NET4GAS

Connecting Markets

Kde a kdy se v ČR objeví vodík a kolik bude stát?

SŽ, Praha

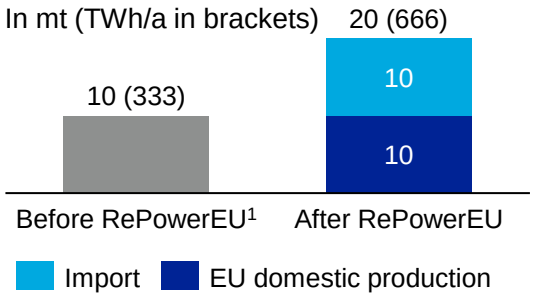
3.10. 2023

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

Ambition: REPowerEU 2030

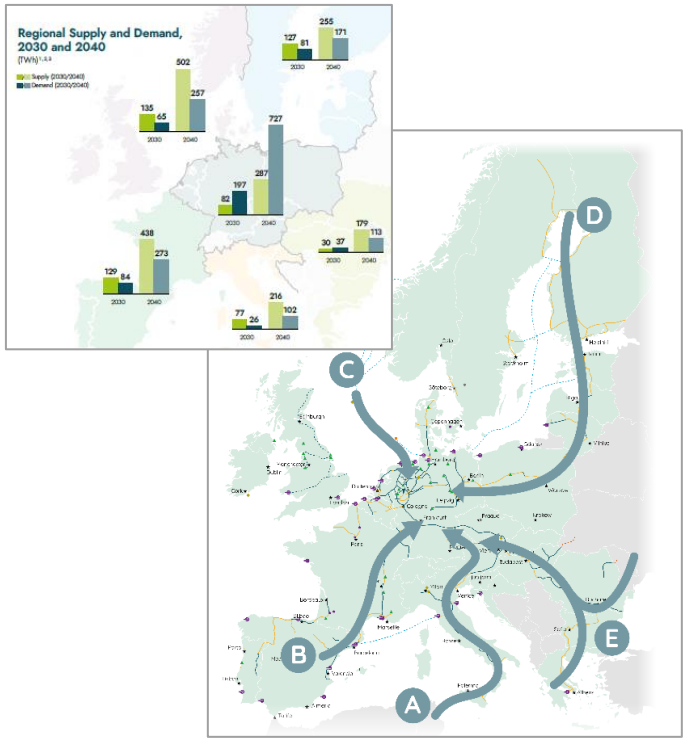
- EU **plan to address the current energy security crisis**
- Focus on **supply diversification, energy savings**, and **accelerated transition to clean energy**
- **Hydrogen is integral part of this plan**
  - **Increase of 2030 supply target** from 10[1] to 20 mt of renewable H2
  - **Recognizing the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

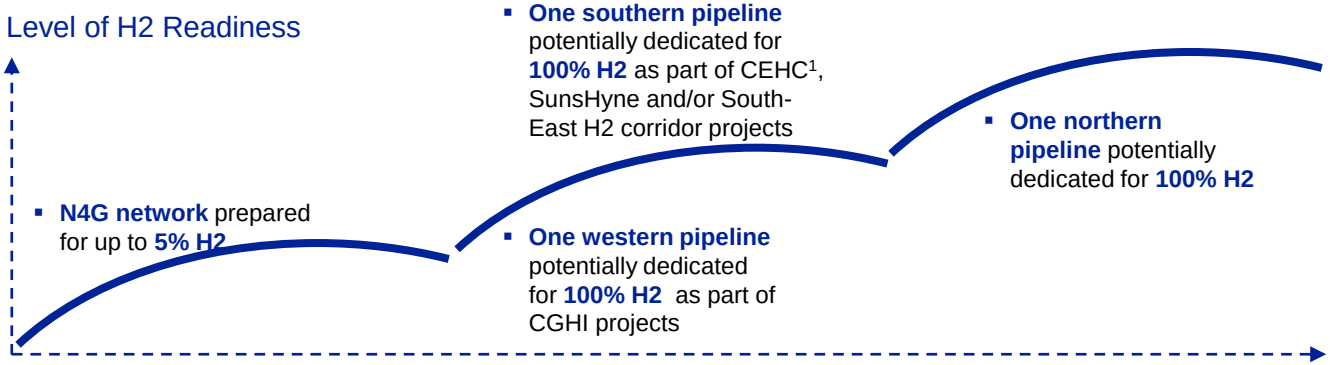
- Identify and develop relevant partnerships / cooperation with neighboring TSOs and other players within the emerging hydrogen value chain to focus on key topics such as joint transport projects, grid readiness, H2 injection, or deblending

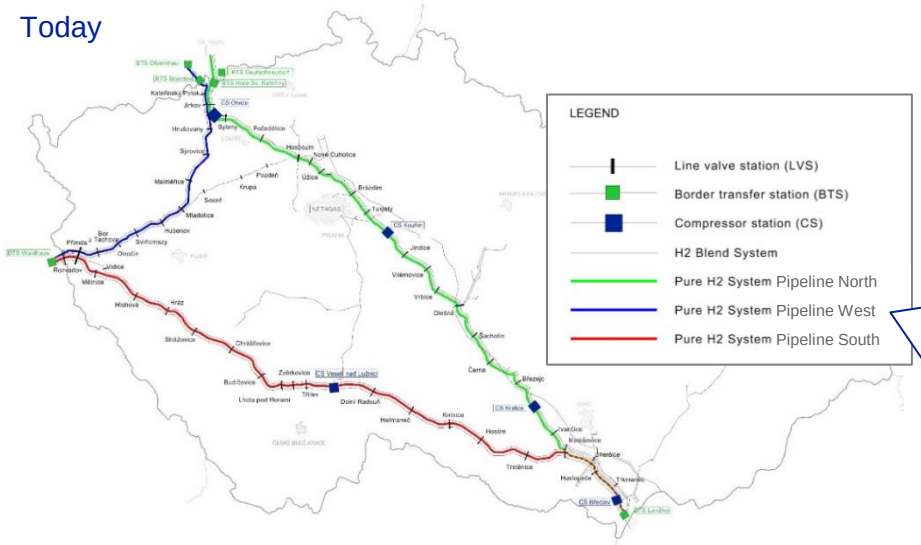
5 Organization & Governance

- 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

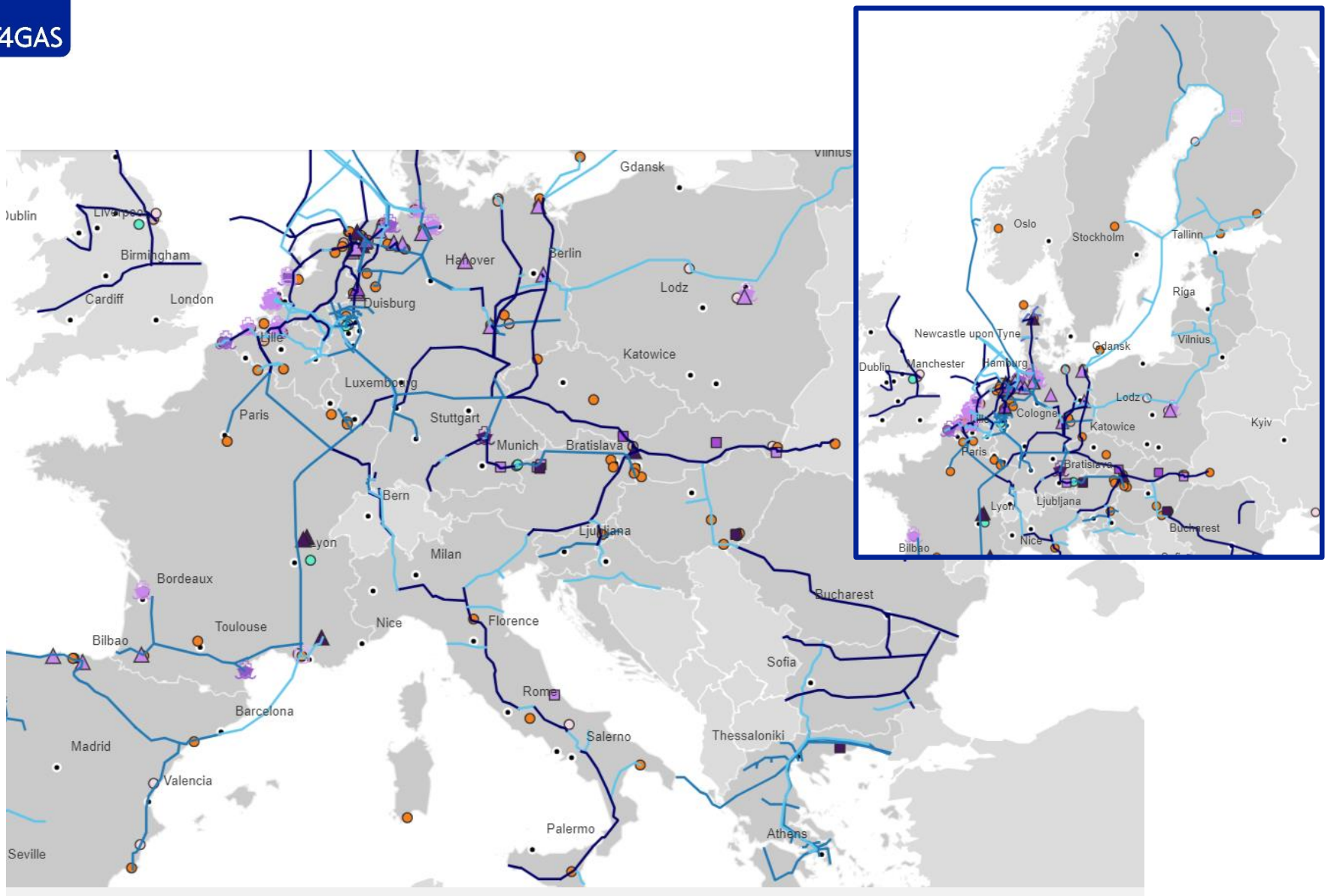
1. Central European Hydrogen Corridor

We are currently developing 5 pure 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		

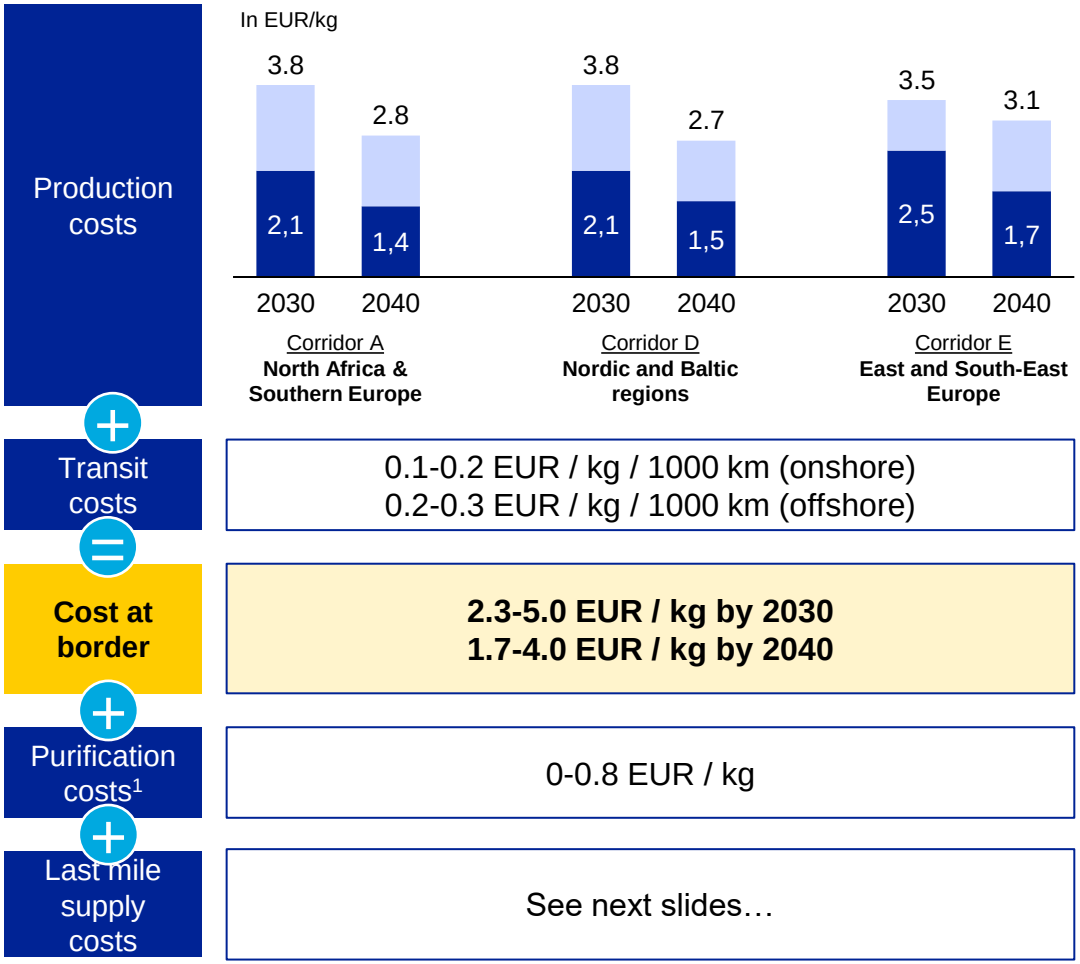
1. Subject to meeting all contractual capacity obligations

European Corridors 2030 www.h2inframap.eu



Hydrogen imports will ensure affordable access to hydrogen at scale from 2030

Estimated costs of imported renewable & low carbon H2



Comments

- **Cost of renewable & low carbon H2 imported** to CZ borders: 2.3-5.0 EUR/kg in 2030, 1.7/4.0 EUR/kg in 2040 **vs**. **realistic cost of domestic production** of renewable H2: 8-15 EUR/kg in 2030
- **Potential of low production costs** in favorable regions **already proven** in Gulf region:
  - Green H2: 2 EUR/kg today, 1.4 by 2030, 1.1 by 2050
  - Blue H2: 1.3 EUR/kg today, 1.1 by 2030
- Key **drivers of reducing the price of imported** renewable and low carbon **H2**
  - Support of more colors of hydrogen – blue H2 as more affordable alternative (at least during the initial phase)
  - Connection to multiple source regions – 1. Higher chance of actual supply 2. Increased competition for producers
- **Imported H2 will most likely require purification** to ensure desired quality for mobility

Sources: EHB, Leef Technologies, AFRY, Rina, internal analysis

1. Subject to required technical grade of hydrogen. Assuming technical grade of 1.8 (98% purity) – 2.5 (99.5%) can be achieved when transporting via repurposed gas pipelines. Currently assuming cost of 0.8 EUR/kg to purify H2 from technical grade of 1.8 (98%) to 3.7 (99.97%). Assuming technical grade of 3.7 as sufficient for FCEV

Last mile supply: Overview of options to supply H2 fueling stations from planned H2 triangle

Overview of last mile options for connecting H2 fueling stations

Pipeline

Direct connection

- Direct connection to TSO grid or fueling station at H2 triangle premisses
- Good solution for high volumes and short distances

DSO connection

- Connection via DSO grid
- Good existing NG grid penetration of Czechia
- Most DSO grid likely not ready for pure H2 before 2040

Trucking/Railroad

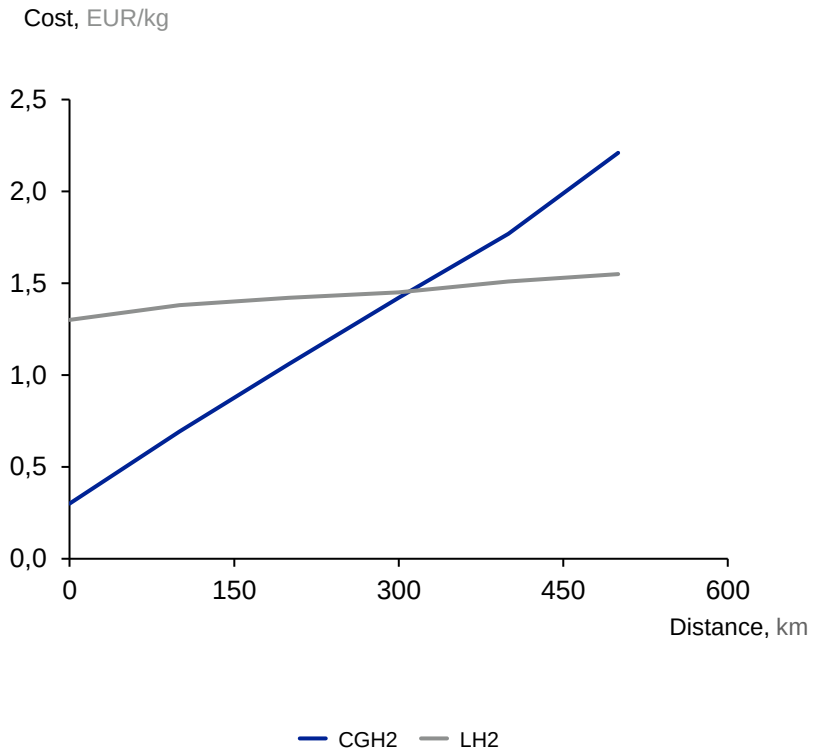
Compressed gas H2

- Compressed gaseous H2 transported via trailers
- Good option for small distances, efficiency drops rapidly with distance due to low energy density
- Limited potential to scale

Liquified H2

- Liquified H2 transported via trucks
- Alternative option to CGH2 for larger distances and scale
- Technology still in early stage, high costs associated with liquification

Costs and options for distribution (trucking only)



Source: BCG analysis

Last mile supply: Developing last mile supply infrastructure along H2 triangle could accelerate H2 development within mobility sector

Comments

- Utilization of H2 supply infrastructure along the planned H2 triangle could enable access to affordable hydrogen, accelerating of the development of hydrogen consumption in mobility sector
- Several options to be considered:
  - Option A: Filling stations for CGH2 transport to H2 fueling stations
  - Option B: H2 fueling stations directly at the premises of H2 triangle
- Example: Building CG H2 supply infrastructure at the locations of N4G compressor stations could cover most of the highway infrastructure in Czechia

Illustrative example: 100km geographical reach of CGH2 filling hubs at N4G compressor stations

To be further explored