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## H2 repurposing and integration into pipelines

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# Snam is one of the main global energy infrastructure company

## Key figures

<b>€ 24 bn</b> RAB + affiliates ('20)	<b>€ 31 bn</b> Enterprise Value	<b>1%</b> Debt cost
<b>€ 1.218 m</b> Net profit Adj. ('20)	<b>~ € 17 bn</b> Market Cap	<b>BBB+</b> Rating

## New companies for energy transition

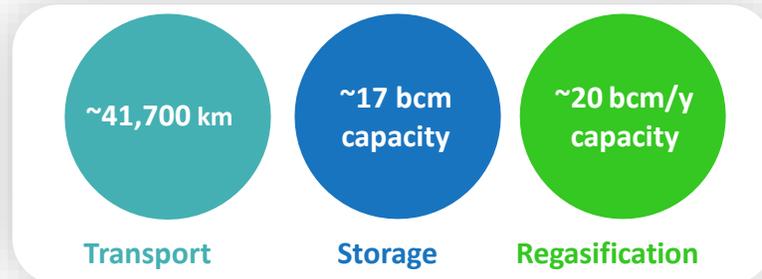


## International associates and presence



Headquarters in **New York City** and **New Delhi**

## Natural gas



**30.3%**



**69.7%**

**Free float**  
~80K investors



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# SNAM - An Italian and European leader in gas infrastructures



- NATIONAL GAS PIPELINE NETWORK
- COMPRESSOR STATIONS
- STORAGE FIELDS
- REGASIFICATION TERMINAL
- > IMPORT POINTS

## Integrated operations in Italy



### TRANSMISSION

- 32.767 km of gas transmission pipelines
- 13 compressor stations (973 MW installed power)
- 75,77 Bcm injected into the network



### STORAGE

- 9 storage fields (each with a compressor station and a treatment plant)
- 17,0 bcm of total storage capacity (including strategic storage)



### LNG

- 3 small regasification terminals
- 2 RFSU under construction (adding 5+5 bcm)

## International associates





# Asset readiness: an overview



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# Asset transition: From hydrogen asset readiness...

## ~ 33k km of H2 ready pipelines

- **99%** of the **network** is ready to transport 100% H2 <sup>1</sup> o/w **70%** with **no or limited reductions** on max operating pressure
- **Roadmap** to obtain certification by



## Compression stations

On field tests with **H2-NG blending** mix up to 10% on key Gas Turbines (>50% installed GT)



## ~17 bcm of storage capacity

- **Verified the possibility of storing up to 100% H2** in a lab test unit (2 fields)
- **Detailed engineering for deeper layer of F. Treste field** to be completed by **June 2023**
- **Industrial-scale tests** on tubular material, wellhead & downhole valves planned in 2023

## Gas Metering & other component

- Coordinating a **project** focusing on the **metering** ability to accurately measure H2NG mixtures
- **H2 ready gas chromatographs to be installed from Q1-23** at key foreign interconnections

## Final users

- **Joint initiative with ENEA and DSOs** to assess the H2 blend readiness of the whole infrastructure chain, down to residential users
- **HyTecHeat**, EU research project aimed at adopting hybrid heating technology (based on NG with progressive H2 utilization) in downstream



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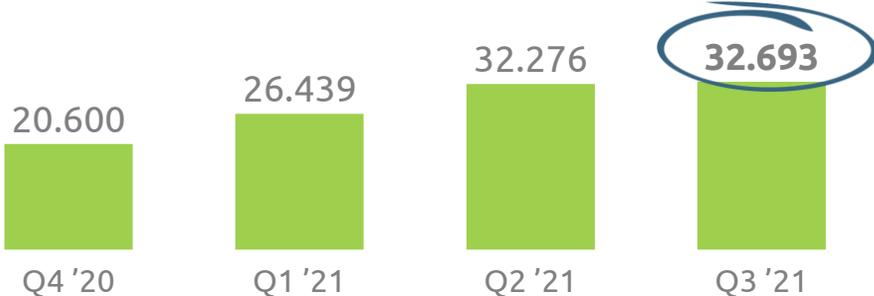
1. Based on Option A of ASME B31.12.

**Plan on track for assets repurposing**

# Snam pipelines are verified for H2 transport

## 100% of Snam network verified for H2 transport

(km, cumulated)



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**Snam network** verified according to ASME regulation

### ≈ 99% of the network

is ready<sup>1</sup> to transport 100% H2  
 70% with no or limited reductions on max operating pressure.  
 Future revisions of the technical standards are expected to overcome limitations



1. Based on Option A of ASME B31.12.

## Setting standards for H2 transport



First example in EU of network H2 readiness certification



Co-operation with other European TSOs to share test results, analysis, studies



### Collaborations with universities and institutions

Collaboration with fire department and universities to develop technical standards for H2 transport



# Longer term potential for H2 backbone...

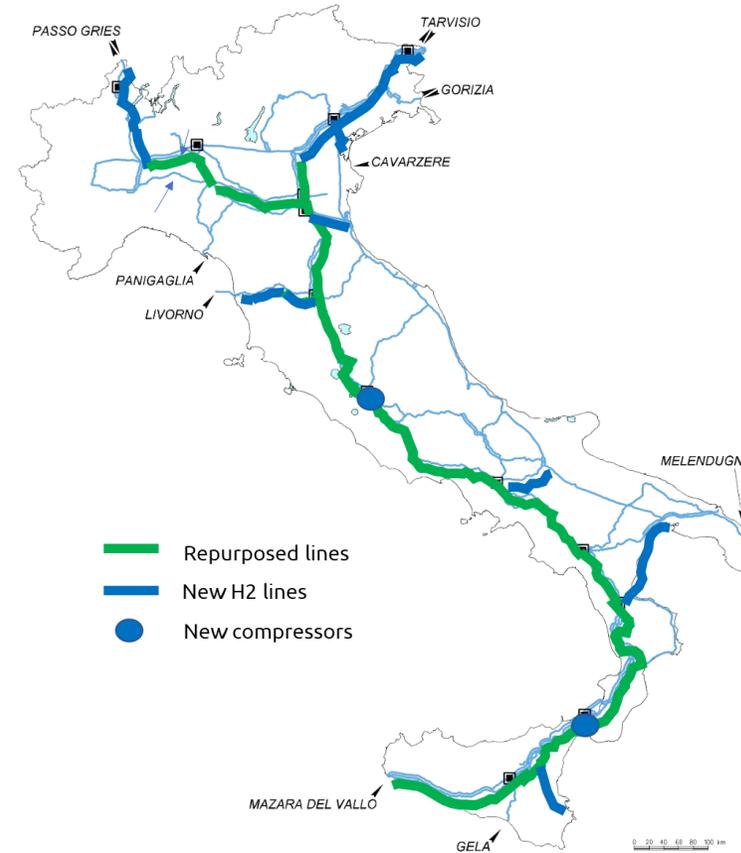
## H2 backbone

Ca **2,700km** of H2 network to bring production from north Africa and Southern Italy to consumption areas

- **75%** of km from repurposing
- **50MW** for compression stations to ensure suitable pressures on the network

## Key figures

- Cost of repurposing **ca €0.6m** per km
- Cost of new build **ca €2m** per km



Our project for an Italian H2 backbone



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# The European Hydrogen Backbone – a vision for a truly interconnected H2 market for Europe

- The European Hydrogen Backbone (EHB) is a **pan-European dedicated hydrogen pipeline transport network**, connecting hydrogen supply and demand at an international level and create a EU market
- **23 gas infrastructure companies from 21 countries** (19 European Member States, UK and Switzerland).
- The backbone has expanded in length: the updated network covers a **total distance of around 40.000 km**.
- The extended backbone requires an **estimated total investment cost of € 43-81 billion by 2040**, based on using **69% of repurposed natural gas pipelines** and 31% new pipeline stretches.
- **Levelized transport costs amount to 0.11-0.21 €/kg per 1000 km**





# Asset readiness: case studies



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# Asset readiness: H2 injection campaign



In 2019, Snam successfully completed two injection campaigns injecting H2NG blend into the network, with percentages of 5% and 10% by volume. The campaigns were aimed at verifying the readiness of existing assets with respect to these blending percentages.

These H2NG blends were used by two industrial offtakers (a pasta factory and a water bottling plant) for the production of heat within their factories



With this experimentation, Snam has initiated the transition for the transport of ever-increasing volumes of hydrogen in its assets, even creating an **internal standard for the transport of hydrogen in pipelines**



# Turbochargers – Full scale Factory/Field Tests

## Factory test - TC BHGE , model NOVA LT12 (New Supply) for Istrana Compressor Station BHGE

- factory test in Florence to verify gas turbine operation fueled with H2NG mixture (H2 up to 5% in volume and variable over time)



### Factory Test Procedure

ID	Phase	FUEL
1	Start	Natural Gas (NG)
2	Warm up	NG
3	Operation	NG
4	Full load	NG
5	Full load	NG + 3% H2
6	Full load	NG + 5% H2
7	Partial load (75%)	NG
8	Partial load (75%)	NG + 3% H2
9	Partial load (75%)	NG + 4% H2
10	Partial load (50%)	NG
11	Partial load (50%)	NG+ 3% H2
12	Partial load (50%)	NG + 4% H2
13	Partial load (50%)	NG
14	Stop	NG



## Factory test - TC BHGE, model PGT 25 for Sergnano Compressor Station (Storage plant)

- Test procedure to verify gas turbine operation (H2 up to 5% in volume and variable over time)

## Field test – NOVA LT12 and PGT 25

- Test procedure for a field test to verify gas turbine operation (H2 up to 10% in volume and variable over time)

# Storage: tests confirm the possibility to store H2 in depleted fields

## Test Results

### Mineralogical Analysis

Exposure of reservoir & cap-rock samples to gas mixture with increasing H2 blend

- » ✓ No risk of dissolution / alteration of reservoir & cap rock minerals in **100% H2 environment**

### Diffusivity Tests

Gas diffusion measurements for cap rock samples representative of Stogit fields

- » ✓ Confirmed gas-tightness of reservoir for blends **up to 100% H2**

### Microbiological Analysis

Microbiological reservoir characterization based on bio-chemical kinetics

- » ✓ No risk of H2S production or methanation in the reservoirs by microbial activity

### Test on Well Specimens

Testing on wells material

- » ✓ No impact on cements **up to 100% H2** and to elastomeric up to 20% H2\*

## Tests with multi-reactor

**Ongoing tests in a reactor** on microbiological activity with **up to 50% H2 blending** (up to 100% in 2022) at reservoir pressure & temperature conditions



### Pilot test

**Development of a pilot test in Snam storage sites** to confirm test results in the long-term behavior

Tests confirm it is possible to store H2 in our natural gas depleted fields

\* Ongoing test on 100% H2.

# Snam Italian H<sub>2</sub> projects

## The collaboration with Iris Ceramica Group



Snam and **Iris Ceramica Group** have signed a MoU in order to develop a **the first H<sub>2</sub>-based factory ceramic factory**. The company is responsible for 90% of the national ceramic production and the new factory will be 100% hydrogen ready.

## Decarbonization of steel making sector



On may 2021, within the Forgiatura A. Vienna plant, the **first global NG-H<sub>2</sub> blend test composed by 30% of H<sub>2</sub>** has been performed in forging processes employed in industrial scale steel manufacturing.

**Tenaris, Edison and Snam** will collaborate to implement the most suitable solutions for the **production, distribution and use of green H<sub>2</sub>** at the Tenaris mill, contributing their skills to invest in the best available technologies.



## Airports decarbonization



The agreement between **Snam and Sea Milano** for supplying **green H<sub>2</sub> for the refuelling of vehicles** used for internal and external transport at Malpensa Airport

**Snam and Sagat** (Turin Airport) have signed a termsheet for **the installation of 1.2 MW FC to decarbonise the production of electricity and heat consumed at the airport**



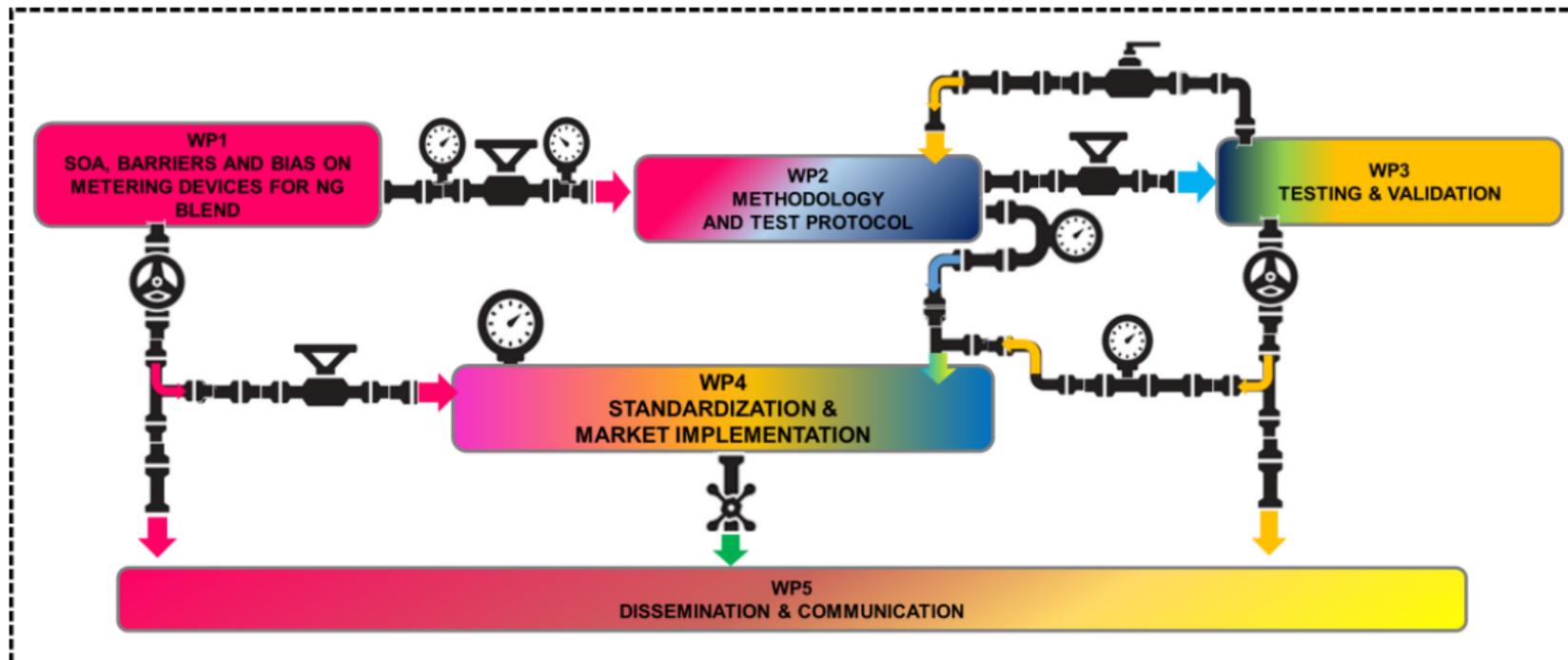
## Valcamonica project

On 9th December 2020 FNM, a2a and Snam signed an MOU for the **conversion from Diesel to Hydrogen of the railway service on the section Brescia - Iseo – Edolo**. The project foresees the commissioning of **14 Ilint-coradia hydrogen trains from Alstom by 2024**



# THOTH2 project

novel meTHOds of Testing for measurement of natural gas and H2 mixtures



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EUROPEAN PARTNERSHIP

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# Q&A SESSION



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