



Hydrogen in Gas Grids

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Injection of hydrogen in high-pressure gas grids

Dr. Vanesa Gil
ARAID Senior Researcher
Head Research&Development at FHA
Aragon Hydrogen Foundation (FHa), SPAIN

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This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 875091 'HIGGS'. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe research.



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING



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Duration: 36 months **Start:** 01.01.2020

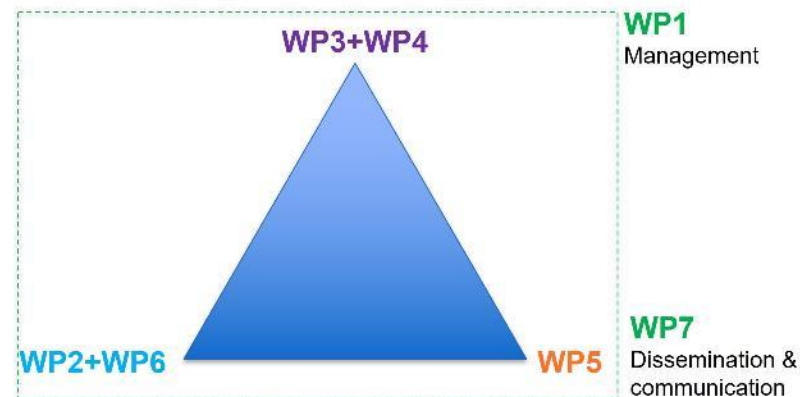
• **Funding:** 2,107,672.50 €

Goal

HIGGS project aims to pave the way to **decarbonisation of the gas grid** and its usage, by **covering the gaps of knowledge of the impact** that high levels of **hydrogen** could have **on the gas infrastructure**, its components and its management.

How?

- Mapping of technical, legal and regulatory barriers and enablers → **survey of state of art**
- Testing and validation of systems and innovation → **building a testing facility**
- Techno-economic modelling to develop operation strategies



➔ Defining a set of conclusions as a pathway towards enabling the injection of hydrogen in high-pressure gas grids ➔

Specific objectives

1. **Investigation** on the present regulations, standardizations and certifications (**RSC**) of the EU for **most critical bottlenecks**
 - a) on limitations with respect to **hydrogen concentrations in the gas system**,
 - b) on the corresponding **standards**.
2. Provide updated information on **equipment and infrastructure** of the **existing high-pressure NG grid in EU**, to identify the most representative facilities → detailed survey on pipelines, facilities, installations and equipment
3. Setup of **mitigation measures** for existing gas appliances and gas system.

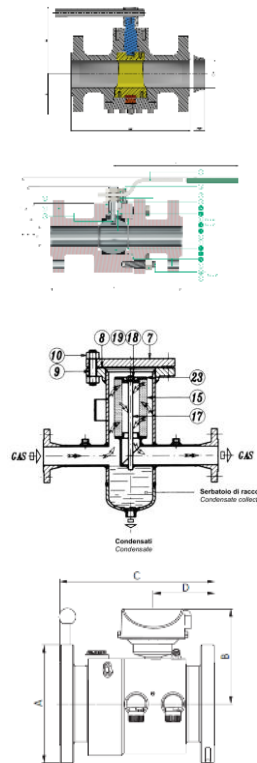


Infrastructure analysis results: Target elements to be tested in the platform

- Predominant **pipeline's steel grades**: API 5L Gr. B, **X42**, **X52**, **X60** and **X70**.
- **Most common facilities**: **valve nodes**, **metering** and **pressure reduction stats.**
 - Composed of **pipes**, **valves (ball, butterfly, plug)**, **filters**, **pressure regulators**, **flow meters** and **instrumentation (pressure switch, pressure and temperature transducer)**.
 - Installed by **welding** or using **flanged joints**.

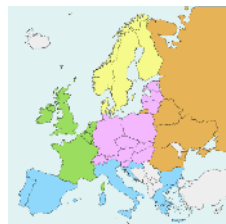
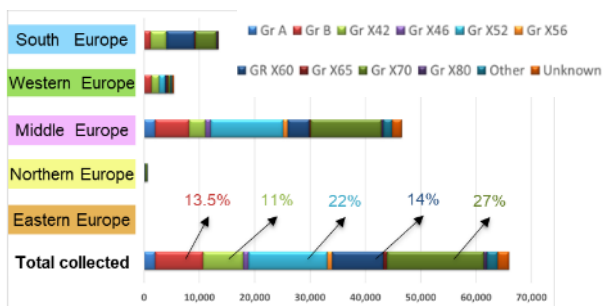
→ Transfer to R&D platform design in WP3

All the Legal, regulatory and technical information is on HIGGS Project public deliverable D2.3. Available soon on the HIGGS Project website (<https://www.higgsproject.eu/>)

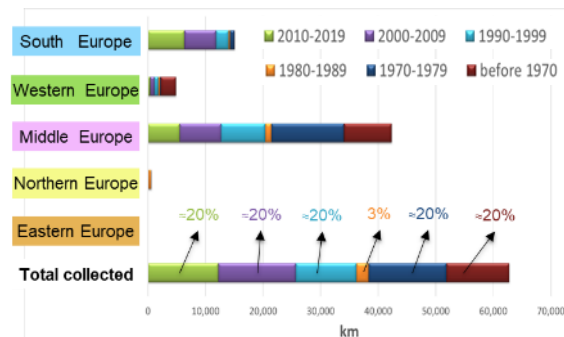


Infrastructure analysis: pipelines

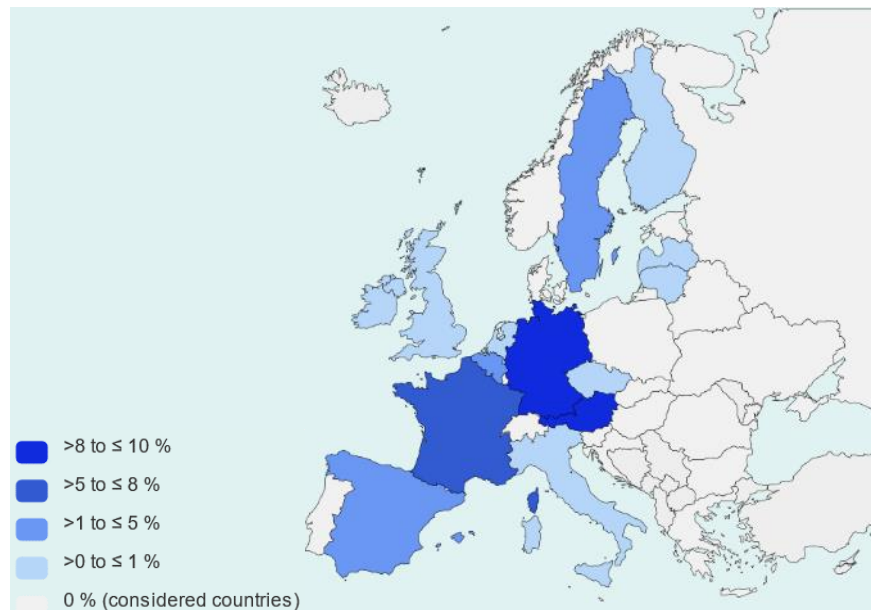
Materials



Renewal time



RSC analysis: Allowed H₂ concentration in NG



- Transmission natural gas grid, 80 barg
- Key elements in the experimental platform
 - Admixture system/Blending station
 - Testing platform (dynamic/static section)
 - Purification prototype (membranes)
- Several levels of blending possible (0-100 %vol H₂)



*Test platform site, FHA facilities
(Huesca, Spain)*





- 0-100 vol% H₂ in CH₄
- Impurities H₂S, CO₂
- 3-4 months gas exposure @ 80 bar

DYNAMIC SECTION: Visual inspection for crack detection, metallographic and mechanical investigation (H₂ embrittlement)

Pig trap

- C-ring specimens
- 4-point bend specimens
- Precracked fatigue compact tension (CT) specimens

STATIC SECTION: Monitoring H₂ leakages (pressure control & chromatography)

MEMBRANE PROTOTYPE: Analysis of composition of gas permeate by gas chromatography

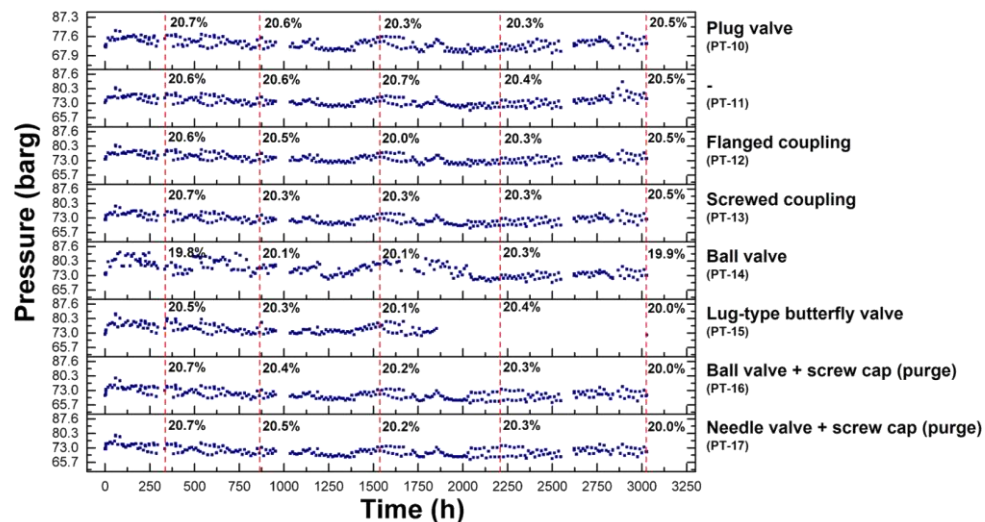
STATIC SECTION



20 %vol H₂ in CH₄ → finished!!

Results:

- Over 3000 h operation
- Only little losses in screwed valves



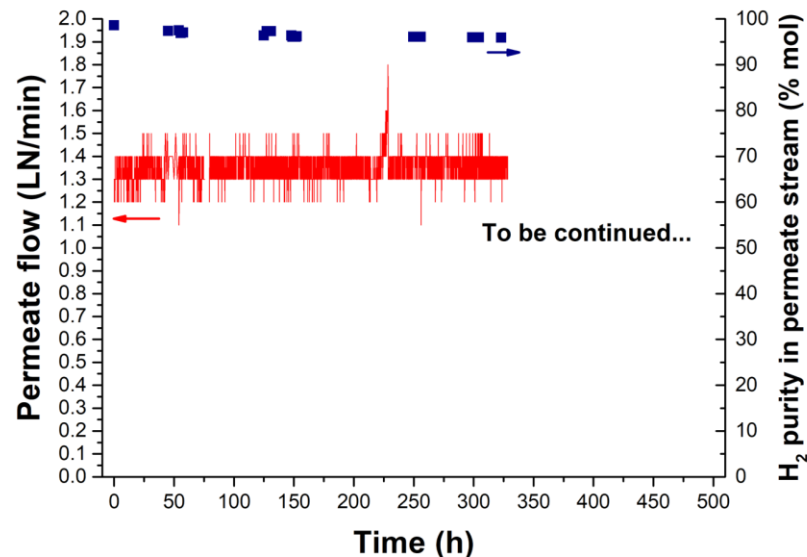
MEMBRANE PROTOTYPE



20 %vol H₂ in CH₄ → ongoing

Results:

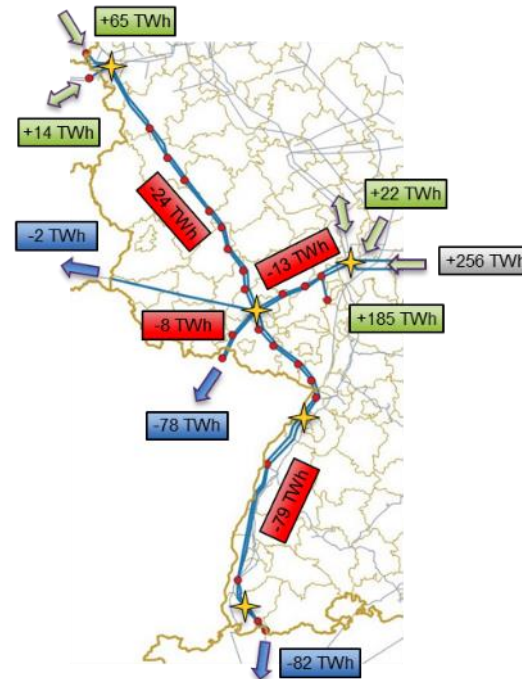
- Over 350 h operation right now
- Little decrease in gas separation performance



Network modelling of TENP/MEGAL pipeline sections

- Modelling scope: Pipelines, compressors, regulator stations
- To be analyzed: **10, 20, 30, 60, 100 (H₂ vol.-%)**
 - Not considering future gas separation technologies
 - Including technology innovations needed
- Target parameters:
 - Fixed OPEX:
 - Maintenance and operation cost for transport systems
 - Variable OPEX:
 - Compression work for gas transport
 - Energy expenses for preheating at regulator stations
 - CAPEX for system retrofit

Pure natural gas



Premixed gases at model inlet nodes



HIGGS

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vgil@hidrogenoaragon.org



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