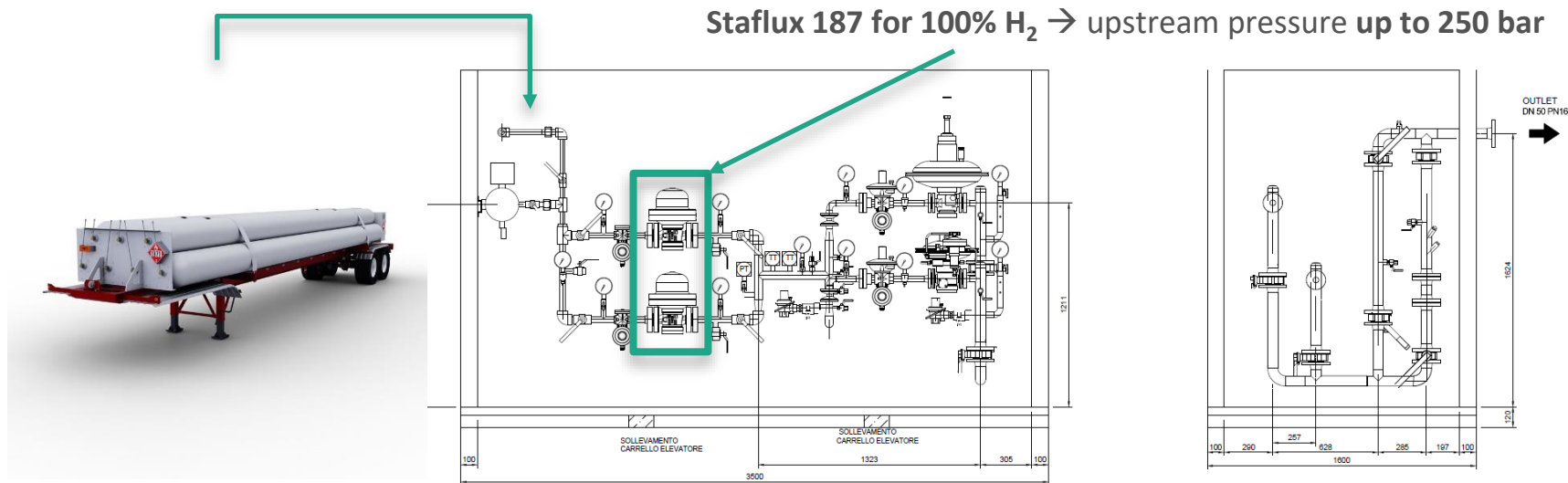
Remote control/setting

PLC based

Minimum flow-rate: 0,25 Nm<sup>3</sup>/h

*\*In manufacturing process for a pilot project in Chile*

# 4. Hydrogen Grid Injection Unit



Rental solution to connect tube trailers for temporary injection of hydrogen

*Designed for an easy transportation and installation at the site*

An aerial photograph of a mountainous landscape. A winding road or path cuts through the green, forested hills. Several power lines are visible, stretching across the terrain. The lighting suggests a low sun, creating long shadows and highlighting the contours of the mountains.

Thank you



**Pietro  
Fiorentini**