

Aquamarine – Pilot to test the hydrogen tolerance of UGS infrastructure in Hungary

Hydrogen-based Energy Storage

4. November, 2021.



Introduction of Hungarian Gas Storage Ltd.

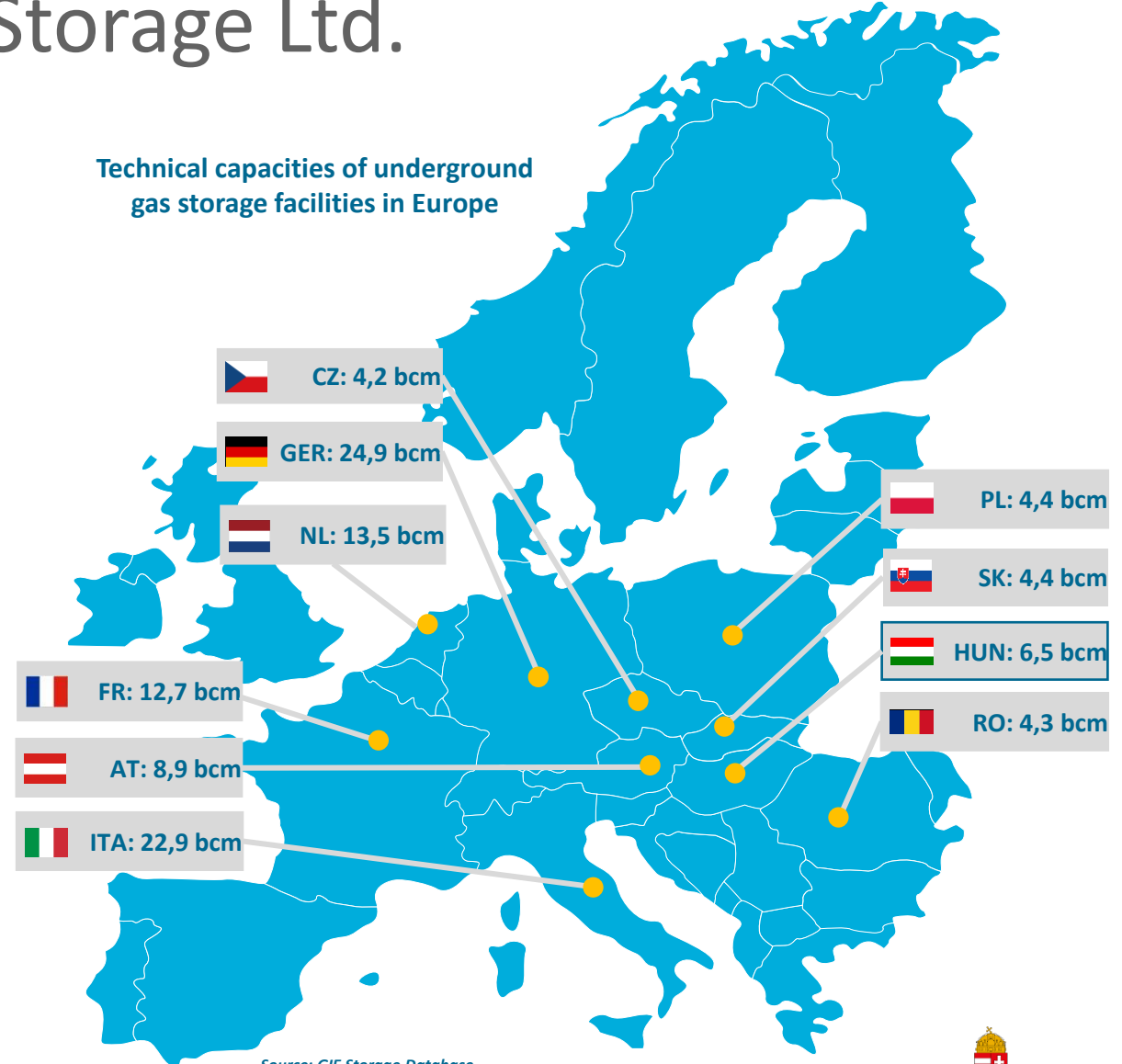
Main activities

- Underground gas storage operations
- Infrastructure operations
- Regulated activities (Mining authorities, Hungarian Energy Office)
- Commercial operation **focuses on gas storage**: HGS does not transport and trade with natural gas
- **Flexibility services provider**: demand-supply balancing operations
- **Crucial pillar** in security of energy supply
- Electricity generation permit
- **4 gas storage sites** in Hungary
- Total of **4,4 bcm working gas capacity** (HU gas consumption ca. 10 bcm/year)
- Sole shareholder: MVM Energy (**100% state owned** company)

HGS in numbers

Million EUR	2020
Net revenues	88,3
EBITDA	117,7
Earnings before tax	99,8
Balance sheet total	511,8
Net debts	153
Investments	13,8
Employees	198

Technical capacities of underground gas storage facilities in Europe

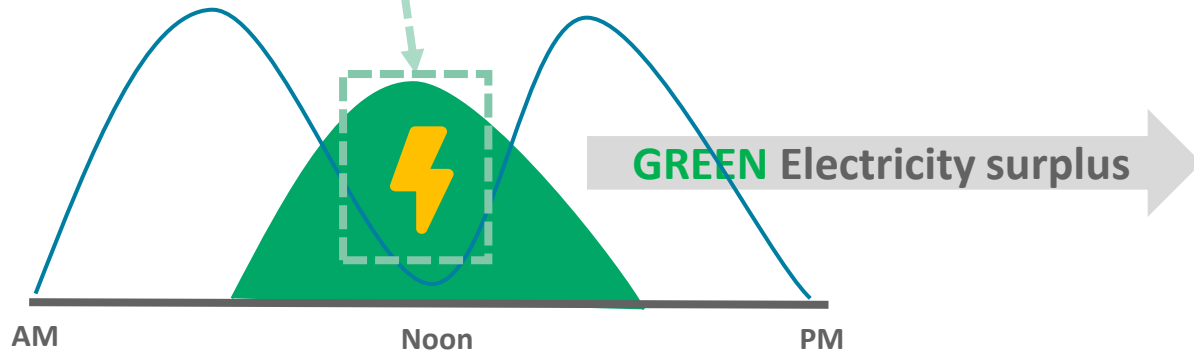
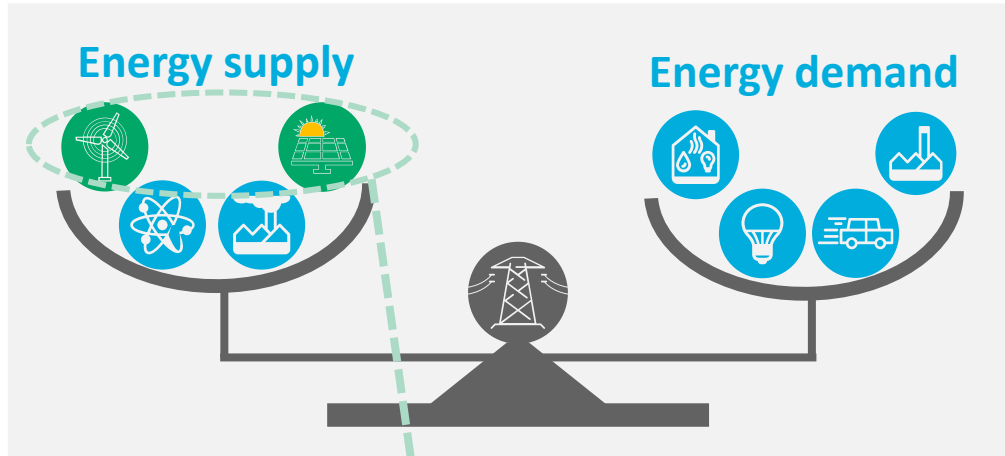


Source: GIE Storage Database
<https://www.gie.eu/transparency/databases/storage-database/>

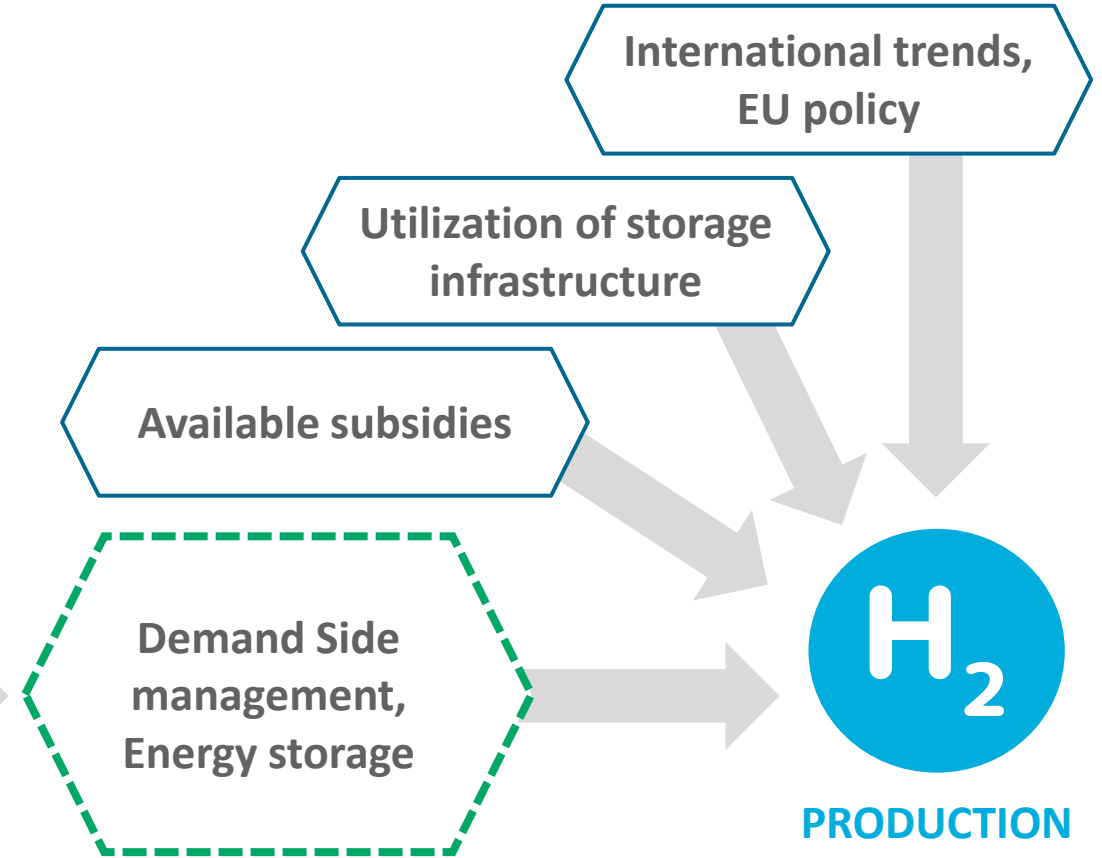


Supporter: MINISTRY FOR INNOVATION AND TECHNOLOGY

Why hydrogen?

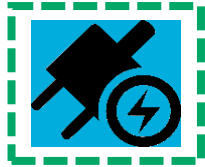


Renewable electricity generation - Electricity use pattern

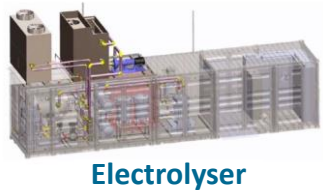


Basic goal: to test the hydrogen tolerance of existing storage infrastructure

GREEN Electricity surplus



+
Water
 H_2O



Electrolyser

Green hydrogen



+
Oxygen
 O_2

Methane
 CH_4

Green electricity can be stored and utilised in different energy carriers

Blended gas

Injection into the transmission system

Own consumption in compressors / equipments

Injection into underground storage

Current projects of HGS

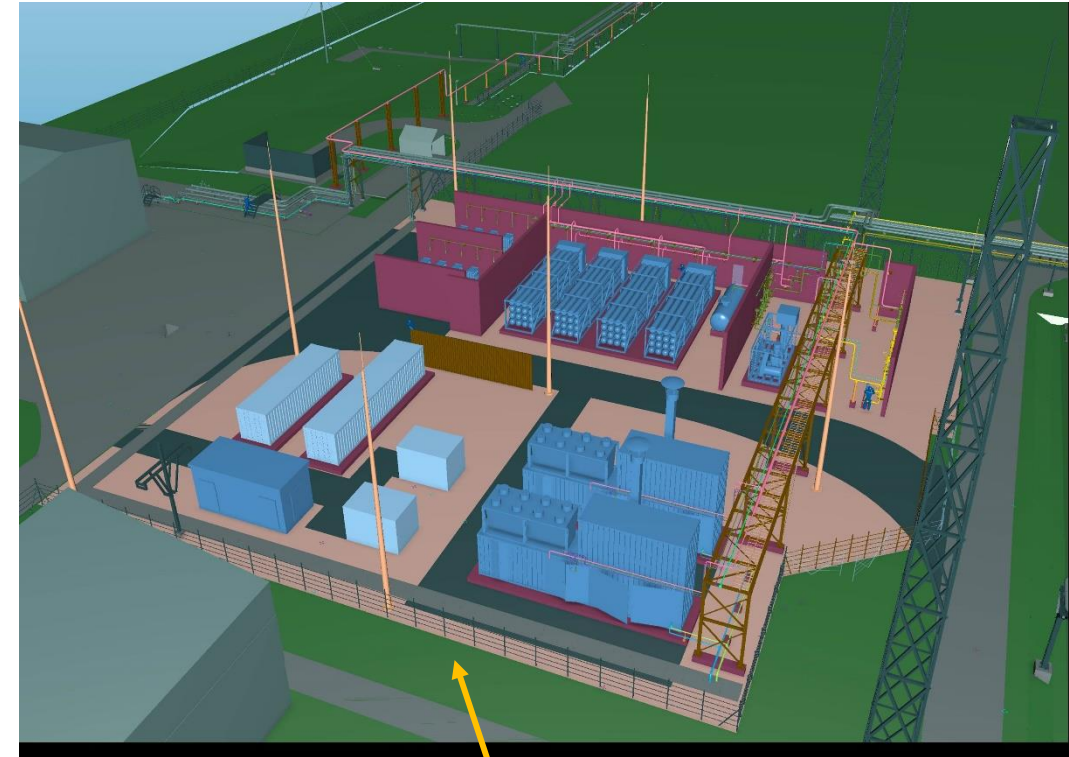


Underground gas storage operations

More goals: system balancing and energy storage in UGS environment plus decarbonization

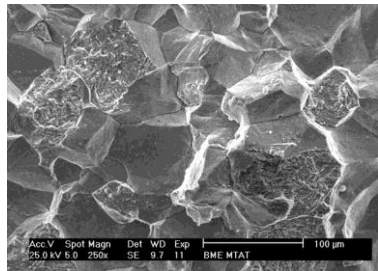
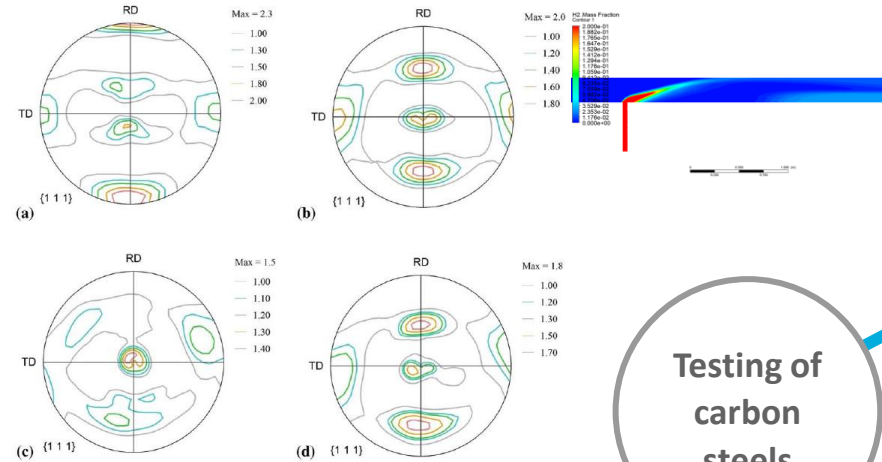
Main parameters of Aquamarine project

- **EUR 8.1 million investment** (67% state supported)
- **2.0 MW electrolyzer** including H₂ compressor unit with buffer tanks
- To connect the H₂ production units to existing methane based fuel systems
- 1 February 2021 – **31 January 2023**
- **Long-term R&D** programs with 4 Hungarian universities and R&D institutes
- Continuous pioneering in the recent regulatory environment
- **Pilot / Test Project:** Effects of Hydrogen blended natural gas on the gas storage infrastructure

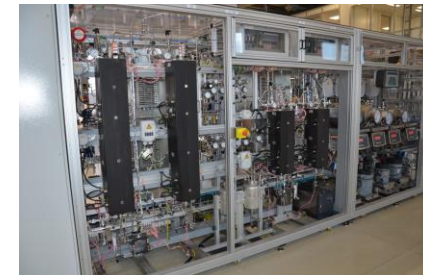
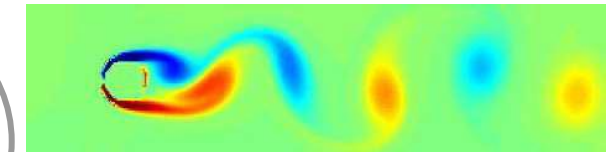
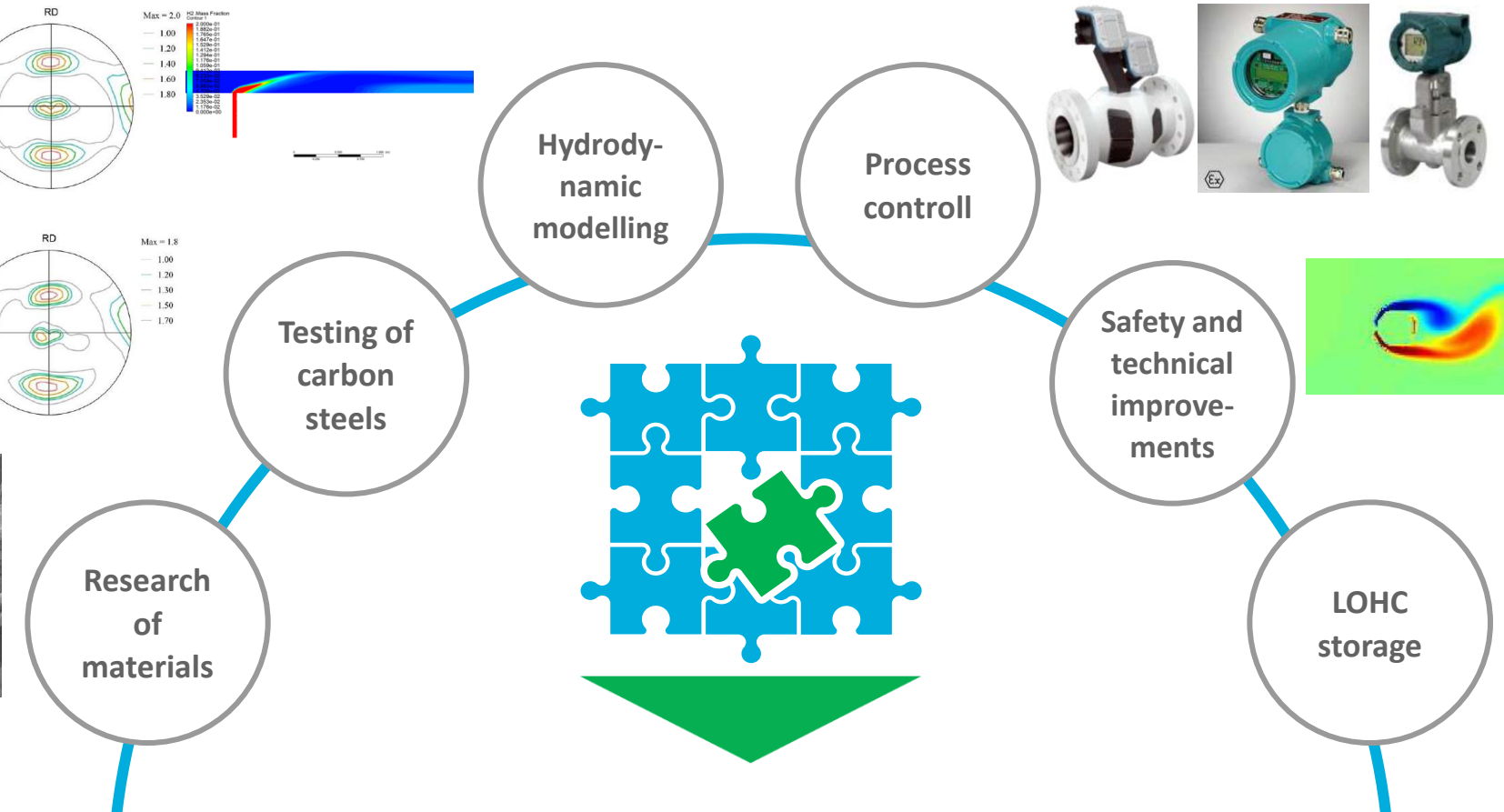


Long term goal: **Large Scale H₂ (= Energy) storage**

Aquamarine - applied R&D programs



Cooperation with 4 Universities



Suitability of existing natural gas infrastructure for hydrogen blended natural gas

HyUsPre – to test also the subsurface ...

- **National Hydrogen Strategy 2030:** „to test the hydrogen tolerance of existing infrastructure”.
- Limited domestic potential to investigate,
- **Join to an EU wide approach** - „Fuel Cell Hydrogen – Joint Undertaking – 2020”,
- Invitation from a consortium leader TNO: 9+1 storage operator, 4 institutions and 3 universities
- **Grant Agreement 31. August, 2021**
- **1. October, 2021.** - detailed R&D program for 27 months
- **Goal:** to test the hydrogen tolerance of the subsurface assets including prous reservoir and also wells

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PROJECT CONSORTIUM

INDUSTRY

- › CENTRICA – UK (UGS operator)
- › EBN – NL (E&P asset owner)
- › Hungarian Gas Storage (UGS op.)
- › NAFTA – Slovakia (UGS operator)
- › RAG – Austria (UGS operator)
- › Shell – NL (E&P assets, UGS op.)
- › SNAM – Italy (TSO for gas)
- › EQUINOR – Norway (E&P)
- › NEPTUNE – UK/NL (E&P)

RESEARCH INSTITUTE

- › TNO – NL (coördinator)
- › Energy Institute Linz – Austria
- › Fondazione Bruno Kessler – Italy
- › FZ Jülich – Germany

ACADEMIA

- › University Of Edinburgh (UoE) – UK
- › Clausthal University – Germany
- › Wageningen University – NL

