



energy to inspire the world

Snam's strategy for Hydrogen - Towards Net Zero

December 10th | Aosta

Conference Fall 2021 - Fondazione Courmayeur



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Agenda



**Snam as a player in
the energy sector**



**Hydrogen
applications**



H2 Valleys

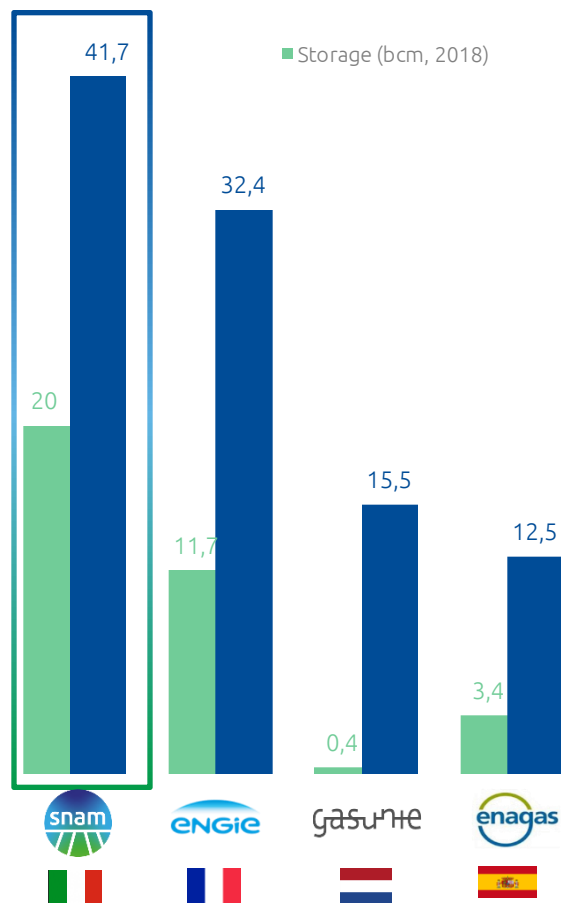


Snam as a player in the energy sector



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Undisputed leader in the natural gas infrastructure



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

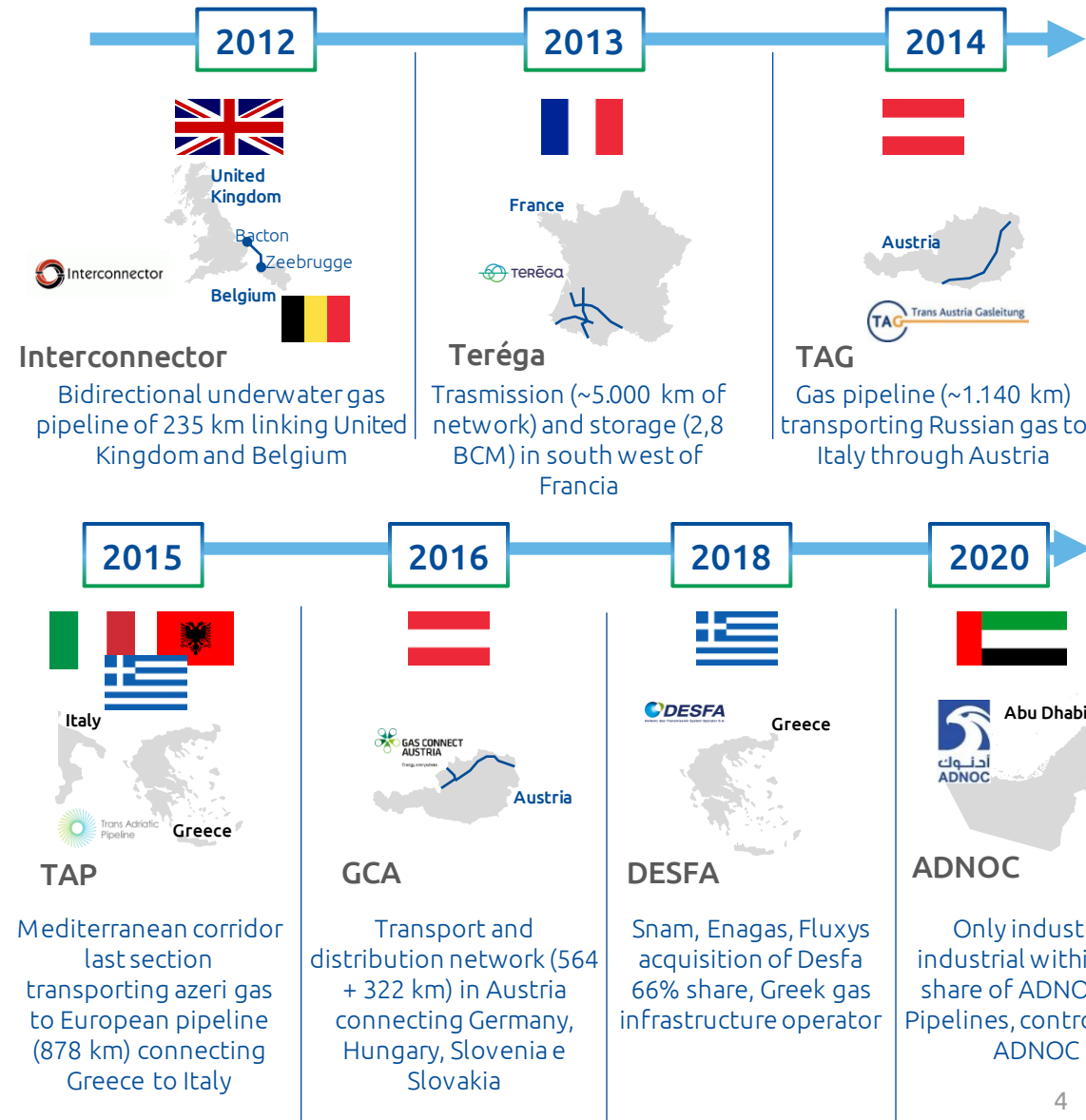


3/3 Our regasification terminals in Italy

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



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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 is one of the main global energy infrastructure company

Key figures

€ 22.6 bn RAB + affiliates ('19)	€ 28 bn Enterprise Value	1.1% Debt cost
€ 1.093 m Net Profit Adj ('19)	~ € 15 bn Market Cap	BBB+ Rating



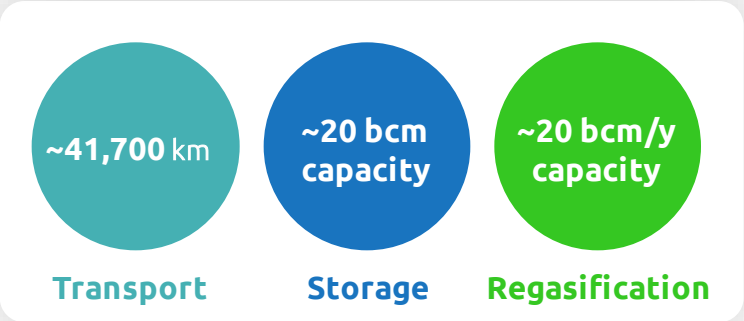
cdp  CDP Reti

69.7%
Free float
~80K investors

International associates



Natural gas¹



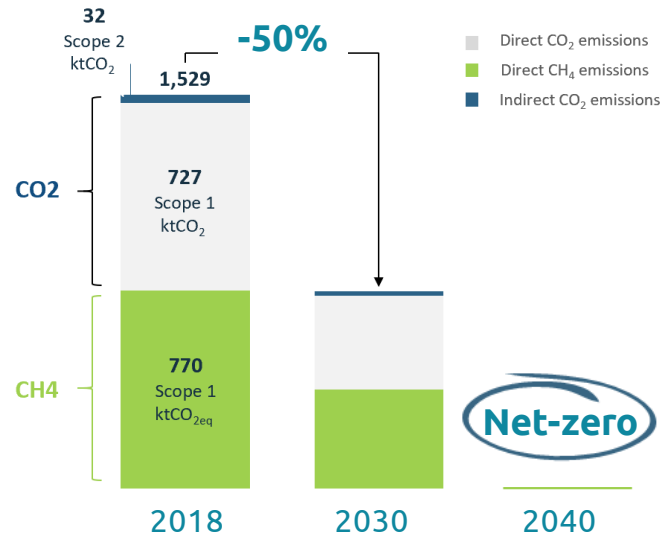
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¹Italy and international associates

Our pathway to net zero

Clear pathway to net-zero in our own scope 1&2 emissions



- **One of the earliest in setting carbon neutrality target** in the utilities sector
- **Target aligned with Paris agreement** to keep temperature increase within 1.5° C
- **Engaged with suppliers and associates** to promote their carbon footprint reduction (Scope 3)



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Enabler of system decarbonisation

Secure asset readiness and flexibility and support green gases development

We ensure readiness of our assets and investments to hydrogen

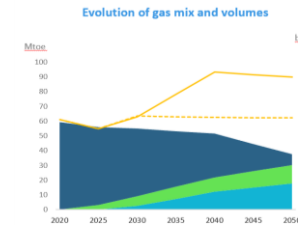


We work with policymakers to promote green gases



We work with green hydrogen value chain players to drive down cost of production

In our long-term scenario we foresee all transported gas by 2050 to be either renewable or abated



Reduce CO2 emissions through our energy transition businesses



Energy efficiency



Sustainable mobility



Biomethane



Hydrogen



Forestation



Hydrogen applications

The role of hydrogen in the decarbonization

The «colours» of hydrogen

«Grey» Hydrogen

Natural gas is separated into hydrogen and carbon dioxide (CO₂)

CO₂ emitted into the atmosphere

«Blue» Hydrogen

Natural gas is separated into hydrogen and carbon dioxide (CO₂). The carbon dioxide is stored and reused

CO₂ captured and reused

«Green» Hydrogen

Water is separated into hydrogen and oxygen molecules thanks to the use of electricity from renewable sources

No CO₂ emitted

Why hydrogen?

- It can be produced **carbon-neutrally** through RES and can **support the development of a decarbonised economy**
- It can be used **to transport and store energy**, but also in **end uses**. Will enable **sector coupling**
- Can be used in **existing infrastructure**

BU Hydrogen

Created in 2019, Snam BUH2 is focused on different kind of activities: **scouting of hydrogen-related technologies**, **designing of innovative business models** and **definition of business cases** for the utilization of hydrogen in different sectors: mobility, industry, energy, services



H2 for Sector coupling and RES integration

Solutions for innovative utilities and sector coupling



H2 for Industry

Supply for green industrial processes



H2 for Transportation

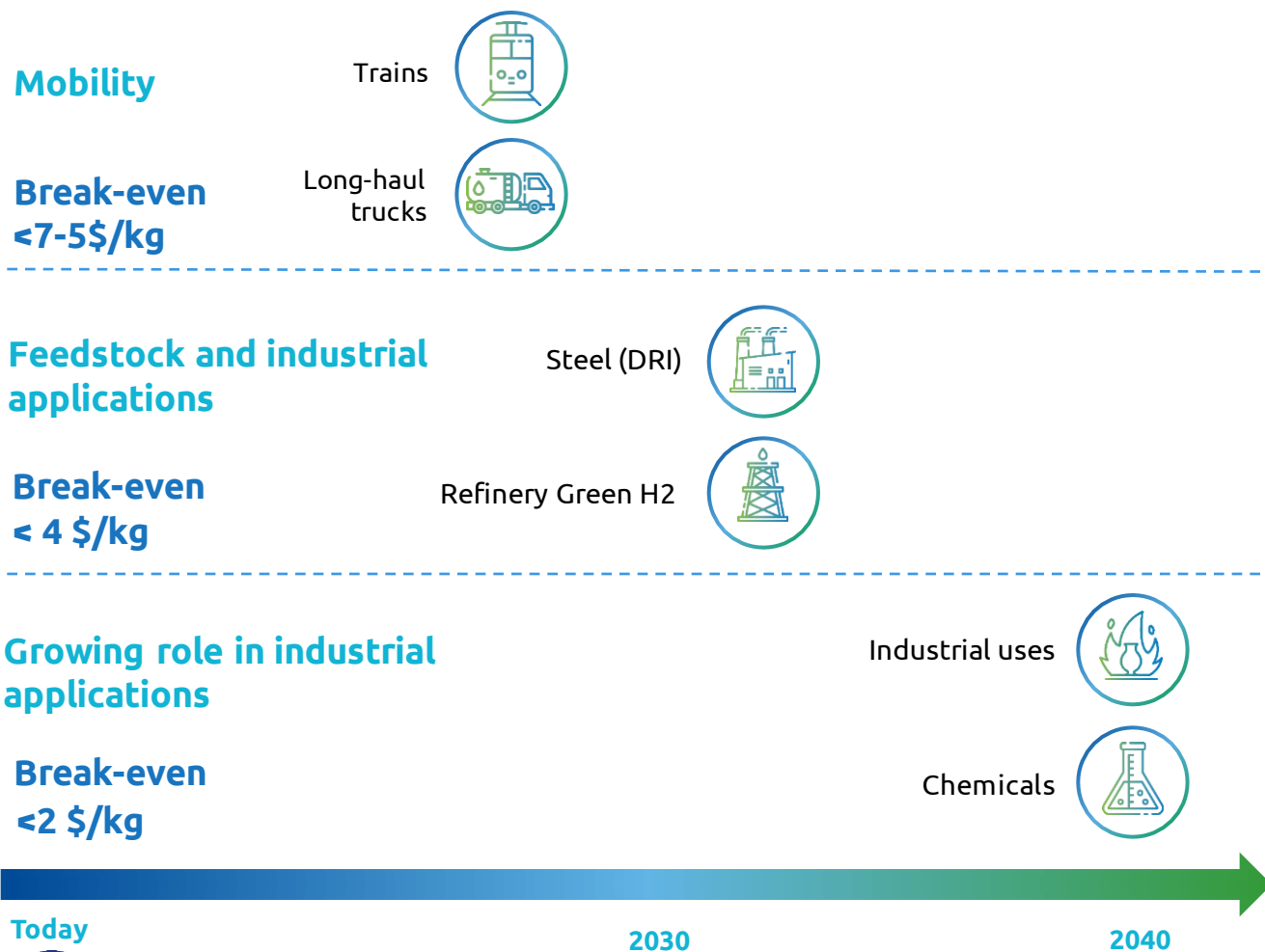
Solutions for sustainable mobility systems



H2 for Commercial Use

Supply for green industrial processes

Hydrogen to become competitive quickly in a number of sectors



Today

2030

2040



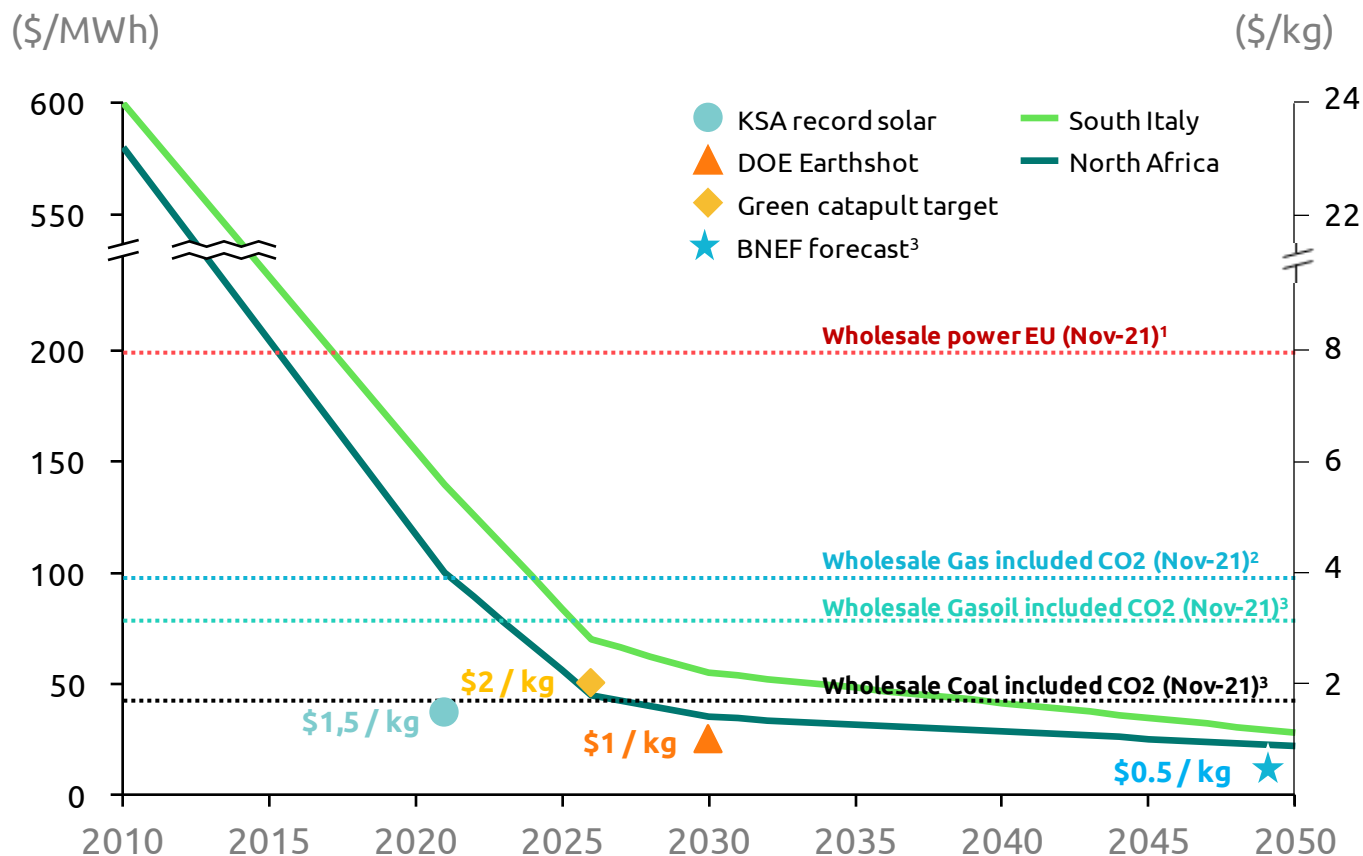
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Source: Snam elaboration on IEA, Hy Challenge, Hydrogen Europe, Lazard



Hydrogen cost reductions are faster than expected

Levelized cost of green hydrogen production falling fast



Hydrogen projects building momentum*

500

Large-scale projects

> 90GW

Global electrolyser production capacity announced (x2 since Jan 2021)

\$155Bn

Direct investments announced

45GW

H2 green catapult target at 2026 for electrolyser capacity

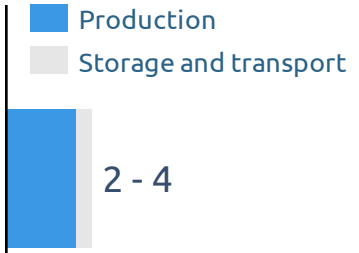
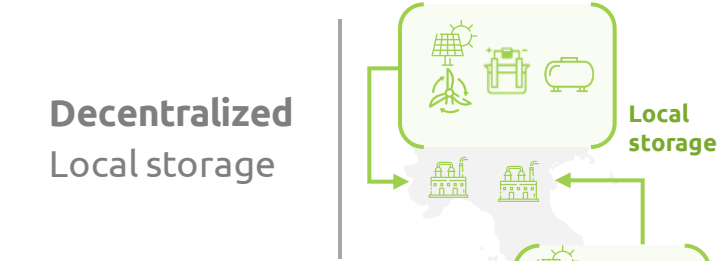
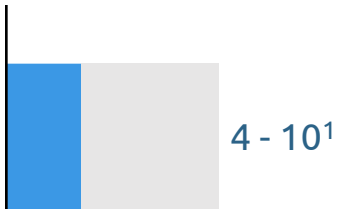
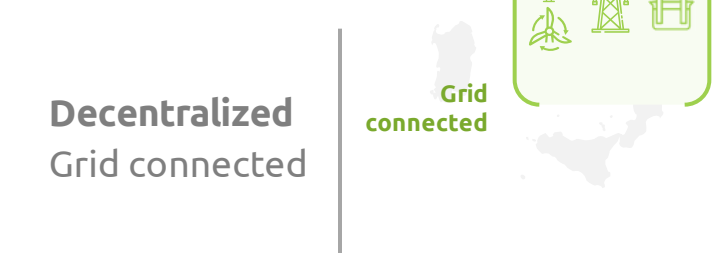
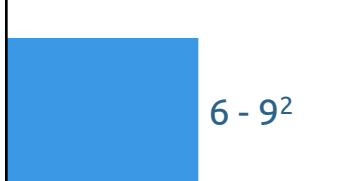
energia per ispirare il mondo



1. Electricity: Italian electricity wholesale price (PUN), Gas: Italian gas wholesale price (PSV), Gasoil: 0.1% CIF MED, Coal: ARA.
 2. LCOE: 10,4 \$/MWh record solar tender in April 2021 - Chinese made electrolyzer (200\$/kW).
 3. November 2021 BNEF levelized cost update.
- Source: Snam analysis.

* Source: Hydrogen Council, BNEF, Snam.

Pipelines will be required to carry hydrogen to create an efficient system

Archetype	Delivered cost in 2030, €/kg	Production	Transport & Storage	Security of supply
 Centralized H2 pipeline	 2 - 4	Low-cost RES Economies of scale for H2 production	Existing natural gas pipelines can be repurposed Optimized storage requirements	Large scale production and storage sites spread over large areas Enables import from different routes
 Decentralized Local storage	 4 - 10¹	High cost RES: small, low productivity RES No economies of scale for H2 production	High cost of decentralized storage to balance seasonality	Requires local and non-optimal backup solutions
 Decentralized Grid connected	 6 - 9²	Grid power needs 100% green resources No economies of scale for H2 production	High transport cost due to electricity grid fees	Depends only on electricity network

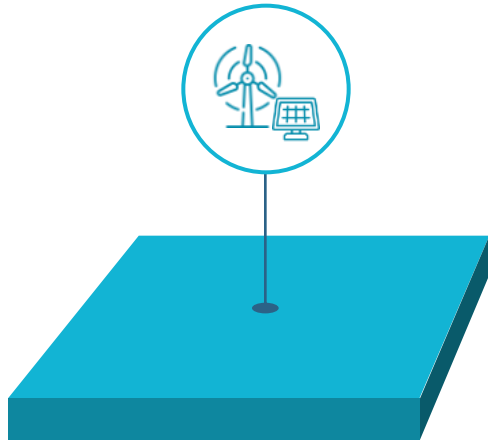


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1. Lower bound considering daily storage to manage intermittency – Upper bound considering monthly storage.
2. Lower bound considering 60% power from grid and 40% from RES – Upper bound considering 100% power from grid.

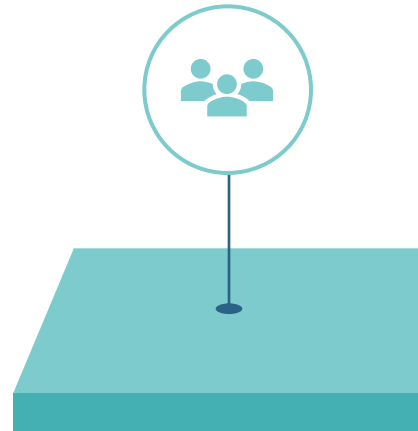
Source: Snam team analysis.

Roadmap for H₂ production and transportation



Local production of green H₂

Decentralized dedicated production plant for a unique off-taker



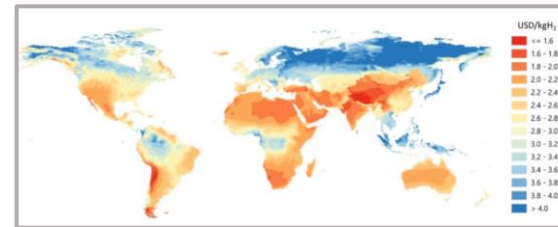
Local/nearby off-takers and H₂ market



Scale-up of the production plants in order to supply H₂ to different off-takers concentrated in an area



Decentralized large scale RES and H₂ production system installation



Installation of large scale PV or hybrid plants in areas with GHI (global horizontal irradiation) very high and constant during the year



H₂ (blended or 100%) transport through existing or new pipelines



Use of the existing gas pipelines or construction of new ones to transport 100% H₂ or H₂-NG blend

Snam's pillar for hydrogen development



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 NG and H2** out of NGH2 blend

Negligible investment to reach 5-10% NGH2 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 gasses
- **Technical standards:** involvement in focus groups 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
- **Partnership** with other operators of the value chain
- Scouting for promising **technologies**

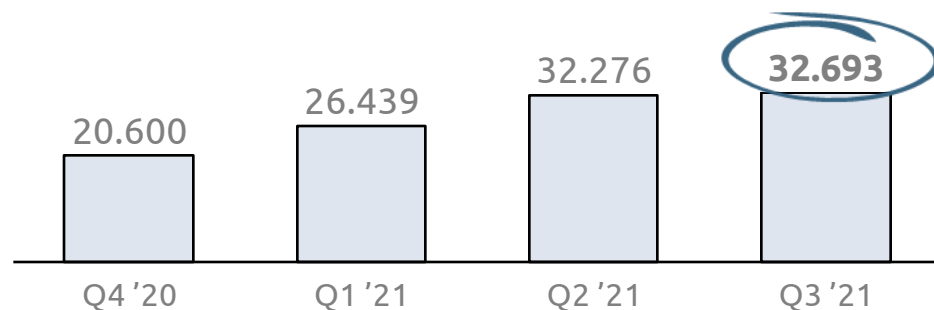
Scouting the market for investment opportunities and partnership

Snam as an Enabler

Snam pipelines are verified for H2 transport

100% of Snam network verified for H2 transport

(km, cumulated)



Snam network
verified according
to ASME regulation

≈ 99% of the network

is ready¹ 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

Setting standards for H2 transport



First example in EU of network H2 readiness
certification

H2GAR

*H2 Gas
Assets Readiness*

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





Energy
networks

10Y view: deliver first section of H2 backbone

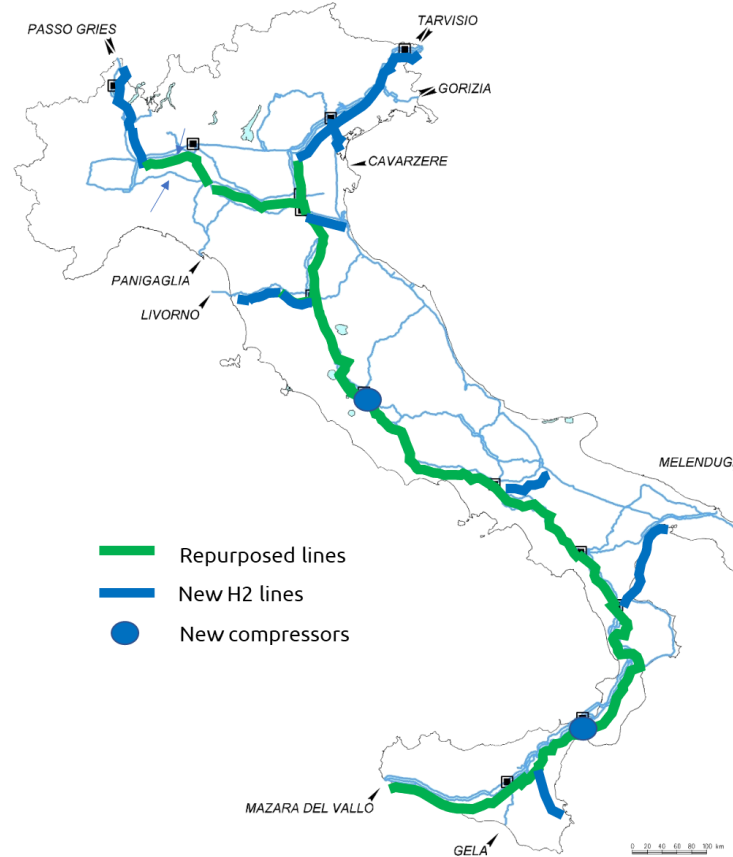
H2 backbone

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



Ca €3bn

Cumulated capex 2021-2030

**Premium
regulated**

Return expected

Our project for an Italian H2 backbone

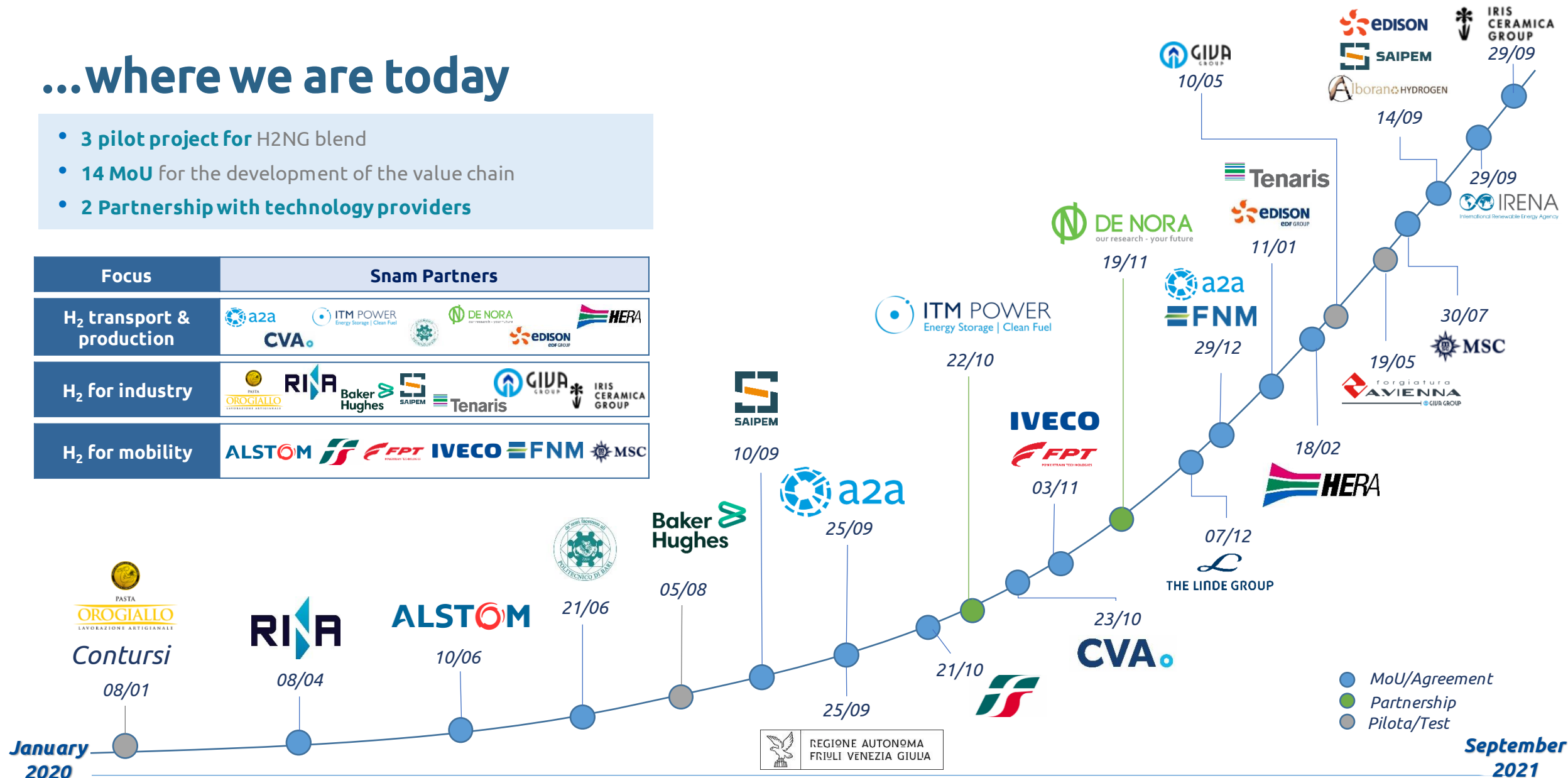


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...where we are today

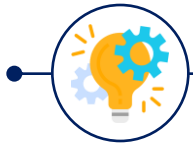
- 3 pilot project for H2NG blend
- 14 MoU for the development of the value chain
- 2 Partnership with technology providers

Focus	Snam Partners
H ₂ transport & production	
H ₂ for industry	
H ₂ for mobility	



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Projects: some on-going initiatives



End user enablers



On may 2021, within the Forgiatura A. Vienna plant, the **first global NG-H₂ 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: H₂ 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.



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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**



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



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.

Project example: Giva experimentation



Snam @snam · May 19

Snam, @RINA1861 and the **GIVA** Group: the first test with a 30% natural gas/hydrogen blend in steel forging. The mix was used to power furnaces at the Rho plant of Forgiatura A. Vienna (**GIVA** Group).

snam.it/en/Media/Press...



RINA1861 @RINA1861 · 19 mag

Abbiamo eseguito con @snam e il Gruppo **GIVA** il primo test al mondo di utilizzo di un mix di #idrogeno e gas naturale, fornito da @GruppoSapio, nella lavorazione dell' #acciaio. L'idrogeno conferma il suo potenziale per la decarbonizzazione rina.org/it/media/press...

#MakeltRINA



MilanoFinanza @MilanoFinanza · May 19
Snam, Giva e Rina insieme per il primo test con idrogeno nella lavorazione dell'acciaio

Marco Alverà



On may 2021, within the Forgiatura A. Vienna plant, the first global natural gas-hydrogen blen test composed by 30% of H2 has been performed in forging processes employed in industrial scale steel manufacturing.

The experimentation considered the natural gas-hydrogen blend in order to heat the Forgiatura A. Vienna plant furnaces up and has been performed with success on site, after a series of studied and laboratory tests lasted almost a year

The partners:



Snam, which promoted and designed the project,



RINA, inspection, certification and engineering consulting multinational company which took care of engineering analysis e laboratory tests,



Gruppo GIVA, steel manufacturing global leader, which provided the Forgiatura Vienna plant for the on field test execution.



Hydrogen Europe @H2Europe · May 20

A 30% blend of natural gas and #hydrogen had been used to power furnaces at a steelmaker in Italy. @snam, Giva Group and @RINA1861 said the trial was a success and was a first step to gradually introducing #zeroemission hydrogen in steelmaking production.



ANSA Ambiente & Energia @ansa_ambiente · May 19

Un test sul mix di gas naturale e #idrogeno per riscaldare i forni di un impianto durante la forgiatura: è la prima sperimentazione a livello globale, che si è tenuta a #Rho, nello stabilimento di #Giva, con il supporto di @snam e @RINA1861.
#ANSAAmbiente



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Ongoing Projects in the Mobility Sector



On 21st October 2020 FS and Snam signed an MOU to conduct techno-economic feasibility studies and to consider new business models relating to the development of hydrogen rail transport

Highlights of the agreement:

- Analysis and feasibility studies and development of joint projects on convertible lines to Hydrogen on the national territory
- Experiments with technological solutions related to the production, transport, compression, storage, supply and use of hydrogen to contribute to the development of sustainable mobility



On March 18th 2020, Snam and Alstom signed an exclusive partnership agreement for the development of hydrogen rail transport in Italy

Highlights of the agreement:

- Sharing of strategic studies on the Italian market
- customized end-to-end business models
- Alstom: OEM and maintenance
- Snam: infrastructures for the production, transport and supply of H₂
- Pilot projects
- Communication and dissemination activities
- Business development



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

Highlights of the agreement:

- The project foresees the commissioning of 14 Ilint-coradia hydrogen trains from Alstom by 2024
- Feasibility development for green hydrogen production sites from renewable / circular resources
- Feasibility development for the development of hydrogen refueling stations in the terminal part of the section
- Feasibility development for logistics and infrastructure of hydrogen transport from production to consumption

Project example: partnership with Iris Ceramica Group

Milan, 29 September 2021

Iris Ceramica Group and Snam have signed a **MoU for an industrial project that involves the study and development of the world's first ceramic factory powered by green hydrogen.**

The new Iris Ceramica Group plant will be built in Castellarano, in the province of Reggio Emilia, and it will be equipped with **native technologies** that will allow the use of green hydrogen.



COMUNICATO STAMPA



Iris Ceramica Group e Snam:
accordo per sviluppare la prima industria ceramica al mondo ad idrogeno verde

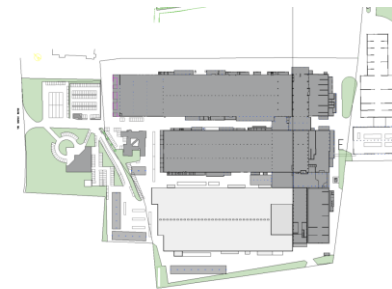


The solution developed by Iris Ceramica Group with the support of Snam will immediately allow the Castellarano factory to create ceramic surfaces born from a **blend of green hydrogen, produced thanks to solar energy, and natural gas.**

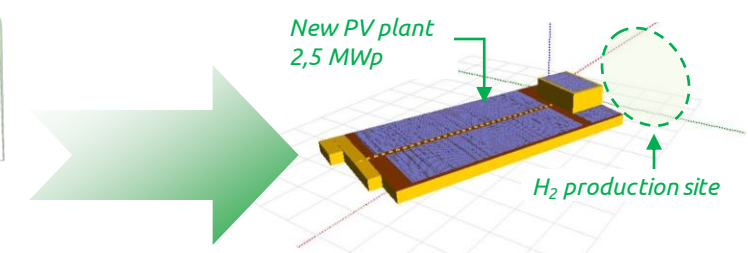
A **photovoltaic system** will be installed on the roof of the plant (with a power of **2.5 MW**) that will be combined with an **electrolyzer and a storage** system for the hydrogen produced on site.

The use of a blend of green hydrogen with natural gas will allow in the immediate to **reduce CO2 emissions** and will pave the way for the exclusive use of renewable energy later on - **for zero-emission production**, being the plant **designed to run 100% on hydrogen.**

Initial Layout



Rendering to-be of PV plant





H2 Valleys



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Why do we talk about «H₂ valleys»?

Benefits of an H₂ valley



Optimization of sectorial integration in broader energy system context

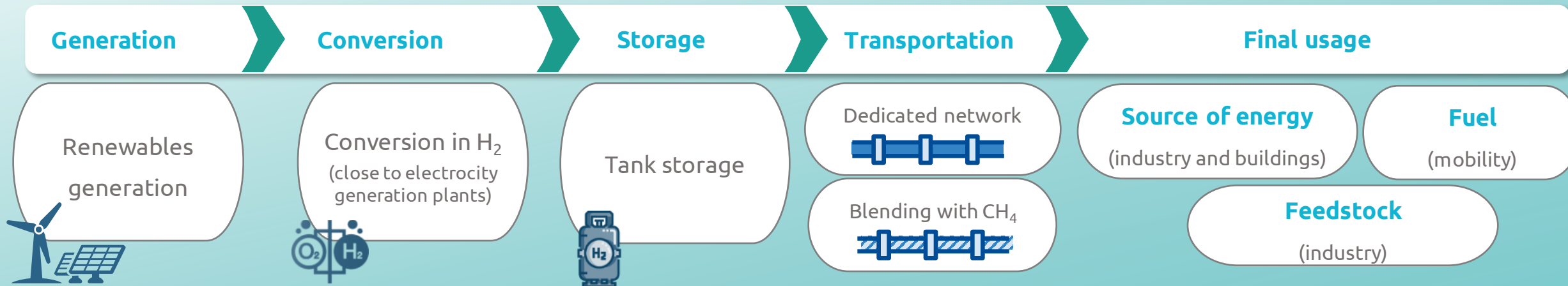


Supports a pathway for scale-up thus is an exceptional viable solution

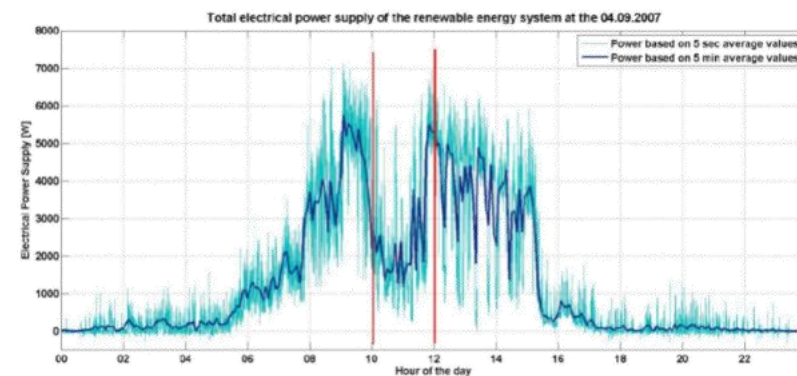
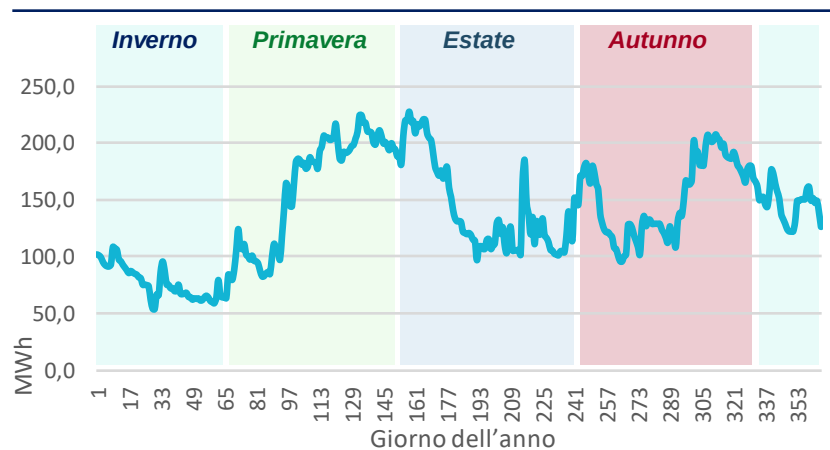
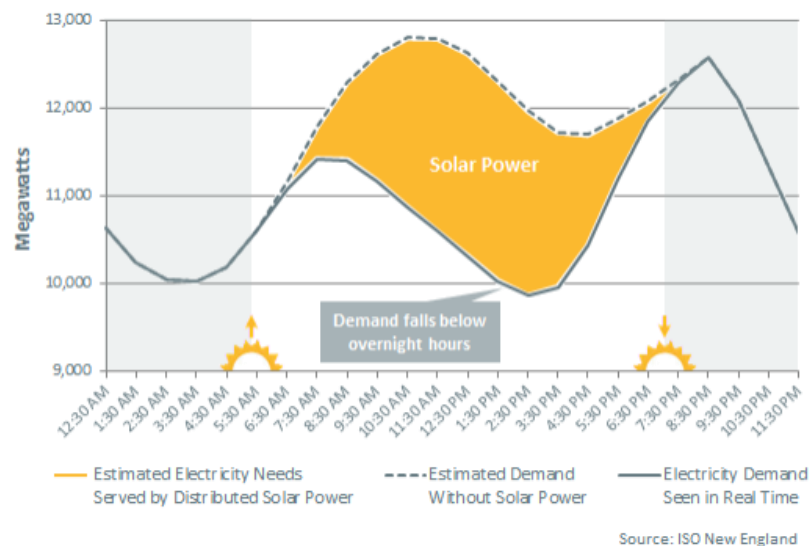
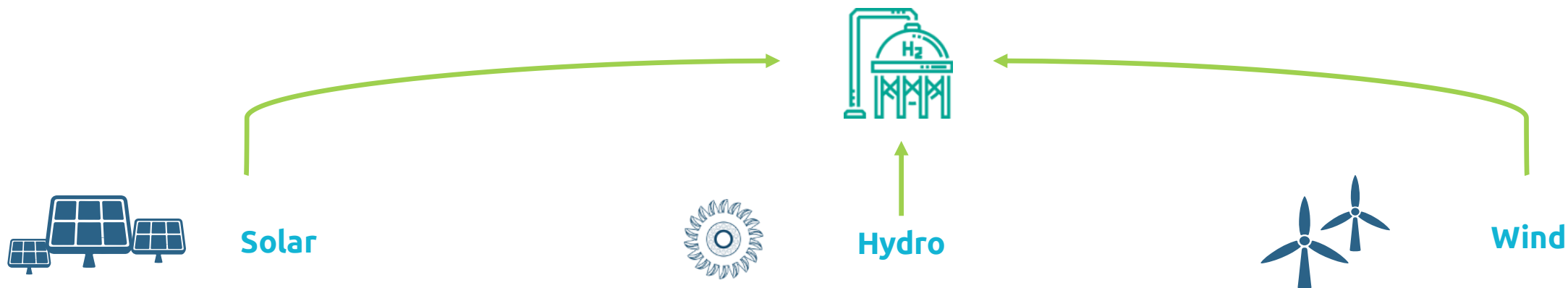


Promotes synergy between consumption and production

The value chain for energy consumption decarbonization



Integration with RES



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Fonti:

- ISO New England
- Profilo produzione mediato impianto idroelettrico Acqua corrente nord Italia (A2A)
- "Energy flow management of a hybrid renewable energy system with hydrogen"

Valle d'Aosta: an avantgarde hydrogen Valley

Among the strategic objectives, Valle d'Aosta is **pursuing decarbonisation**. The strategy focuses on the implementation of interventions to **achieve the fossil free target by 2040**: investments for energy efficiency, promotion of renewable energies and sustainable mobility. Specific attention is given to the **production and use of non-traditional fuels such as hydrogen**.



H2 Mobility

Transport



Fuel switching for a **zero-emission regional mobility**.



Experimentation of the use of hydrogen from RES sources for road transport.

Development of **hydrogen-powered mobility** through the decarbonisation of urban or suburban public transport, with the aim of reducing the share of polluting buses circulating in Valle d'Aosta.

Green Industry

Steel Sector



Development of a **green supply chain in "hard to abate" sectors.**



Decarbonization of industrial processes with high thermal intensity.

Promote the **decarbonisation of the steel sector** through the experimentation of zero-emission solutions based on hydrogen from RES sources within a steel making industrial plant.



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Q&A



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Thank you for your attention

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BU Hydrogen*

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