Connecting Markets

Jesenná konferencia SPNZ

Horný Smokovec

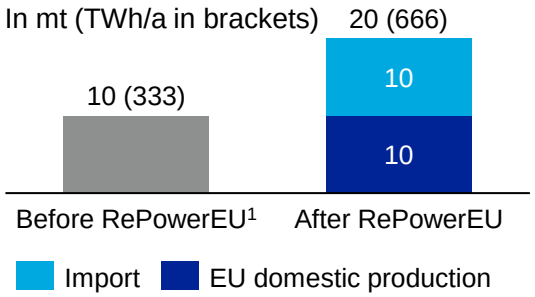
28.-29. 9. 2023

N4G assets / Czechia well positioned to support EU's growing hydrogen ambition

Ambition: REPowerEU 2030

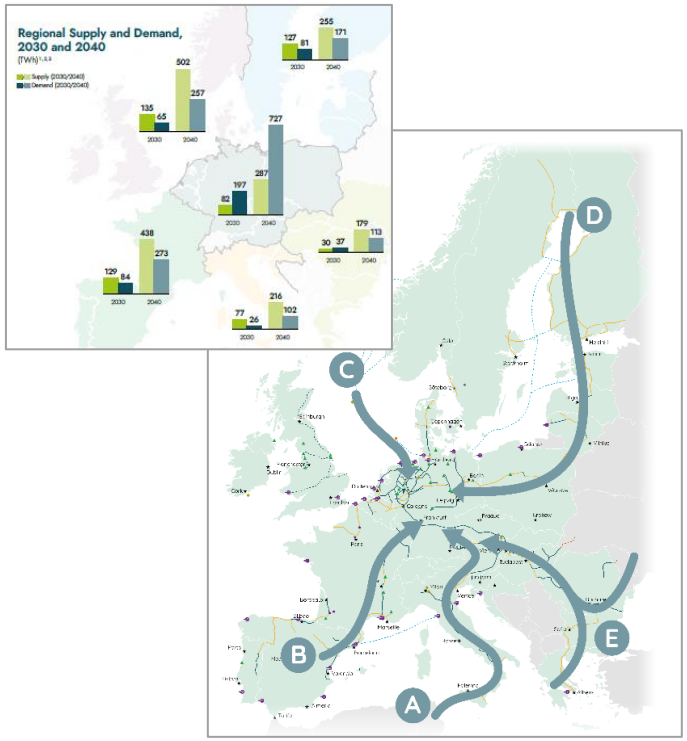
- EU **plan to address the current energy security crisis**
- Focus on **supply diversification, energy savings**, and **accelerated transition to clean energy**
- **Hydrogen is integral part of this plan**
  - **Increase of 2030 supply target** from 10[1] to 20 mt of renewable H2
  - **Recognizing the importance of import** to meet this target (50% of the target to come from non-EU import)

REPowerEU 2030 H2 supply target



Enabler: European Hydrogen Backbone

- Regional differences in supply and demand show the **importance of connecting regions across Europe**
- **Five supply corridors** defined to ensure access to supply across all demand regions



N4G / Czechia position

Net4Gas / Czechia well positioned: 3 out of 5 corridors utilize N4G assets

- **A: North Africa & Southern Europe:** Entry point @ Lanzhot for domestic demand and export to Germany
- **E: East and South-East Europe:** Entry point @ Lanzhot esp. for domestic demand and export to Germany
- **D: Nordic and Baltic regions:** Entry point @ Brandov esp. for transit from/to Germany

N4G launched H2 Readiness program in Jan 2021

Strategic, technical, and organizational aspects covered

Hydrogen readiness

1 Market & flow scenarios

- Monitor H_2 adoption within EU (and key regions)
- Develop H_2 supply / demand trends and resulting flow / blending scenarios
- Identify potential priority grid sections for capability improvement

2 Grid readiness

- Evaluate compatibility of the existing N4G grid for 5% and 10% H2 blends, and identify critical bottlenecks
- Evaluate on high-level compatibility of selected coherent / separated parts of the existing N4G grid with pure H2 transport
- Develop strategies for 5%, 10% and 100% H2 Readiness of the N4G grid incl. implementation roadmap and required financial costs
- Develop key H2 requirements for new investments

3 Policy & regulation

- Participate in development of required legislation & regulation changes to enable H2 in the Czech grid and set clear requirements for formal (re)qualification of N4G assets for H2
- Monitor development of key EU-wide legislation and resulting threats / opportunities

4 Partnerships

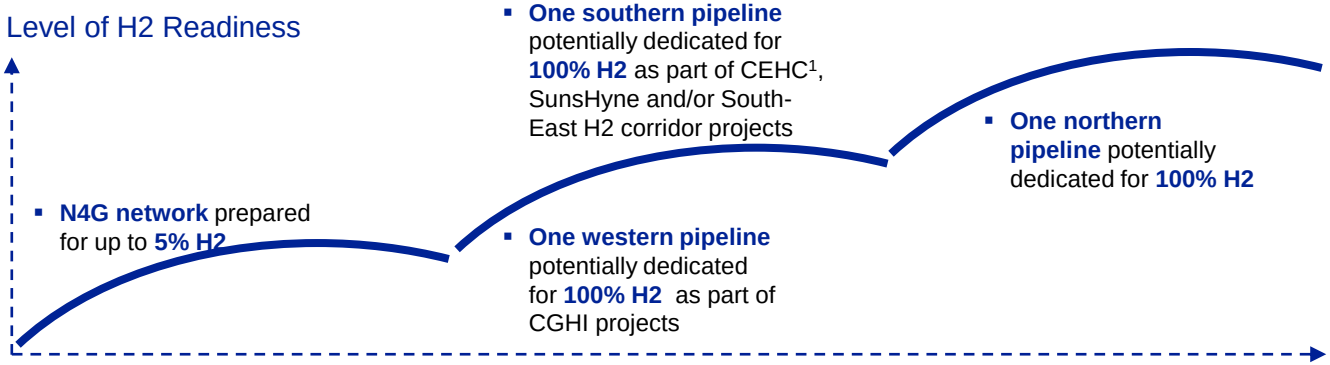
- Identify and develop relevant partnerships / cooperation with neighboring TSOs and other players within the emerging hydrogen value chain to focus on key topics such as joint transport projects, grid readiness, H2 injection, or deblending

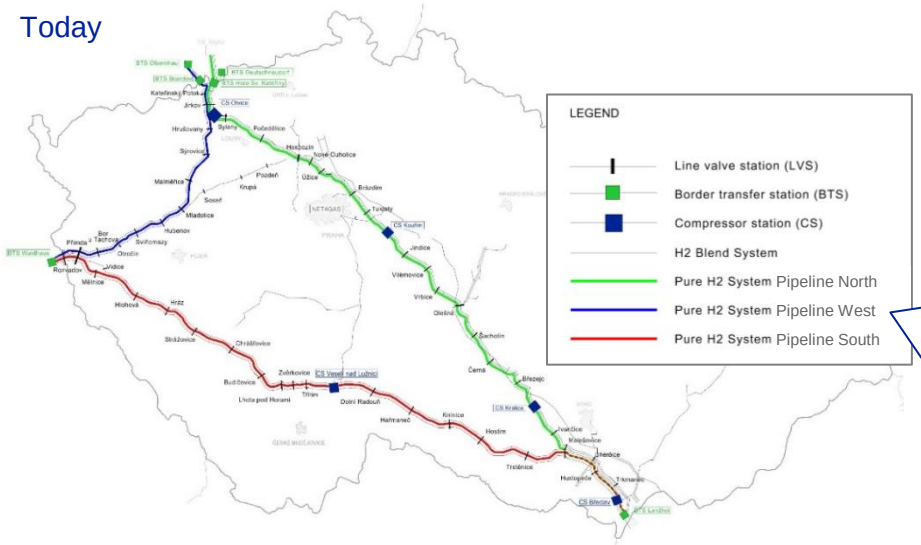
5 Organization & Governance

- Define the necessary project organization structure and build strong H2-only focused core team
- Ensure gradual transfer of hydrogen related know-how to the entire organization

N4G is aiming for combination of blend-ready network and pure H2 triangle in the mid-term

Emerging H2 mid-term vision (and a great starting position for Czechia)





Each of the 3 pipeline corridors consists of 3 large-scale pipelines, so that in the medium and long-term perspective 1 pipeline can rather easily be separated on each corridor for pure H2 transportation

Comments

- **Initial vision** given current uncertainties
- **First appearance of H2** (blend) in N4G network expected **by ~2025**
- **First dedicated N4G hydrogen corridors** expected to be made available via **repurposing** of existing infrastructure **~2030**
- To-date results strongly indicate **viability of H2 retrofits** of existing N4G infrastructure **at reasonable costs**

All triangle corridors are currently being developed in dedicated projects together with other TSO partners: German OGE, Ontras, Gascade, Slovak Eustream, Austrian TAG, Italian SNAM, and Ukrainian Gas TSO of UA

1. Central European Hydrogen Corridor

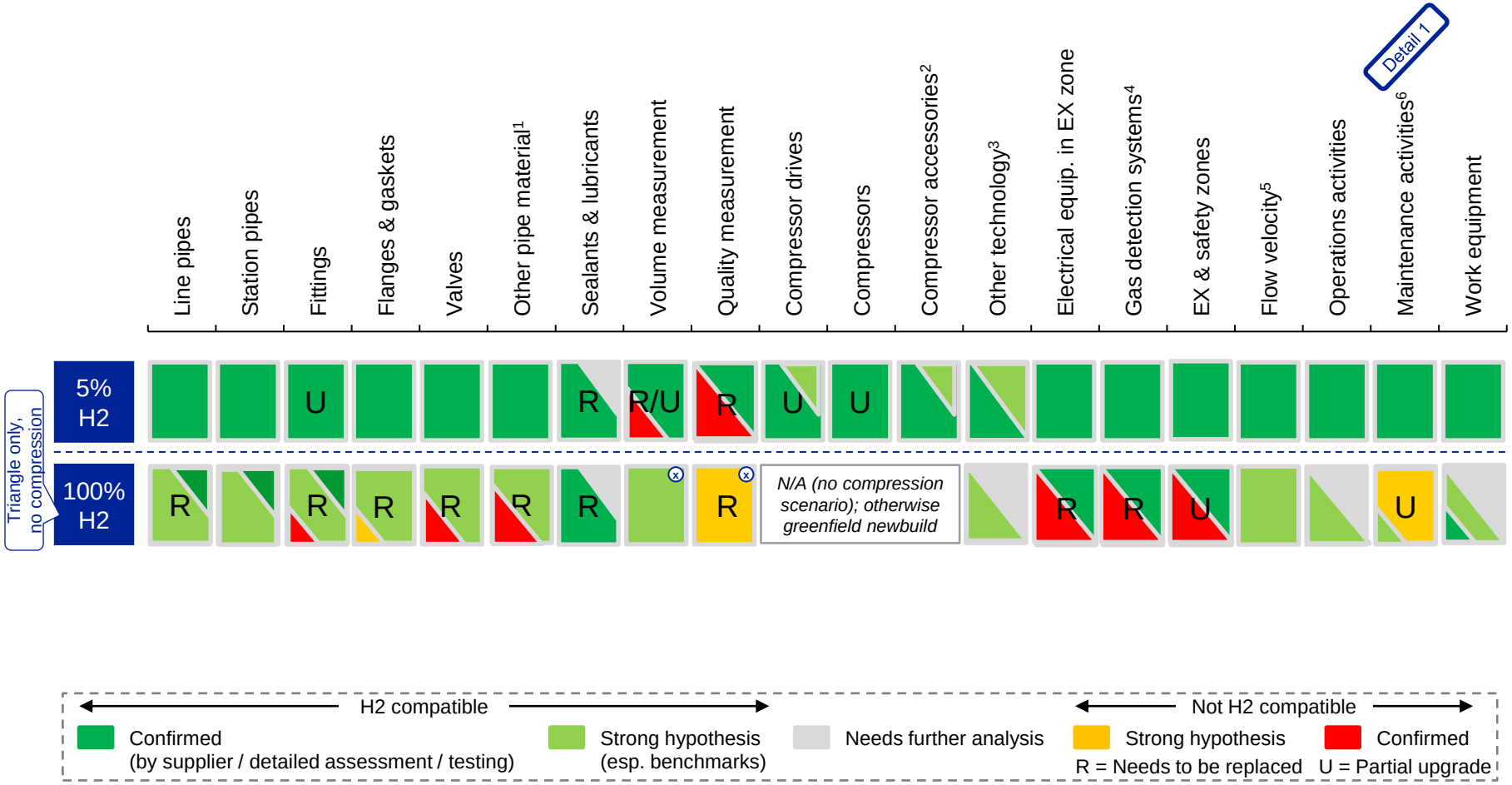
We are currently developing 5 H2 tranport corridor partnerships

Partnership	Participants	Description	Maturity	PCI submitted	Pre-selected for PCI by EC
CEHC	OGE, NET4GAS, eustream, GAS CONNECT AUSTRIA	▪ H2 transport from Ukraine to Germany via SK and CZ ▪ Utilization of southern N4G branch since 2030[1]	Pre-feasibility in progress	✓	✓
SunsHyne	snam, TAG, eustream, NET4GAS, OGE	▪ H2 transport from North Africa & Italy to Germany via AT, SK and CZ ▪ Utilization of southern N4G branch since 2030[1]	Pre-feasibility in progress	✓	
CGHI	NET4GAS, GASCADE	▪ H2 transport from Baltic sea and North Germany to South Germany ▪ Utilization of western N4G branch from 2030[1]	Pre-feasibility In progress	✓	✓
N4G & Ontras	NET4GAS, ONTRAS	▪ H2 transport from Lanžhot to Ontras network in North Germany ▪ Utilization of northern N4G branch after 2035[1]	Project concept in progress		
South-East Corridor	NET4GAS, eustream, FGSZ, BULGARTRANSGAZ, DESFA, OGE + others in progress	▪ H2 transport from Turkey and/or Greece Europe to Germany via BG, RO, HU, SK ▪ Utilization of southern N4G branch after 2030[1]	Partnership forming		

1. Subject to meeting all contractual capacity obligations

Current status of H2R analytics on N4G network

Reflects current technical view, not H2R qualification/certification status



1. Thermowells, cleaning chambers, isolation couplings 2. Fuel path incl. regulation station, anti-surge system 3. Filters, coolers (only on CS), CP, TDW, TZB 4. Incl. EPS 5. Incl. vibrations and pulsations 6. Cleaning & inspection, venting and other manipulations, excavations

⊗ Considering only devices at BTS Brandov Import. BTS Lanzhot assumes new section

Detail 1

Hot tapping: No changes to current practice for H2 blends foreseen[3]

Key degradation mechanisms considered

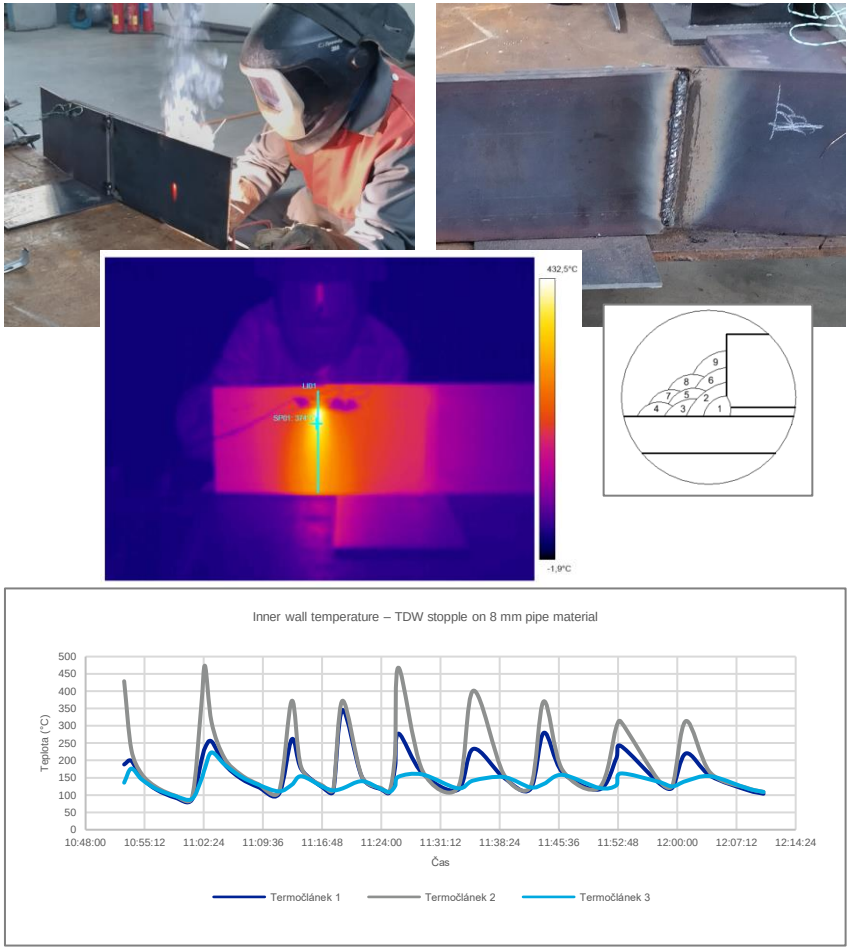
Hydrogen Induced Cracking due to elevated temperatures – short exposures

- Based on preliminary results from ongoing JIP (joint industry project), considerable increase of hydrogen diffusion into the steel lattice in short time starts only above **~730°C** (austenitic temperature)

High Temperature Hydrogen Attack – long exposures

- Based on widely accepted Nelson Curves, hot tapping on N4G steels could have effect only by long **(>100h**) exposures to high temperature **(>200°C**) hydrogen at high pressure **(>40bar partial pressure[2]**)

Own experiment to understand inner wall temperatures



Results & implications

Max. measured inner wall temperature below 500°C

- Conservative WT (8mm) chosen / would be lower by higher WT

Fast temperature decrease below 200°C

- Exposition to >200°C only in minutes[1]

Limits for HIC or HTHA are by far not overstepped by N4G hot tapping practices

1. ~75s cooling from ~500°C to ~200°C and 9 passes = ~11mins above°200°C 2. 5% H2 @ 70bar = 3.5bar hydrogen partial pressure 3. Some activities – e.g. material compatibility of TDW high-strength stopple fittings – still ongoing & monitored

Repurposing of N4G H2 triangle seems highly feasible after first detailed assessment

First internal bottom-up estimate. Work-in-progress. No compression

Key retrofit items identified for ~900 km of potential H2 triangle	Costs (relative to largest item)
Separation of H2 triangle pipelines from rest of the network	■■■■■
Replacement of valves & resealing of flanges	■■■■□
Replacement and strengthening of maintenance equipment for minimization of venting	■■■□□
Upgrade of commercial metering at border transfer stations	■■■□□
Cleaning & purging with nitrogen before conversion	■■□□□
Repair of individual pipes	■■□□□
Replacement of electrical equipment in EX zones, which is not in ATEX IIC class	■□□□□
Replacement of devices affected by potential vibrations stemming from higher flow velocities	■□□□□

Repurposing CapEx lower than ~0.2 mil. EUR / km indicated by EHB studies

NET4GAS

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Ďakujem za pozornosť!