



Introducing H2 Into Energy Network

H2 ASSET READINESS

Agenda

- **Snam overview**
- **H2-NG Snam approach**
- **Pipelines**
 - **Feasibility & pilot phase**
 - **Standards upgrade**
- **Compressor Stations**
- **Storages**



Snam overview

Europe's largest natural gas utility...

€ 22,4 mld

Regular Asset Base
(incl. associates)

~ € 28 mld

Enterprise Value

~ € 1010 mln

Net Profit Adj. (2018)

~ € 16 mld

Market Capitalization



59%



国家电网公司
STATE GRID
CORPORATION OF CHINA

35%

National
Foundations



6%

cdp•reti

30.3%



69.7%

Free float

~80,000 investors

International associates in Europe



TEREGA



GAS CONNECT
AUSTRIA
Energy, everywhere.



Interconnector



DESFA
Hellenic Gas Transmission System Operator S.A.



Trans Adriatic
Pipeline



Trans Austria Gasleitung

SME vertical integration



a Snam
company

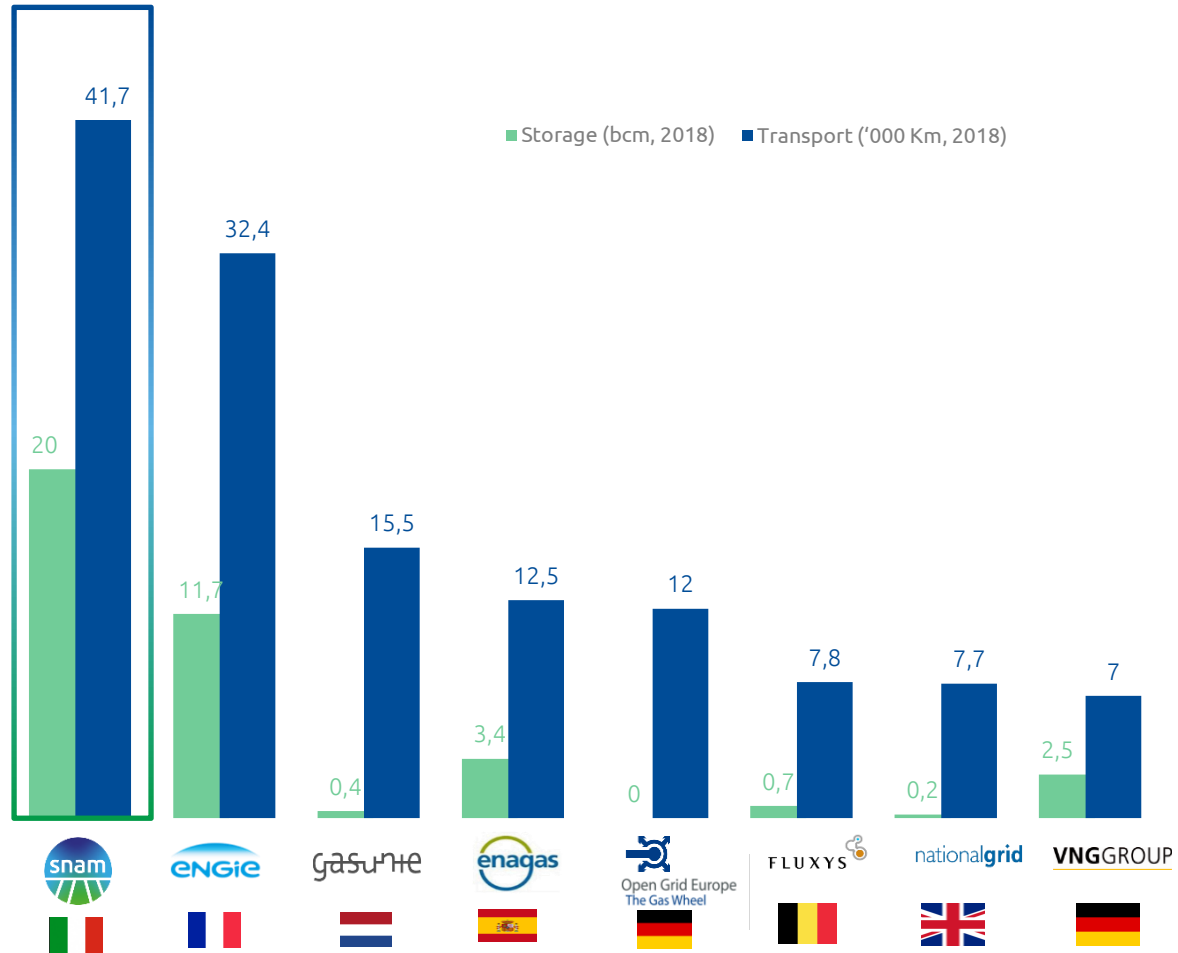


TEP
a Snam company

cuboGas

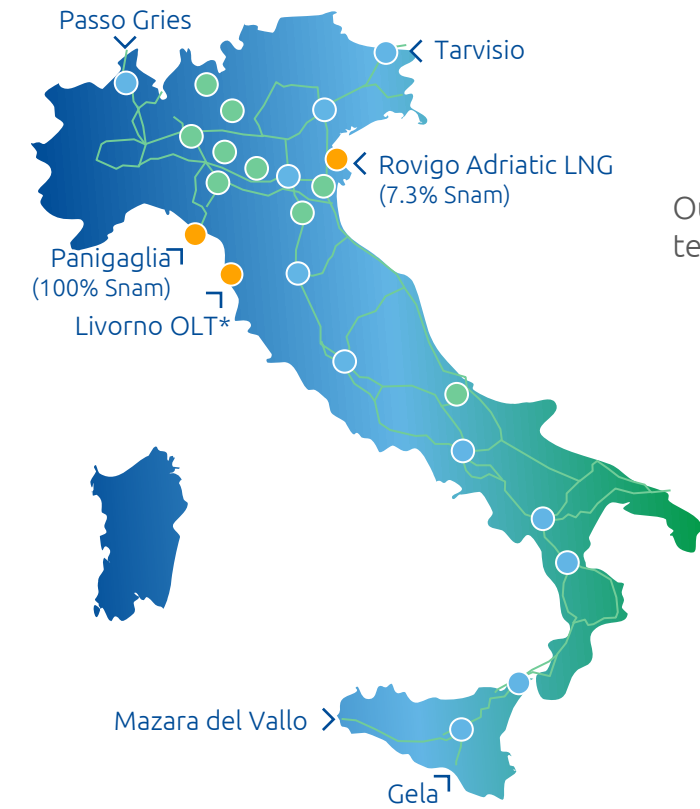
for the energy transition

... leader in gas infrastructure



NOTE:
Data referred to Snam and its subsidiaries (Teréga, TAP, IUK, TAG, Desfa). Countries are France, Austria, Belgium, UK, Greece, Italy.
(Source: Snam)

- National pipeline network
- Compression stations
- Storage sites
- Regasification terminals
- > Entry points

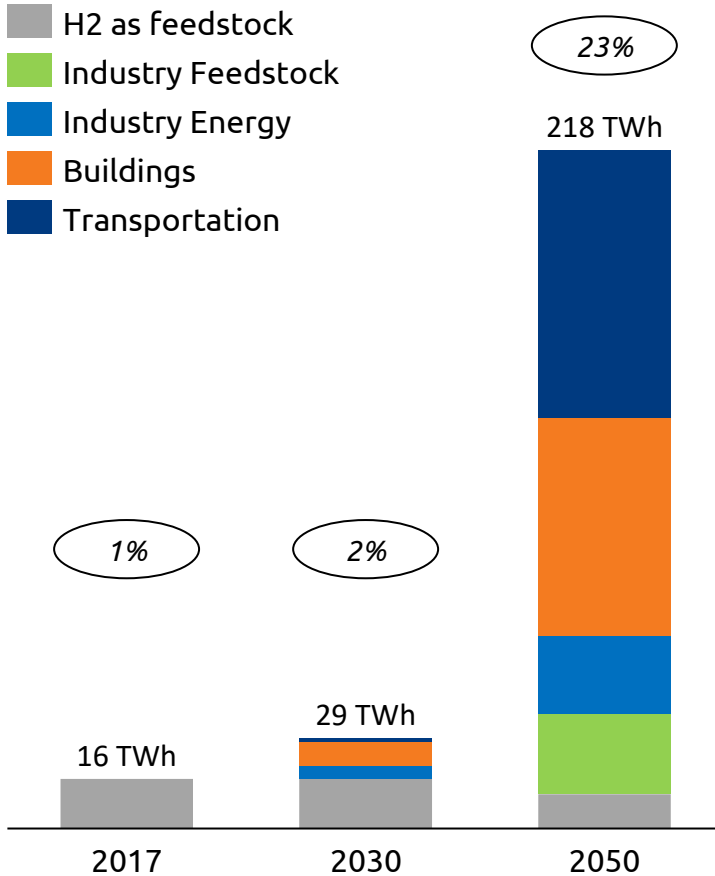


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Our regasification terminals in Italy

Snam owns 100% of Panigaglia LNG terminal and 7.3% of Adriatic LNG
*On 26th Feb 2020, Snam completed the acquisition from Iren Group of a 49,07% stake in the share capital of OLT Offshore regasification terminal

Snam and the hydrogen opportunity: 3 streams of action



1

Asset Readiness

- **Pipelines:** network is largely hydrogen ready, key reason to underpin replacement;
- **Components:** gas chromatographs and other minor instruments would need replacing (< 1% RAB);
- **Gas compressor units:** testing the impact of a 5-10% blend;
- **Geological storage sites:** ongoing analysis and research;
- Ongoing assessment of use of **membranes to separate GN and H₂** out of H₂NG blend.

Negligible investment to reach 5-10% H₂NG readiness

Ongoing investment in the grid «Hy-ready»

2

System Design

- **Long-term scenarios:** Expected key role of hydrogen in the energy mix;
- **Grid evolution:** Development of pathway analyses with increasing share of green gases;
- **Technical standards:** Involvement in focus group to develop common rules on H₂ in Italy and Europe.

Ongoing work

to support long-term grid planning

3

Value chain development

- Evaluating potential opportunities/pilot projects to scale up clean H₂ production and use;₂
- **Potential partnership** with other operators of the value chain;
- Scouting for promising **technologies**.

Scouting the market for investment opportunities and partnership

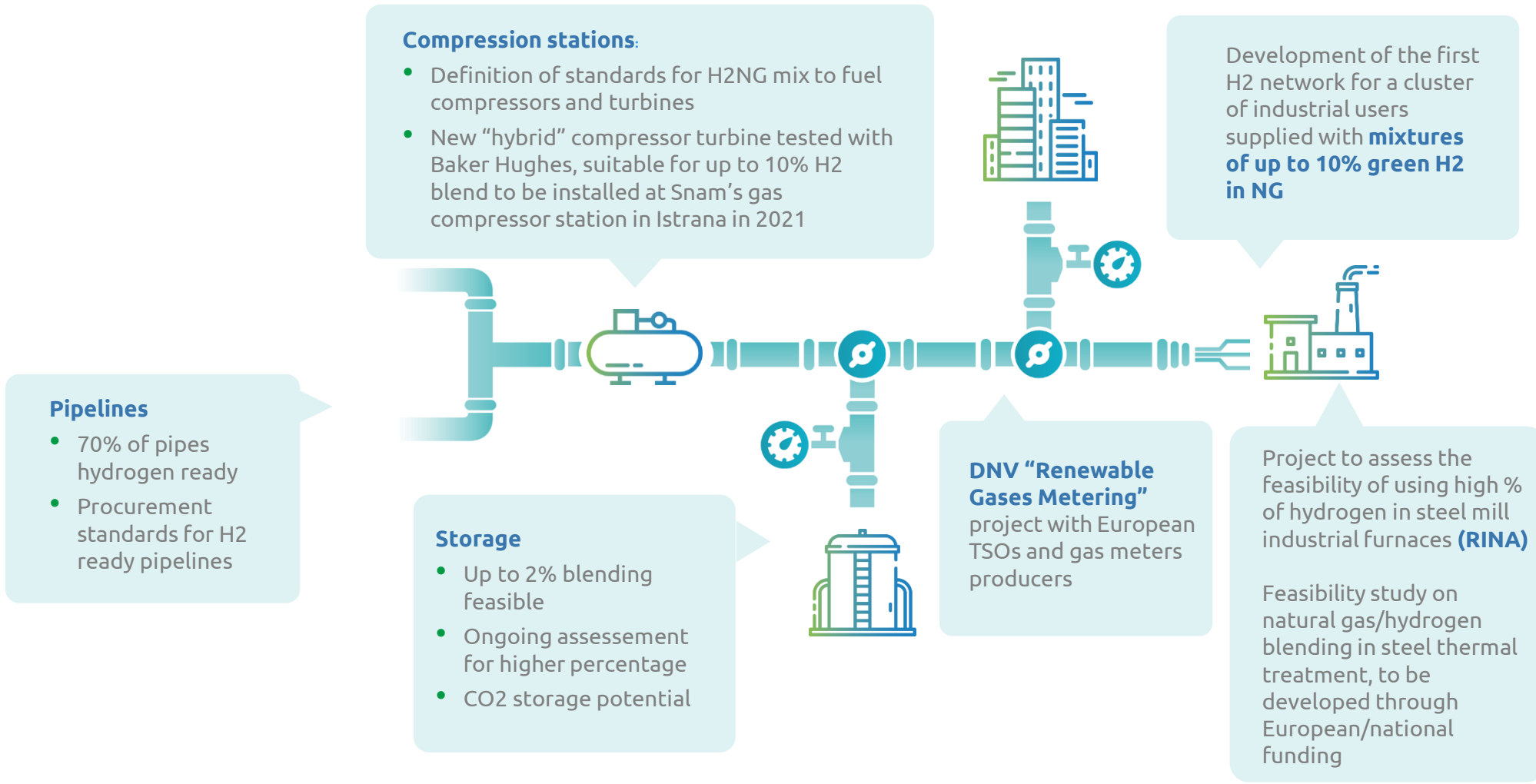
Covering all H2 Value Chain





H2-NG Snam approach

H2-readiness along the infrastructure value chain



Sector collaboration

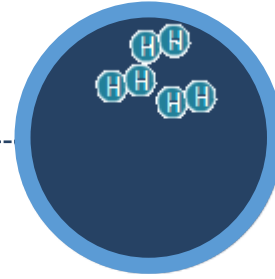
H2 Gas Asset Readiness (H2GAR) cooperation between EU TSOs. 6 working groups on pipelines, compressor stations, separation systems, metering, safety and underground storage

European H2 Backbone plan – done in collaboration with 11 EU gas infrastructure companies - for a dedicated hydrogen transport infrastructure

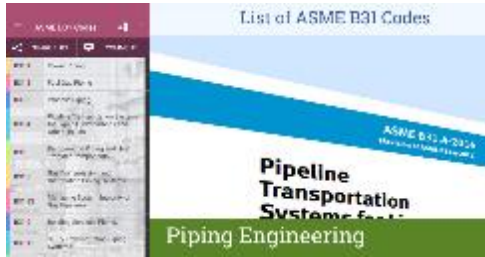
Working for a «Hy-ready» network

H2NG Snam approach

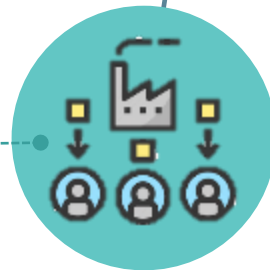
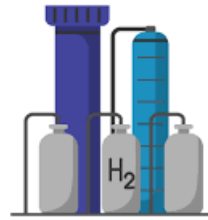
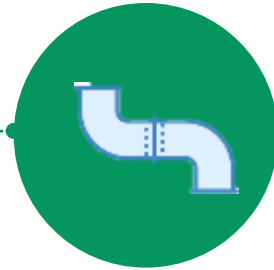
Carbon Steel pipelines
behaviour vs. H₂



International\national
H₂ Standards



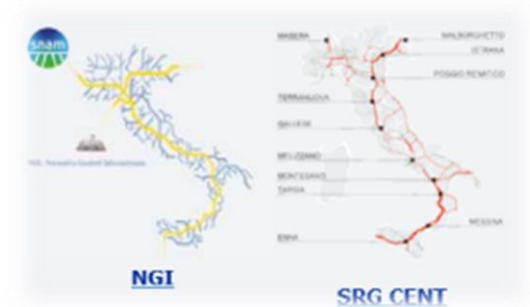
Supplier
management



Pilot Projects



Snam Technical
Standards





Pipelines

General assessment: features and constraints



Goal

Injection into a **portion of the network** of a **mixture of H2NG up to 10 % of volume** to check compatibility of current infrastructure to transport **H2NG mixtures**.

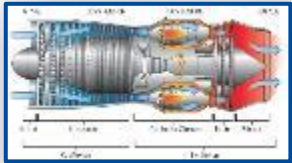
CONSTRAINTS:



CNG distributors



Underground storage in porous rocks



Gas turbines of compressor stations



End Users with production processes sensitive to gas quality

Mixture features (Natural gas up to 10% H2)

- ✓ **Quality characteristics** set by the Ministerial Decree 18 May 2018 for the natural gas transport: **respected**;
- ✓ **Materials HE (Hydrogen Embrittlement): checked**;
- ✓ **ATmosphères ed Explosives zones identification: checked**.

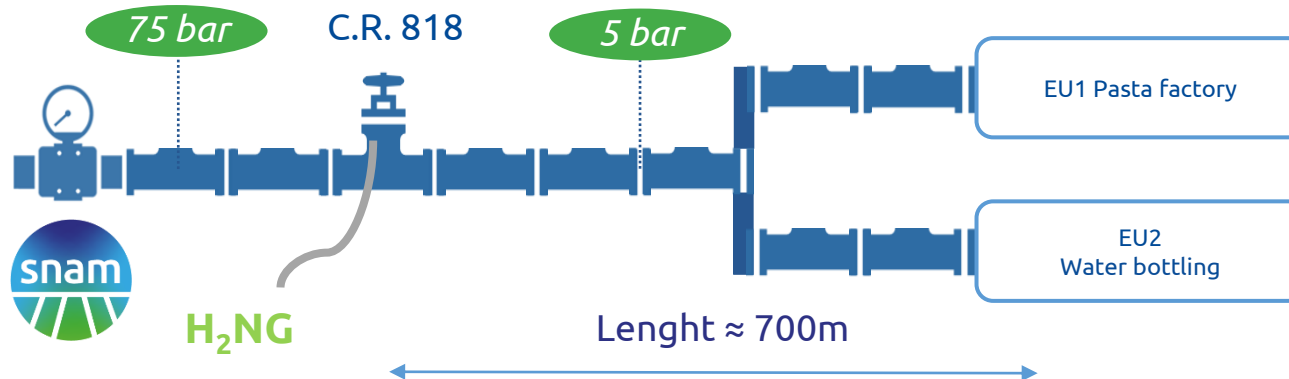
Public bodies Involved

- ✓ **National and Local Fire Departments**

Hydrogen injection into the natural gas network

Injection campaign of a hydrogen-natural gas blend (H2NG) in a portion of the Snam grid

Injection campaign of a **H₂NG blend with H₂ at 5%-10% in volume** in a portion of the Snam gas transport grid, in order to verify the readiness of the existing asset with respect of considered blends transportation



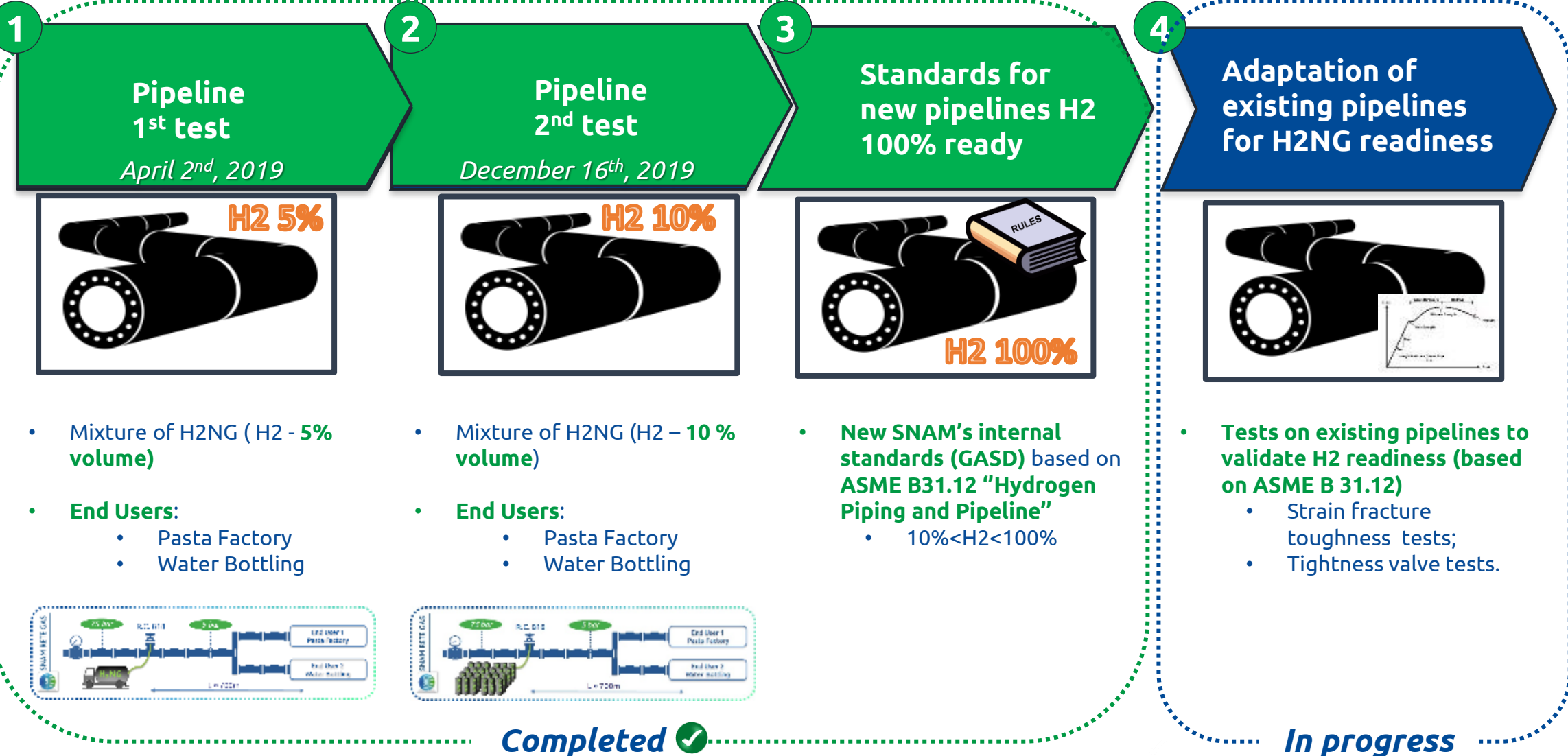
Regular working of Snam Reduction plant (piping and instrumentation)



Regular working pre-heating section (gas boilers)



Snam approach to pipelines readiness





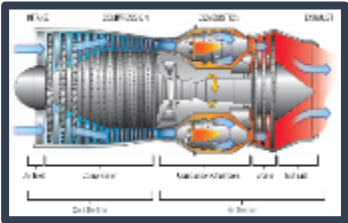
Compressor Stations

Pilot Projects

Pilot studies/projects to evaluate the impacts of H2NG mixtures on the existing network

TC SNAM Suppliers

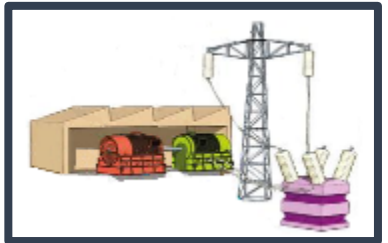
- **Collaboration** with gas turbine suppliers
- Definition of the **maximum H2 limit** that can be mixed
- **Full scale factory/field tests.** H2NG fuel H2 up to 5% in volume, **variable**.



Preliminary studies	Feasibility studies	Factory tests

TC End Users

- **Collaboration** with gas turbine suppliers of **Snam industrial clients**
- Definition of the **minimum H2 limit** that can be mixed
- **Full scale factory test feasibility**



Preliminary studies	Feasibility studies	Factory tests

SNAM Turbocompressors – 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 (most used in exiting plants) for Sergnano Compressor Station (Storage plant)**

Feasibility study to develop a test procedure to verify gas turbine operation fueled with H2NG mixture (H2 up to 5% in volume and variable over time)



- Field test – TC SOLAR**

Feasibility study to develop a test procedure for a field test to verify gas turbine operation fueled with H2NG mixture (H2 up to 5% in volume and variable over time)



Storages

H2 Storage - Injection in NG depleted fields

Scope of work



Feasibility study to identifying, characterizing, investigating and simulating the physical, chemical and microbiological phenomena associated with H2NG storage in natural gas depleted field converted into underground storage

Cooperation



Temporary Association



CO₂ Circle Lab



Project Organization



Different activities divided into "SP" sub-projects, which include:

- **Preliminary phase:** defining state of the art by reviewing scientific literature for each technical/scientific skills
- **Operational phase:** experimental laboratory activities & modeling activities

On the basis of experimental results, a Stogit field will be chosen for the Pilot Project

Sub - Projects



14 different activities, **Work Packages (WP)**, grouped into **7 Sub-projects (SP)** to optimize the sequence and temporal distribution.



SP-1 Reservoir and Cover Rock's Mineralogical, analytical and petrophysical analysis

2 WP



SP-2 Reservoir Microbiological Analysis

3 WP



SP-3 Analysis of fluids and their interaction with changes in thermodynamic conditions

3 WP



SP-4 Fluid dynamic numerical modeling at reservoir scale

2 WP



SP-5 Technical and Engineering components' analysis

2 WP



SP-6 Pilot test



SP-7 Multireactor

2 WP



Thank
You