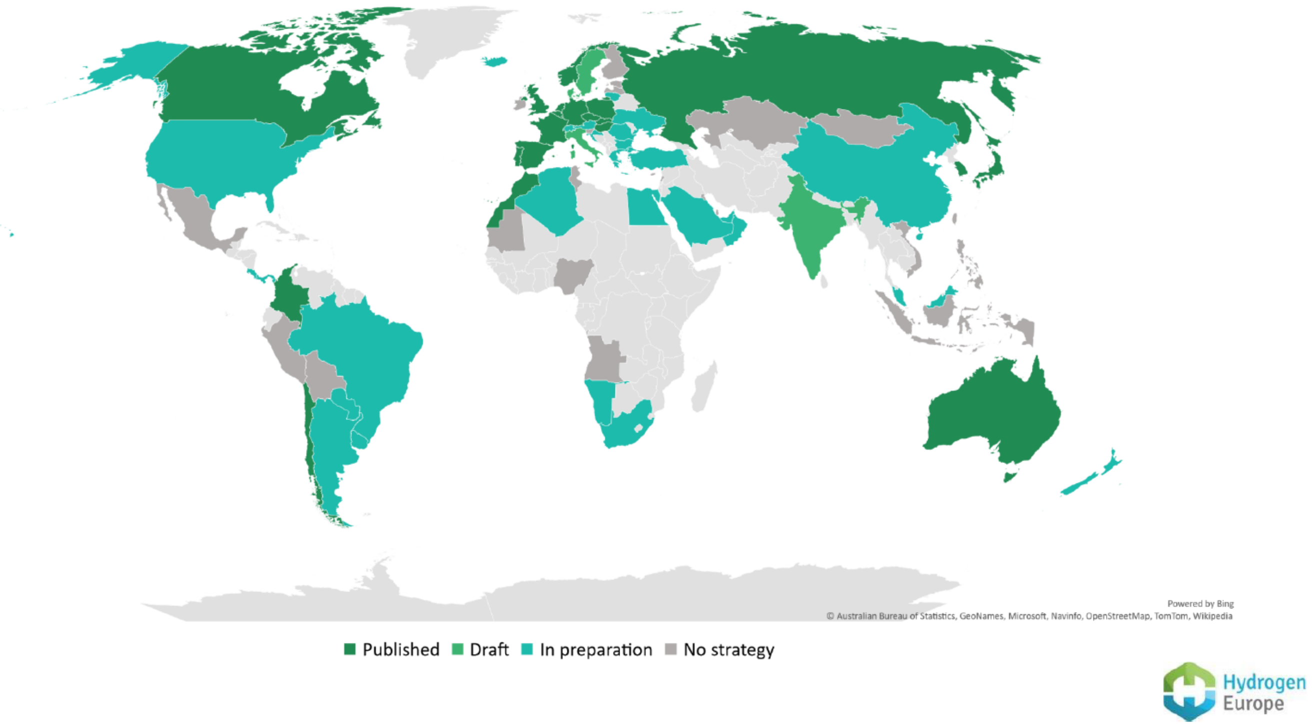
Hydrogen Blending into Existing Gas Networks

March 2022

Increasing Number of National Hydrogen Strategies

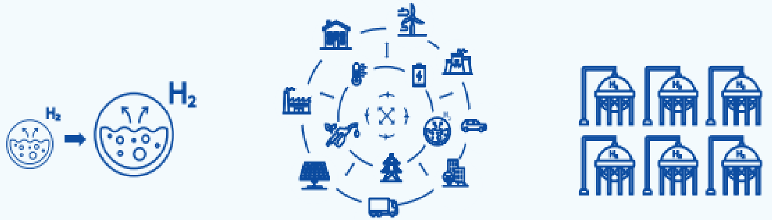


+ 22 countries have published their national hydrogen strategy

REPower EU – What does it mean for Hydrogen?

EU Hydrogen Strategy (July 2020)

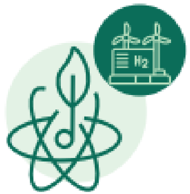
The path towards a European hydrogen eco-system step by step :



Today - 2024 → 2025 - 2030 → 2030 -

Today - 2024	2025 - 2030	2030 -
1 Mt production renewable hydrogen **6 GW** renewable hydrogen electrolysers	**10 Mt** **40 GW**	renewable hydrogen deployed at a large scale

REPower EU (March 2020)



A Hydrogen Accelerator

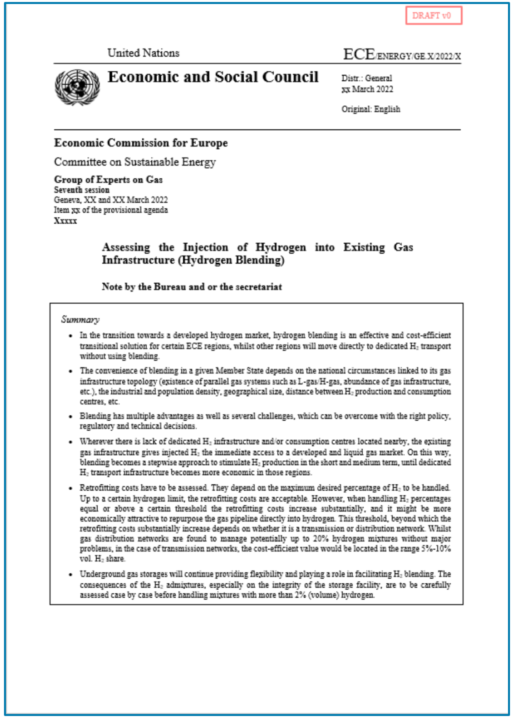
by 2030

Acceleration of **hydrogen infrastructure** deployment (e.g. IPCEI , Partnerships, etc.) and **hydrogen-based solutions**

New Cross-border infrastructure should be hydrogen compatible

20 Mt (10 Mt production and 10 Mt imports)

UN ECE GEG – Draft Report on H_2 Blending into Existing Gas Infra



DRAFT v0

United Nations

ECE/ENERGY/GE.X/2022/X

Economic and Social Council

Distr.: General
xx March 2022

Original: English

Economic Commission for Europe

Committee on Sustainable Energy

Group of Experts on Gas
Seventh session
Geneva, XX and XX March 2022
Item xx of the provisional agenda
Xxxxx

Assessing the Injection of Hydrogen into Existing Gas Infrastructure (Hydrogen Blending)

Note by the Bureau and or the secretariat

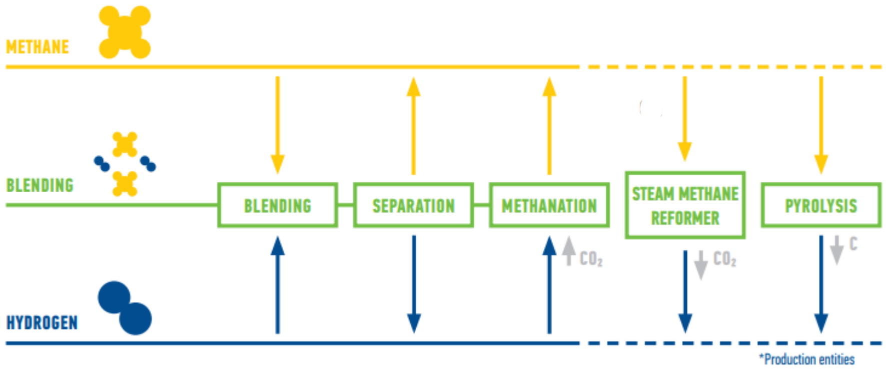
Summary

- In the transition towards a developed hydrogen market, hydrogen blending is an effective and cost-efficient transitional solution for certain ECE regions, whilst other regions will move directly to dedicated H_2 transport without using blending.
- The convenience of blending in a given Member State depends on the national circumstances linked to its gas infrastructure topology (existence of parallel gas systems such as L-gas/H-gas, abundance of gas infrastructure, etc.), the industrial and population density, geographical size, distance between H_2 production and consumption centres, etc.
- Blending has multiple advantages as well as several challenges, which can be overcome with the right policy, regulatory and technical decisions.
- Wherever there is lack of dedicated H_2 infrastructure and/or consumption centres located nearby, the existing gas infrastructure gives injected H_2 the immediate access to a developed and liquid gas market. On this way, blending becomes a stepwise approach to stimulate H_2 production in the short and medium term, until dedicated H_2 transport infrastructure becomes more economic in those regions.
- Retrofitting costs have to be assessed. They depend on the maximum desired percentage of H_2 to be handled. Up to a certain hydrogen limit, the retrofitting costs are acceptable. However, when handling H_2 percentages equal or above a certain threshold the retrofitting costs increase substantially, and it might be more economically attractive to repurpose the gas pipeline directly into hydrogen. This threshold, beyond which the retrofitting costs substantially increase depends on whether it is a transmission or distribution network. Whilst gas distribution networks are found to manage potentially up to 20% hydrogen mixtures without major problems, in the case of transmission networks, the cost-efficient value would be located in the range 5%-10% vol. H_2 share.
- Underground gas storages will continue providing flexibility and playing a role in facilitating H_2 blending. The consequences of the H_2 admixtures, especially on the integrity of the storage facility, are to be carefully assessed case by case before handling mixtures with more than 2% (volume) hydrogen.

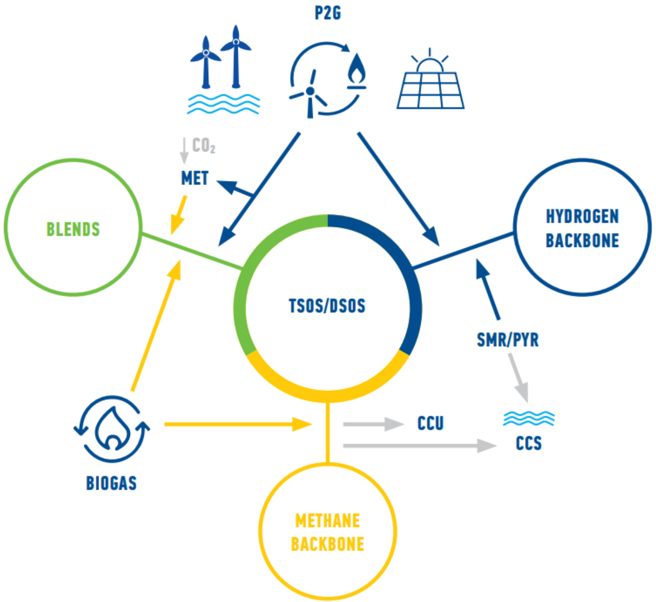
ENTSOG Roadmap 2050

ENTSOG Roadmap 2050 identifies 3 possible, and equally important, grid configurations for achieving a carbon-neutral gas system:

1. Methane (with CCUS, biomethane, synthetic methane)
2. Blending hydrogen and methane
3. Hydrogen



Source: ENTSOG Roadmap 2050 (Dec 2019)



Source: ENTSOG Roadmap 2050 (Dec 2019)

Reusing Existing Gas Infrastructure

Short-term | Medium-term | Long-term

First Projects
Captive Production, Hydrogen Valleys, IPCEIs, hydrogen networks, blending, etc.

Blending hydrogen into gas infrastructure
(it might require retrofitting existing infrastructure)

Repurposing existing gas infrastructure to dedicated hydrogen infrastructure

Newly dedicated hydrogen infrastructure

EU-wide dedicated hydrogen infrastructure based on repurposed gas infrastructure and newly built hydrogen infrastructure

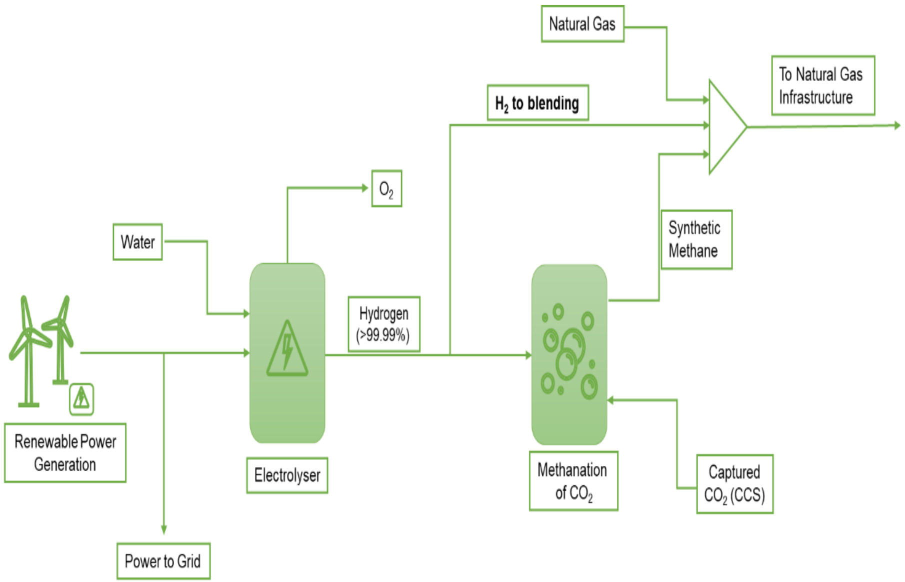
+

Methane network for renewable and decarbonised methane (e.g. biomethane, synthethic methane)

Hydrogen Blending

	Terminology	Technology	Feedstock/ Electricity source
PRODUCTION VIA ELECTRICITY	Green Hydrogen	Electrolysis	Wind | Solar | Hydro Geothermal | Tidal
	Purple/Pink Hydrogen		Nuclear
	Yellow Hydrogen		Mixed-origin grid energy
PRODUCTION VIA FOSSIL FUELS	Blue Hydrogen	Natural gas reforming + CCUS Gasification + CCUS	Natural gas | coal
	Turquoise Hydrogen	Pyrolysis	Natural gas
	Grey Hydrogen	Natural gas reforming	
	Brown Hydrogen	Gasification	Brown coal (lignite)
	Black Hydrogen		Black coal

*GHG footprint given as a general guide but it is accepted that each category can be higher in some cases.



Advantages of Hydrogen Blending into Existing Gas Networks

Costs

Sector Coupling

GHG emissions reduction in all sectors

Effort Sharing among all sectors

Faster GHG Reduction

Quick H_2 Roll-out and Scale-up

Efficiency (thermal use)

De-blending

1. **Transitional cost-efficient stepwise approach** to achieve a EU-wide H_2 network
2. **Enabling H_2 production** when H_2 infra or consumption centres not available
3. **Decentralised** – Flexible location for injection, not linked to clusters
4. **Immediate access to large** transportation & storage **capacities** + integrated gas **market**
5. **Fast and cheap GHG emissions** reductions in ST/MT for all gas consumers
6. **Sector Coupling**
7. **Compatible and complementary** with other H_2 infrastructure deployment
8. **Lack of NIMBY**: pipeline networks are available and socially accepted
9. **Deblending**

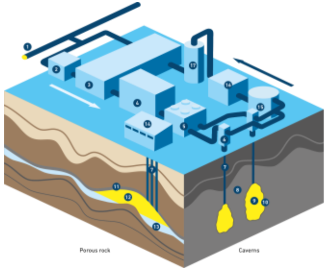
Challenges of Hydrogen Blending into Existing Gas Networks

- **Retrofitting** Costs (over certain %)
- Hydrogen **embrittlement**
- **Interoperability** between gas networks (gas quality)
- Hydrogen **sensitive customers**
- Guarantees of Origin (**GOs**)

- Fixing the **right H_2 %**
- **Tailor-made solutions**
- Setting **admisible H_2 values (%) at IPs** + bilateral solutions
- **Smart & Advanced Gas Quality** handling Solutions
- **Regulatory** Framework

Other elements

Underground Storage

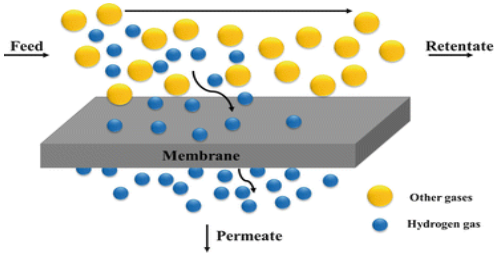


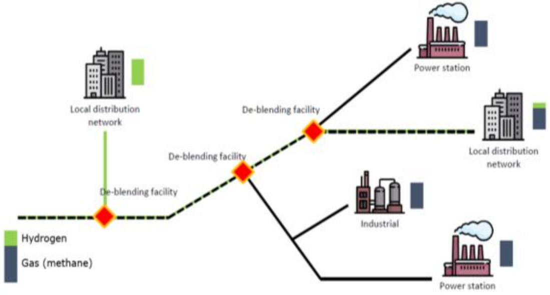
Storage type	Depleted field	Aquifer	Salt cavern	Lined rock cavern
Suitability for hydrogen	Hydrogen-methane blending (up to 10% hydrogen) proven; pure hydrogen storage under study	Under study, but learnings from depleted fields can be utilised	Proven	First hydrogen storage in development (2022)

Distribution

	Project
Blending	GRHYD, France, 2018-2020
	WindGas, Germany, 2012-2016
	RGC Hydrogen Project, 2020-2025
	Green Pipeline project, Portugal, 2021
	Hydrogen Injection, Denmark, 2021
	HyDeploy, UK, 2019-ongoing
	THYGA, 2020-2022

Deblending





Conclusions & Recommendations

Regulatory Framework

Remuneration

Adequate Planning

Set up GOs System

- Convenient for some ECE Regions
- Cost-efficient, transitional step
- Advantages
- Challenges to be overcome by right policy, regulatory, technical decisions
- UGS, DSOs, Deblending

Smart & Advanced Gas Quality Handling

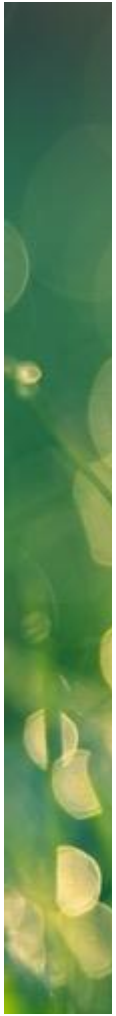
More R&D

Flexible solutions

Blending Roadmaps

Interoperability at IPs

Coordination among Infrastucture Operators



Thanks