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

Hydrogen-based Energy Storage

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)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2020</th>
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</thead>
<tbody>
<tr>
<td>Net revenues</td>
<td>88,3</td>
</tr>
<tr>
<td>EBITDA</td>
<td>117,7</td>
</tr>
<tr>
<td>Earnings before tax</td>
<td>99,8</td>
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<tr>
<td>Balance sheet total</td>
<td>511,8</td>
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<tr>
<td>Net debts</td>
<td>153</td>
</tr>
<tr>
<td>Investments</td>
<td>13,8</td>
</tr>
<tr>
<td>Employees</td>
<td>198</td>
</tr>
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Technical capacities of underground gas storage facilities in Europe

Source: GIE Storage Database
https://www.gie.eu/transparency/databases/storage-database/
Why hydrogen?

- Renewable electricity generation
- Electricity use pattern

Energy supply vs. Energy demand

International trends, EU policy

Utilization of storage infrastructure

Available subsidies

Demand Side management, Energy storage

PRODUCTION

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

GREEN Electricity surplus

Water → Electrolyser → Green hydrogen

Green energy can be stored and utilised in different energy carriers

- Injection into the transmission system
- Own consumption in compressors / equipments
- Injection into underground storage

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

- Hydrodynamic modelling
- Process control
- Testing of carbon steels
- Safety and technical improvements
- Research of materials
- LOHC storage

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 és 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