Connecting Markets

From Vision to Reality: Czech H2 Backbone and its role in the emerging Hydrogen Economy

Czech H2 Backbone Dialogue

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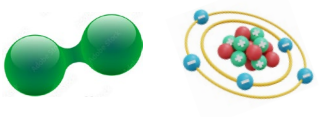
Gas infrastructure will be pivotal to make (green) hydrogen economy viable in Europe

H2 molecules vs. electrons



Some CO2 intensive sectors are hard-to-abate with electrification

- Industrial processes (ammonia, steel, methanol) or heavy-duty long-haul transport
- Already ~8 Mt/y (~265 TWh) consumed in EU

Electrical T&D infrastructure by far not developed for a hypothetical full electrification scenario

- Hundreds of GWs of new RES power would be needed in EU, doubling the current capacity

Intermittent nature of renewable electricity sources will require a coupling medium such as H2 (P2G)

- Batteries with system backup for minutes at max (at costs ~100 EUR/MWh el.), while gas infra for whole seasons (at ~10 EUR/MWh H2)

H2 molecules will be required to support electrons

Location of (green) H2 production

Green H2 needs low-cost RES electricity to be competitive, which is location specific

- >50% of green H2 production costs is cost of input electricity from RES

RES location can push green H2 production costs from as low as 2 EUR/kg in e.g. Southern Europe towards 8+ EUR/kg in Central Europe

H2 demand clusters are far from places suitable for low-cost RES el. production

Transporting H2 is much cheaper than transporting electrons

- Foreseen German H2 pipeline backbone of 9ths km, 101GW feed-in capacity, and 19B EUR costs, compared with German SuedLink 4GW HVDC, 700km, and 10B EUR el. transmission project

Electrolysis will be located in geo areas suitable for RES

Importance of gas pipelines

There are ~200 ths km high-pressure transmission pipelines in Europe

- Most of which can be repurposed for transporting H2

Levelized costs of transporting 1 kg H2 per 1000 km could be as low as 0.10 EUR in repurposed pipelines

H2 Purity through (repurposed) pipelines could gradually increase from initial 98+% towards 99.5%

- 99.5% is suitable for most demand cases except for mobility, where purification with costs <0.7 EUR/kg would be required

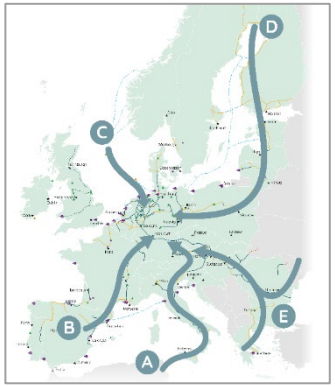
Pipelines will be key to supply H2 demand centers in EU

Czechia (and N4G) have good prospects for participating in the emerging EU H2 economy

Favorable geographical location of Czechia

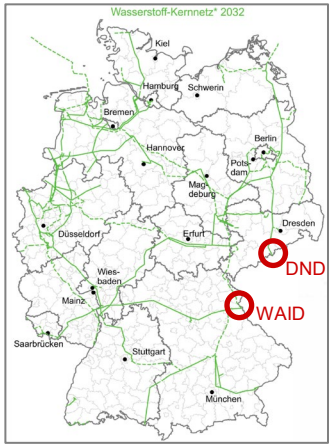
CZ lies on the foreseen trans European H2 corridors

- 3 out of 5 corridors could utilize N4G assets
- But strong competition from alternative routes



CZ adjoins the approved German H2 core network

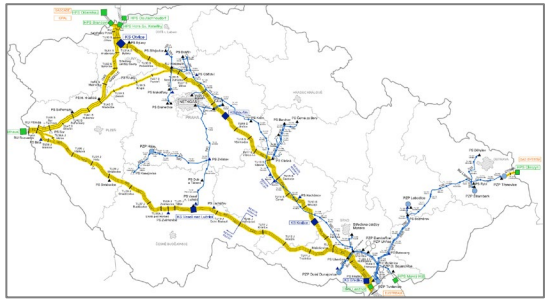
- ~9ths km of high-pressure pipelines to be operational by 2032
- Connection @ IPs Waidhaus & Deutschneudorf



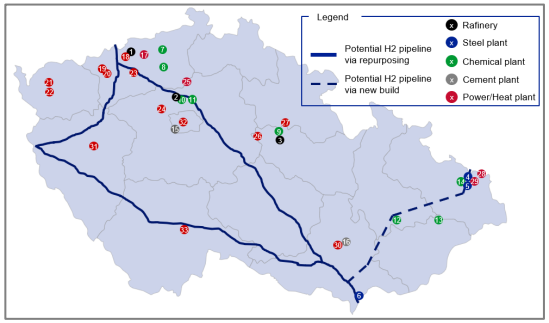
Robust N4G infra in the vicinity of expected industrial demand

N4G has a robust transport infra to safely accommodate both future H2 and CH4 needs for decades to come

- 3 parallel high-capacity lines on most branches

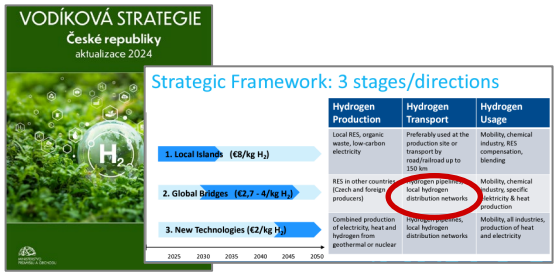


Many for H2 relevant Czech industries are placed along the N4G infra



Strong political support within the Czech H2 Strategy framework

Czech H2 Strategy: Transport of H2 via the existing TSO infra is highlighted as one of key building blocks



Hydrogen as one of key strategic pathways for N4G under the state ownership

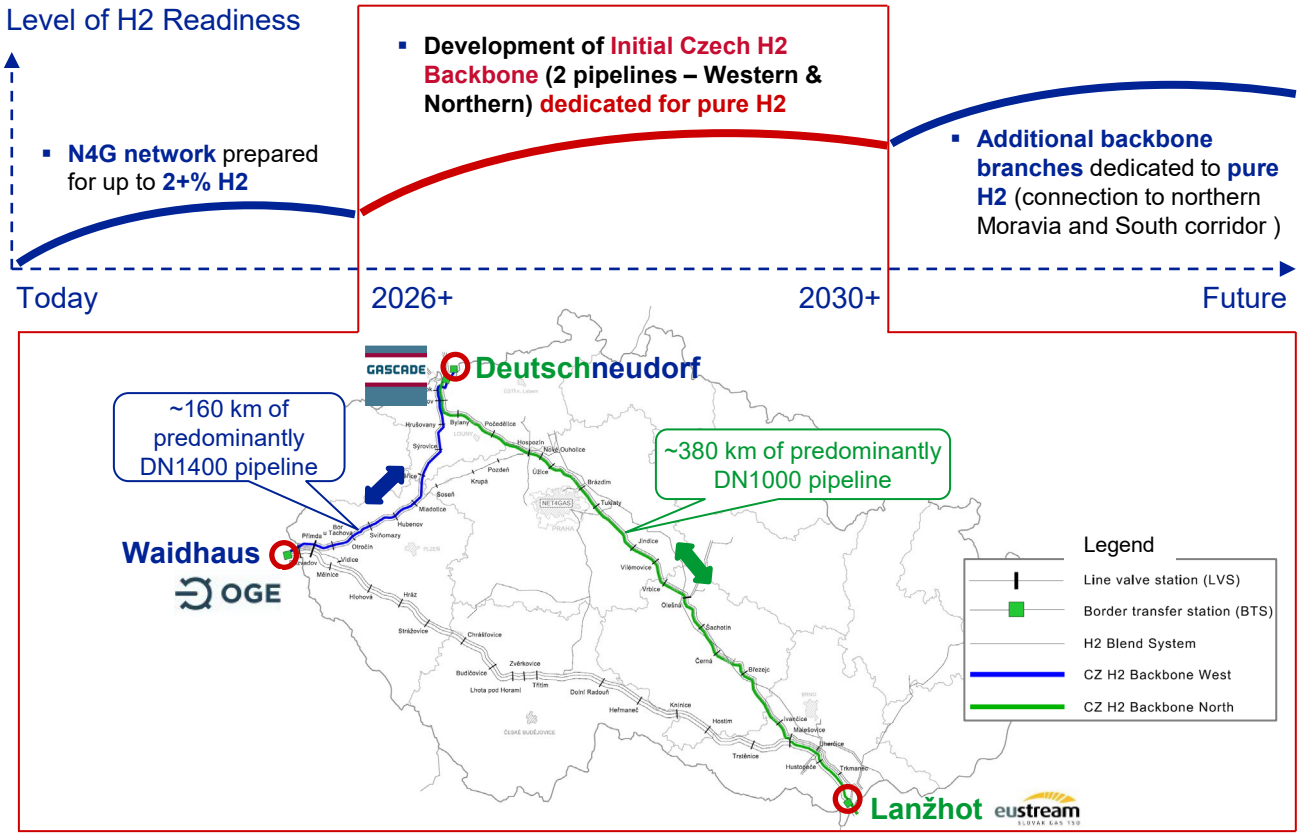
MINISTRY OF INDUSTRY AND TRADE

NET4GAS

ČEPS

N4G is working towards initial CZ H2 Backbone to connect 3 key cross border points by ~2030

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



Comments

- **First dedicated N4G H2 corridors** expected to be made available via **repurposing** of existing infrastructure **~2030**
  - Depending on demand development, regulatory regime, and financing scheme
  - **Currently West and North corridors prioritized**, connecting 3 IPs (DND, LAN, WAID), with **shared starting capacity of 6GW** (144 GWh per day), **98+% H2 purity**, and expected **pressure** in the system at **30-40 bar**
- To-date results strongly support **viability of H2 retrofits** of existing N4G infrastructure **at reasonable costs**
  - West with completed basic design phase and North with feasibility study

H2 corridors are currently being developed in dedicated projects together with other TSO partners

NET4GAS is currently working on development of 4 international hydrogen transport corridors

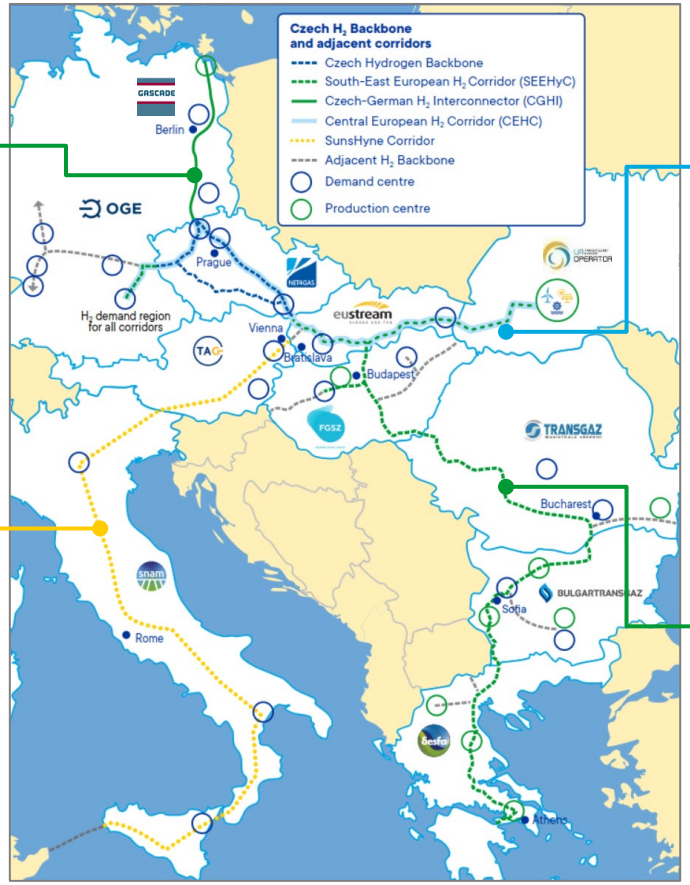
CEHC & CGHI included on 1st PCI/PMI H2 list
(from 51 applications[1] & 4 selected projects in HI East)

Czech German Hydrogen Interconnector (CGHI)

- **Route:** 1068 km from the Baltic Sea and northern Germany to Czechia and southern Germany
- **Target capacity:** 144 GWh/d
- **Status:** FEED[2]
- **Start of operation:** 2030

SunsHyne Corridor

- **Route:** ~3400 km from northern Africa to central Europe
- **Target capacity:** 144 GWh/d
- **Status:** Pre-feasibility
- **Start of operation:** 2030+



Central European Hydrogen Corridor (CEHC)

- **Route:** 1225 km from Ukraine to central Europe
- **Target capacity:** 144 GWh/d
- **Status:** Feasibility
- **Start of operation:** 2030+

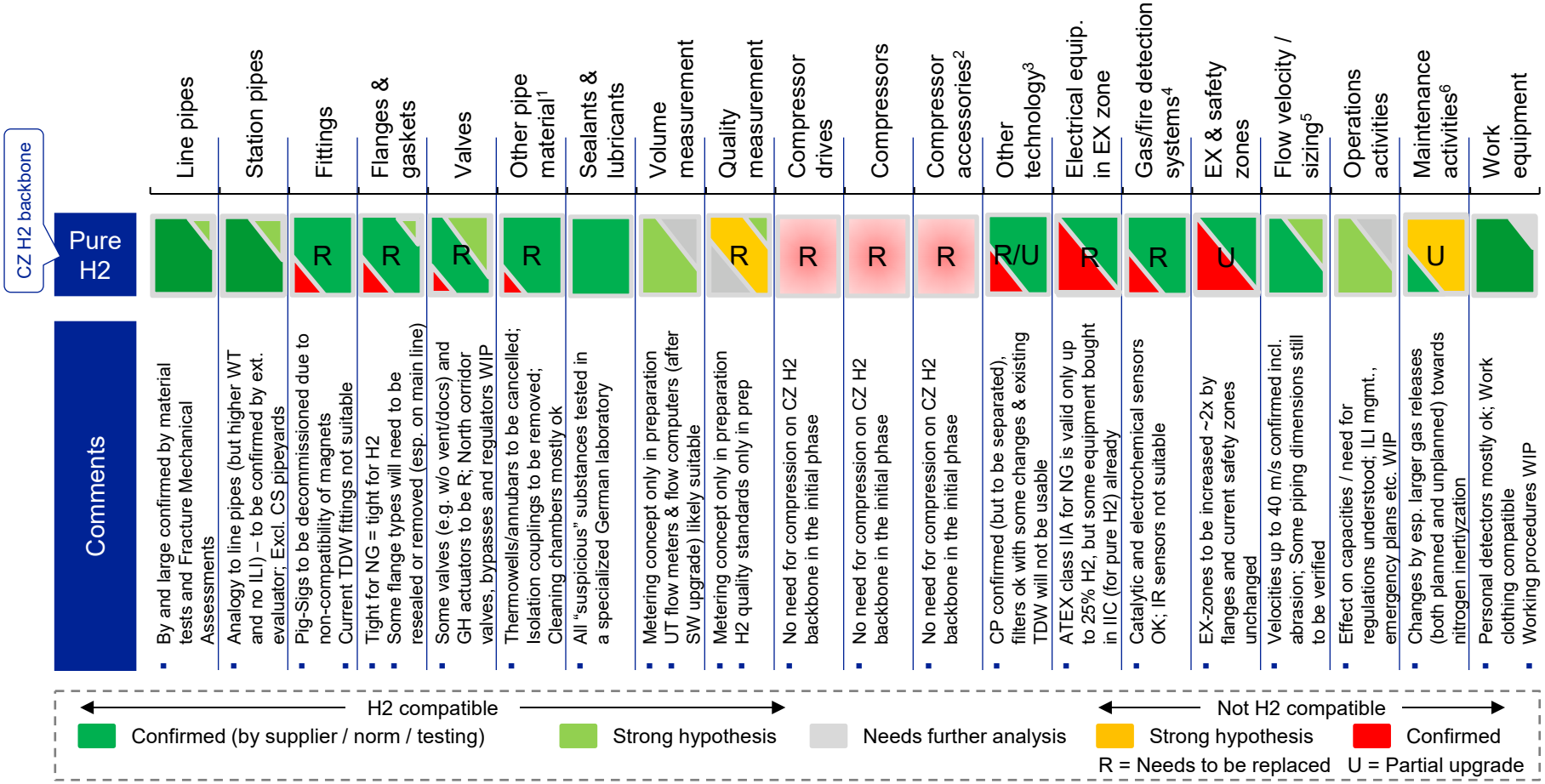
South-East European Hydrogen Corridor (SEEHyC)

- **Route:** ~3000 km from the Balkans to central Europe
- **Target capacity:** 80+ GWh/d
- **Status:** Pre-feasibility
- **Start of operation:** 2030+

NET4GAS aims to defend PCI status in the upcoming 2nd PCI round

1. Transmission and storage projects 2. Front end engineering and design
Note: www.cghi.eu, www.cehc.eu, www.sunshynecorridor.eu, www.seehyc.eu

Detailed technical concept for Czech H2 Backbone nearing finalization



CZ Backbone West: Basic design stage completed, Permit design phase to start
CZ Backbone North: Feasibility study completed, Basic design stage to start

1. Thermowells, cleaning chambers, isolation couplings, etc. 2. Fuel path incl. regulation station, anti-surge system 3. Filters, Cathodic protection TDW 5. Incl. vibrations and pulsations 6. Cleaning & inspection, venting and other manipulations, excavations

Biggest retrofit cost item is separation of H2 backbone pipelines from the rest of the network

Key retrofit items for the foreseen CZ H2 Backbone	Costs[4] (relative to largest item)
Separation of H2 backbone pipelines from rest of the network ▪ Redesign of main nodes (Lanzhot, Primda, Malesovice, Jirkov), upgrade of pigging chambers (old design and/or one-way), cut-off & capping of connection branches, diversification of DS connections, separation of cathodic protection	
Selective replacement of valves & resealing (or cancellation) of flanges ▪ Replacement of some valves (based on type, age, tightness, documentation), adjustment of LVS[1] bypasses, resealing of main flanges, cancellation of some flanged/screwed connections, replacement of GH[2] actuators, retrofit of control valves	
Replacement and strengthening of maintenance equipment ▪ Including mobile compressors & flares of different sizes, and nitrogen purging equipment – all with potential synergies with Decarb. project ▪ Extension of paved areas at line valve stations to accommodate the equipment	
Upgrade of commercial metering at border transfer stations ▪ Retrofit of Lanzhot's 2nd metering section for ~150+ GWh/d capacity (35bar & 35m/s)	
Cleaning & purging with nitrogen before conversion ▪ Includes 5 cleaning runs, natural gas recompression, nitrogen purging at 1 bara, and H2 first fill works	
Repair of individual pipes ▪ Repairs of pipes with higher wall thickness reduction – generally >20%	
Replacement of electrical equipment in EX zones, which is not in ATEX IIC class ▪ Upgrade of all relevant actuators, control and junction boxes assumed due to extension of EX zones and increased requirement for ATEX ▪ Relocation of some lighting poles	
Replacement of devices affected by potential vibrations stemming from higher flow velocities ▪ All annubars, thermowells and remaining pig-sigs to be replaced	

Capex per retrofitted km estimated ~1/3 of western European benchmarks[3], and <1/10 compared to newbuild

1. Line valve station 2. Gas hydraulic 3. Based on EHB 2023 study 4. No compression, current prices, 98% H2 purity, excl. linepack

Tight repurposing schedule until 2030, with several table stakes still to be solved by mid 2026