energy to inspire the world

The role of Infrastructure in Energy Transition

Biennale della sostenibilità Venezia, 13 ottobre 2023

Dina Lanzi

Decarbonization Technical Development

H2it Vice president

SNAM - An Italian and European leader in gas infrastructures

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

Interconnector · GAS CONNECT AUSTRIA · TAG Trans Austria Gasleitung · ADNOC · Trans Adriatic Pipeline · DESFA · TERĒGA

Snam started a re-positioning process on new businesses focused on ecological transition

New businesses
for energy transition

ITM POWER · DE NORA · dCarbonX · STOREGGA

Decarbonization (H2 and CCS)

cuboGas · JV Iveco · JV API · JV ENI

Snam4Mobility

RENERWASTE · IES

Snam4Environment

ENERGY SOLUTION TEP · TEA · MECI · EVOLVE

Renovit

Arbolia

System needs: addressing the energy trilemma

SYSTEM NEEDS

Security of Supply

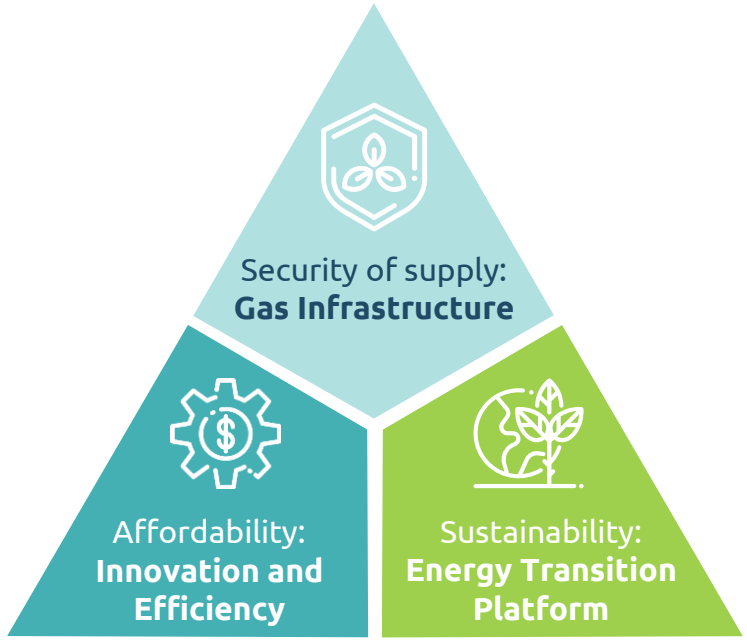
Develop the **gas value chain infrastructure** to enhance resilience through flexibility and adequate sizing

Sustainability

Accelerate **energy transition** through green and low-carbon gases development

Affordability

Ensure energy cost-competitiveness through **innovation efforts and efficiency initiatives**



energy to inspire the world

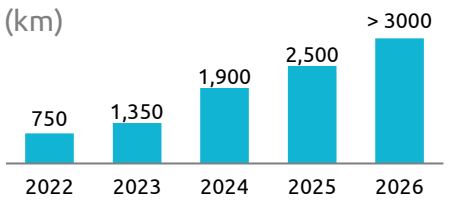
Note: Reference to article 194 of the Treaty on the Functioning of the European Union.

Asset transition: From hydrogen asset readiness…

~ 33k km of H2 ready pipelines

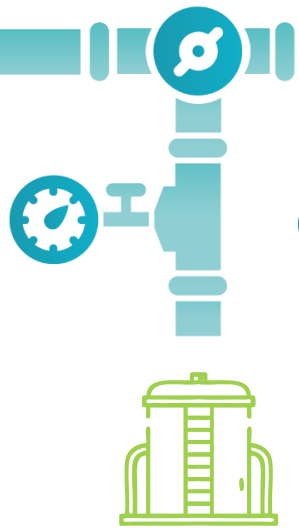
- **99%** of the **network** is ready to transport 100% H2 [1] **o/w 70%** with **no or limited reductions** on max operating pressure
- **Roadmap** to obtain certification by

RINA Model completed and validated



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

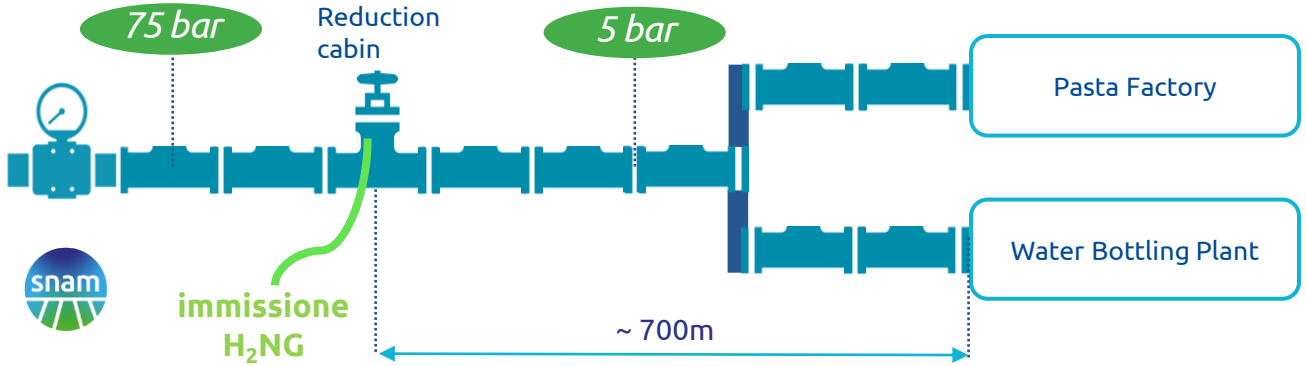
Plan on track for assets repurposing

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

First Hydrogen Injection in the gas network– Contursi campaign

Injection of a blend hydrogen- natural gas on a portion of Snam network in Contursi Terme (Salerno).

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.



✓ **Normal functioning of regulation plant (piping e instruments)**

✓ **Normal functioning of the pre-heating section (heaters)**

Projects: some on-going initiatives

End user enablers

GIVA GROUP, snam, RINA

On may 2021, within the Forgiatura A. Vienna plant, the **first global NG-H_2 blend test composed by 30% of H2 has been performed in forging processes employed in industrial scale steel manufacturing.** The experimentation on plant furnaces has been performed with success on site, after a series of studied and laboratory tests lasted almost a year

Focus next slides

The **'Divina' project** (Decarbonisation of the Glass Industry: H_2 and New Equipment), **co-ordinated by Snam, RINA and Bormioli**, aims to **reduce emissions in the glass melting stage**. In the working group also STARA GLASS, Università degli Studi di Genova, Stazione Sperimentale del Vetro, IFRF Italia, SGRPRO and RJC SOFT collaborate.

Bormioli Rocco, GRUPPO BORMIOLI LUIGI GLASSMAKER, snam, RINA

Industrial & Services

Focus next slides

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**

FNM, snam, a2a

Tenaris, snam, EDISON

Tenaris, Edison and Snam will collaborate to identify and implement the most suitable solutions for the **production, distribution and use of green hydrogen at the Tenaris mill**, contributing their skills to invest in the best available technologies.

Snam is currently involved in different projects in the airport sector aimed at **decarbonising the production of electricity and heat consumed at the airport** and supplying **green H2 for the refuelling of vehicles** used for airport internal and external transport

IRIS CERAMICA GROUP, snam

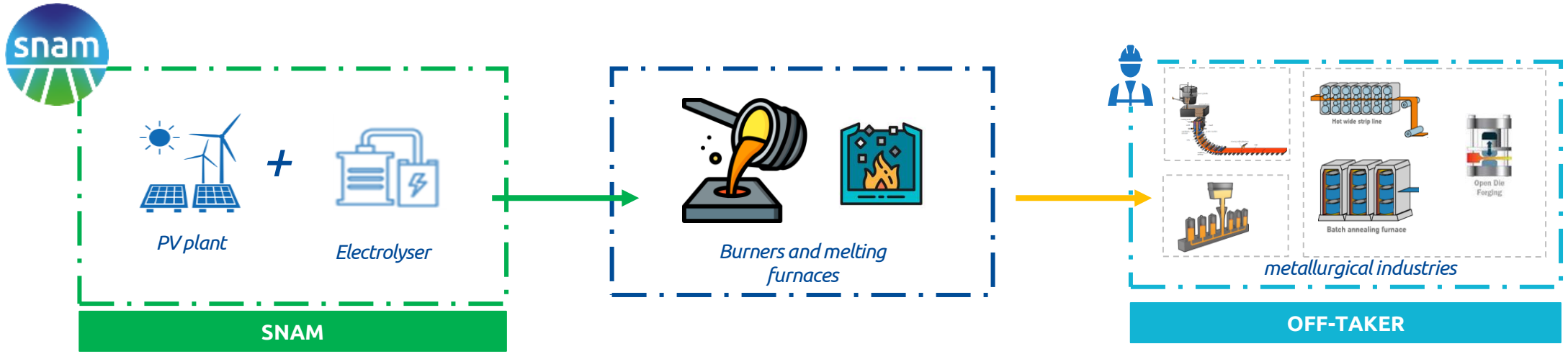
Focus next slides

Snam and **Iris Ceramica Group** have signed a MoU in order to develop a **new green H2 and gas fueled ceramic factory**. The company is responsible for 90% of the national ceramic production and the new factory will be 100% hydrogen ready.

H_2aaS: Demo testing platform on site for industrial decarbonization

***Snam** can supply **a portable testing facilities** the to test and adapt equipment and processes on site, **guaranteeing the feasibility of the decarbonization process** in the industrial plant through hydrogen*

Project scheme



Partner roles

SNAM		OFF-TAKER
• *Supply and O&M of the electrolyser* • *H_2 as a service (e.g. tolling)*	• *Test of furnaces, burners* • *h2 impact on products* • *Process and equipments modification & data-collection*	• *Supply of electricity & utilities* • *Product testing*

Snam's future multi-molecule Energy System

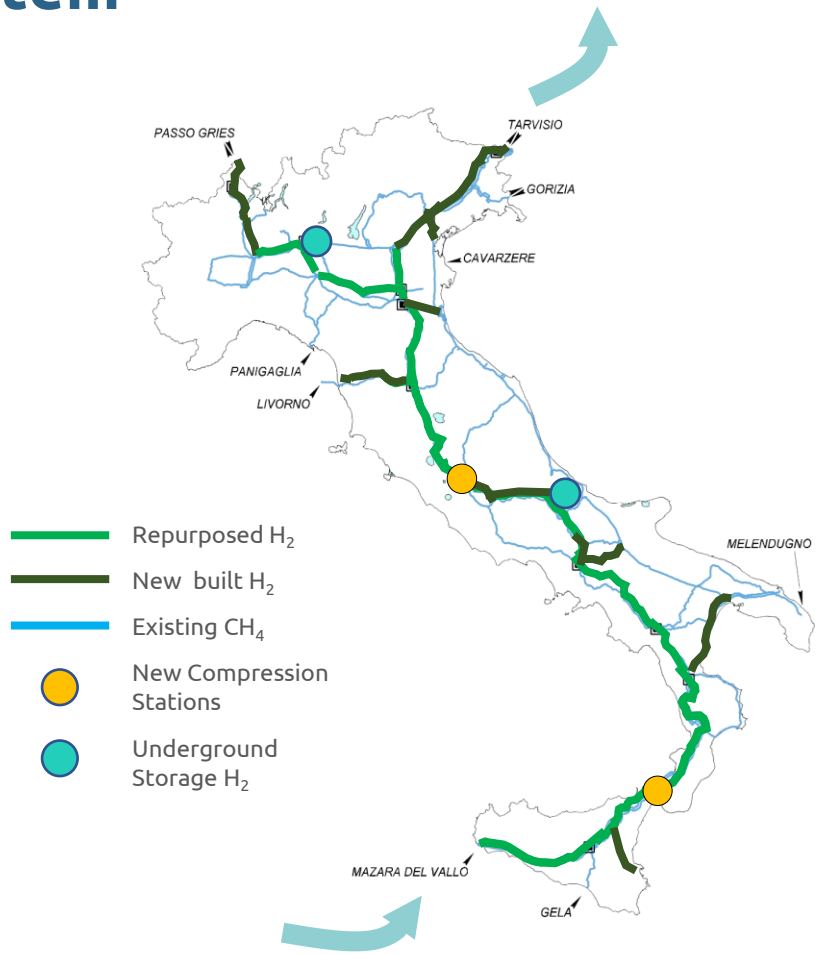
H2 BACKBONE

- **€4bn** cumulated capex throughout 2030-32 to serve Italian market demand (+ upside from export)
- **2300 km** of H2 network o/w 70% repurposed
- **Up to 500 MW** compression stations to enable export

H2 STORAGE

- **€3bn** cumulated capex to 2030-35 (seasonal and intra-day)
- **1.5 bcm** of capacity
- One new site and reconversion of one existing field

Decarbonized gas and H2 package promoting a regulated model



Snam infrastructure is core for the SouthH_2 Corridor

energy to inspire the world

snam

Trans Austria Gasleitung

GAS CONNECT AUSTRIA

bayernets
energie transport systeme

Italian H_2 Backbone & Corridor

Institutional	Midstream partners	H2 Production & offtake partners supporting Snam's backbone

Key takeaways

- **Wide commitment** across all parts of the value chain with ongoing collaboration & working groups (>20 companies)
- **High proportion (70%) of repurposed** midstream infrastructure
- Enables **renewable**, **competitive & scalable H_2 production (>50 GW potential in Tunisia alone + Algeria + ITA, DE, AUT, SK, CZ)**
- **Several Mtpa of** production, midstream and offtake supported by LOIs, with scope for much more. Midstream capacity enables **up to 20%** of the 10 Mtpa REPower EU import target.
- Promotes **sustainability**, **competition** (multiple supply sources & network users) & **market integration**

References for offtake total along route:
Italy: Snam & Terna, Scenarios 2023-2032 (publicly available), 2022
Austria: Austrian Hydrogen Strategy, 2022
Bavaria: NEP Gas 2022-2024
Slovakia & Czech Republic: European Hydrogen Backbone 2022

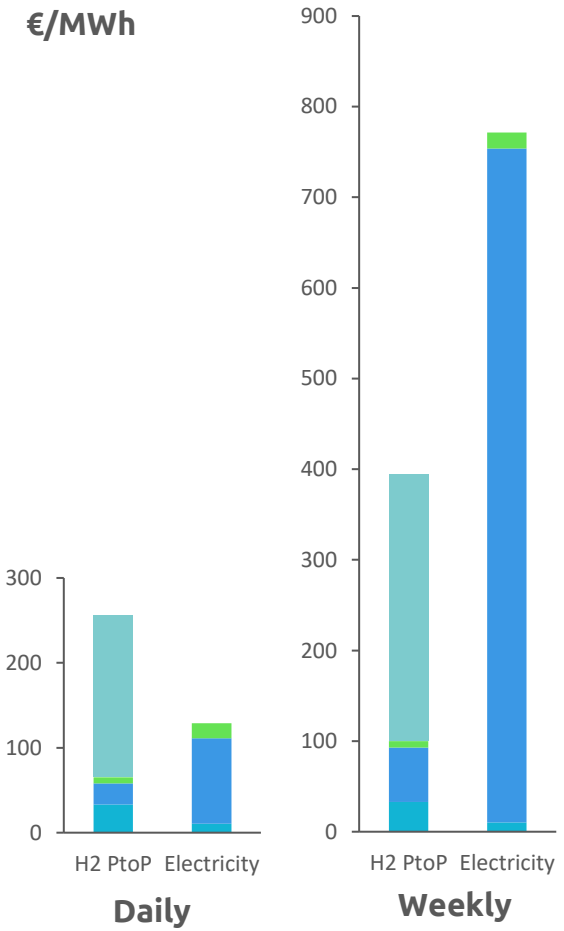
Green gasses can leverage efficient energy storage

Green molecules provide competitive solutions for storage

Levelized cost of storage for different technologies[1], €/MWh

		Today capex range	Daily	Weekly	Monthly	Yearly
Electricity storage	Li-ion battery[2]	250 €/kWh	110	770	3.000+	10.000+
	H2 tank[3]	5-20 €/kWh	20 - 30	50 - 70	100 - 200	1.000 – 2.000
Hydrogen storage	H2 salt cavern	0,4 €/kWh	2	3	6	40
	H2 in depleted field	0,1 €/kWh	3	18	20	30
Biomethane storage	CH4 depleted field	0,05 €/kWh	2	4	4	5

H2 PowerToPower costs half vs batteries for weekly cycles



1. Assumptions: Cost of capital 8%, Exchange rate 0,84 €/$.
2. Large scale Li-ion battery with 4h duration (BNEF cost assumptions: 300 $/kWh).
3. Ranges refer to Compressed H2 (350-700 bar) tanks and LH2 tanks.

Source: BNEF, Snam team analysis.

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

Politecnico di Torino · Politecnico di Torino SEASTAR · CO_2 Circle Lab · iit Istituto Italiano di Tecnologia

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

* Ongoing test on 100% H2.

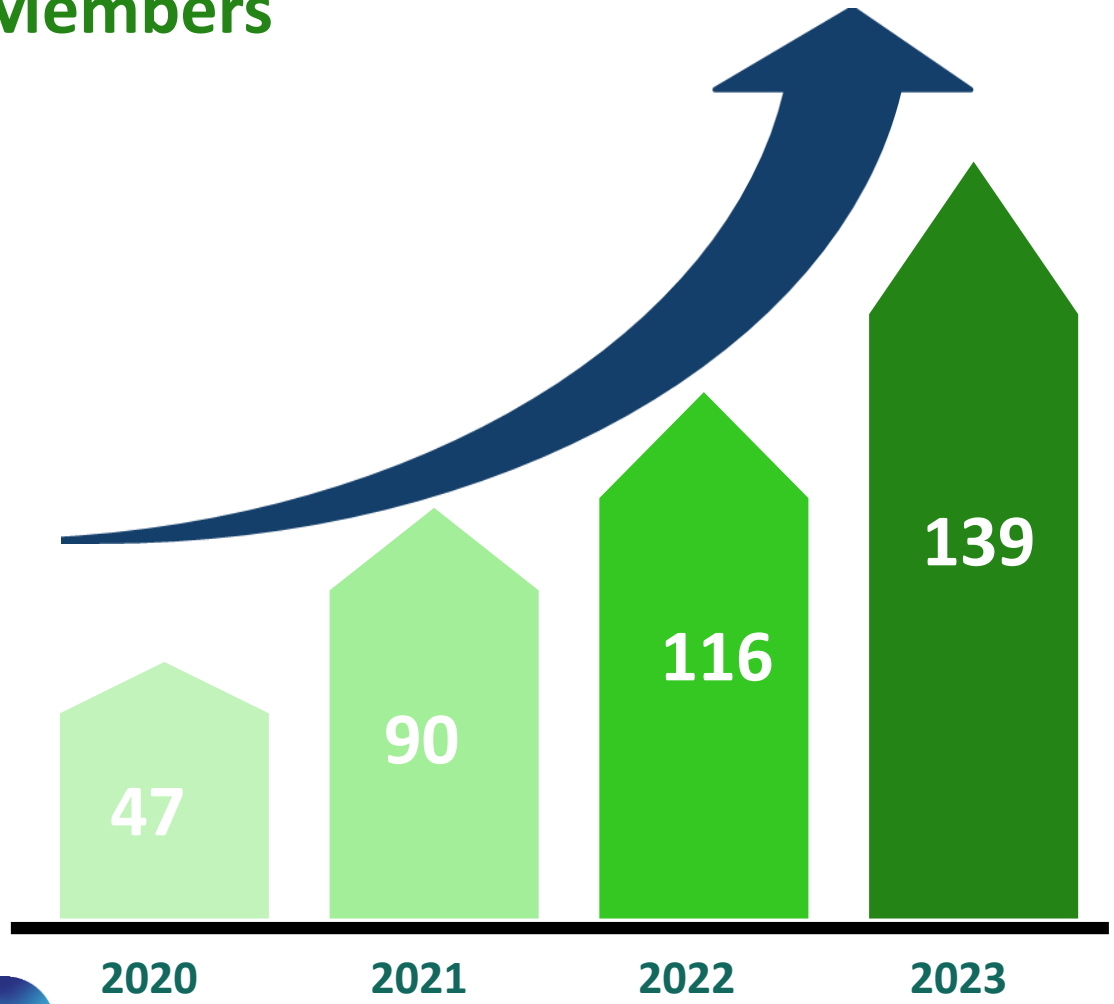
energy to inspire the world

snam

H2IT

We are the voice of the industry and research centers working in the hydrogen value chain. Our mission is to promote the development of an italian hydrogen market, from production to storage and final uses.

Members



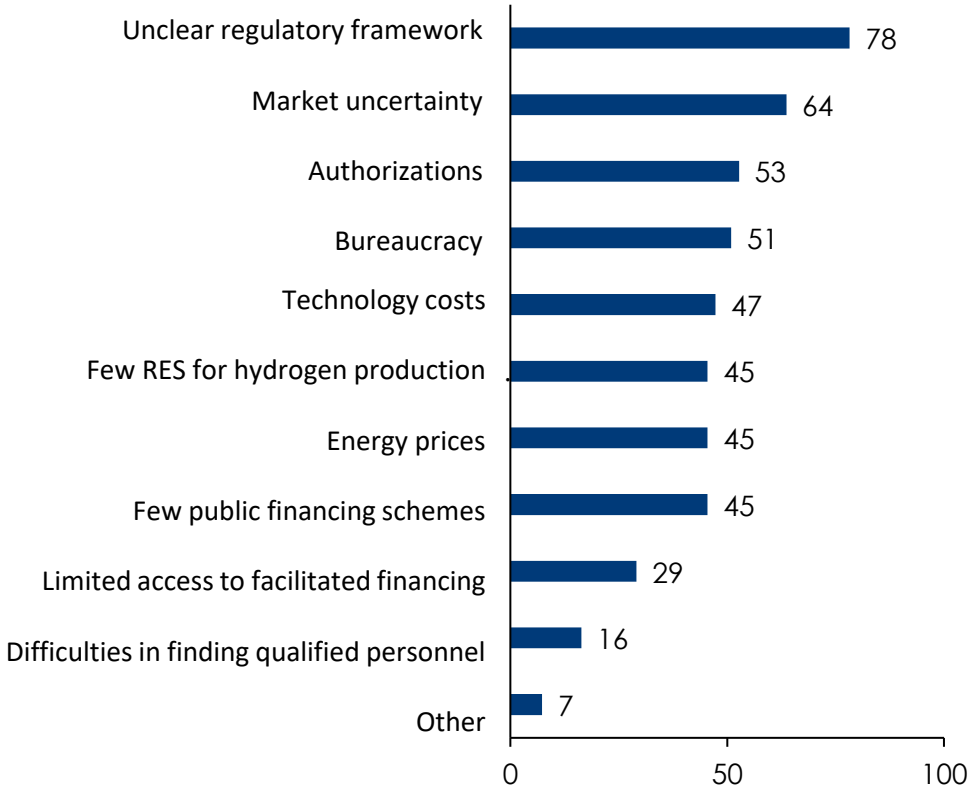
snam energia per ispirare il mondo

Who we are - Our members

We are the voice of the industry and research centers working in the hydrogen value chain. Our mission is to promote the development of an italian hydrogen market, from production to storage and final uses.

H2IT Observatory
Obstacles: clearer regulations and public support for demand generation through training are crucial levers for sectoral development...

Main challenges encountered in Italy (% of companies, multiple answers possible)



Necessary and priority measures (% of companies, multiple answers possible)