



THE ROLE OF POWER-TO-GAS IN THE V4 REGION

**V4 Energy
Think Tank
Platform**
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Scope of the paper

1. Summary of the status of hydrogen and power-to-gas in the region;
2. Relevant targets and objectives based on the National Energy and Climate Plans and Hydrogen Strategies;
3. Relevant models of sector coupling;
4. Open regulatory issues related to the topic;
5. Conclusions

V4 Energy Think Tank Platform

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In the paper we used the following terminology

Source	Colour
Fossil fuels, mainly natural gas	Grey H2
Fossil fuels with carbon capture and storage	Blue H2
Nuclear	Purple H2
RES (PV, Wind, Hydro)	Green H2

- 95% of hydrogen in the world is produced from natural gas or coal (grey H2).
- Out of the 9.8 Mt of hydrogen that is annually produced in the EU, 95% is manufactured from gas which emits about 328 gCo2eq/kWhH2.
- **The paper focuses on Green Hydrogen**, but in case of the status quo we include total H2 production in the region.
- The EU taxonomy declares hydrogen whose production process a maximum of 174 gCo2eq/kWhH2 as low carbon.

Status quo – Mainly grey hydrogen production

Czech Republic

- 10 industrial plants produce grey hydrogen, such as oil refining in the case of Unipetrol and Česká rafinérská.
- TriHyBus project, coordinated by ÚJV Řež, a.s., a Czech Institute of Nuclear Research and joined among others by Linde Gas and Proton Motor (grey hydrogen).
- There is no existing P2G project in the Czech Republic and only **one project in planning phase** in the city of Trutnov. The **hydrogen produced from the PV plant will be supplying buses** going around the city and to nearby.

Slovakia

- 2 big hydrogen producers, chemical plants Fortischem and Duslo located in Nováky and Šala. Most of hydrogen produced in Slovakia is used in the chemical industry, in internal manufacturing processes of chemical and petrochemical plants (**grey H2**)
- The Slovnaft oil refinery plans to increase its hydrogen production capabilities in Bratislava by building another H2 production plant that will be using natural gas for this purpose.

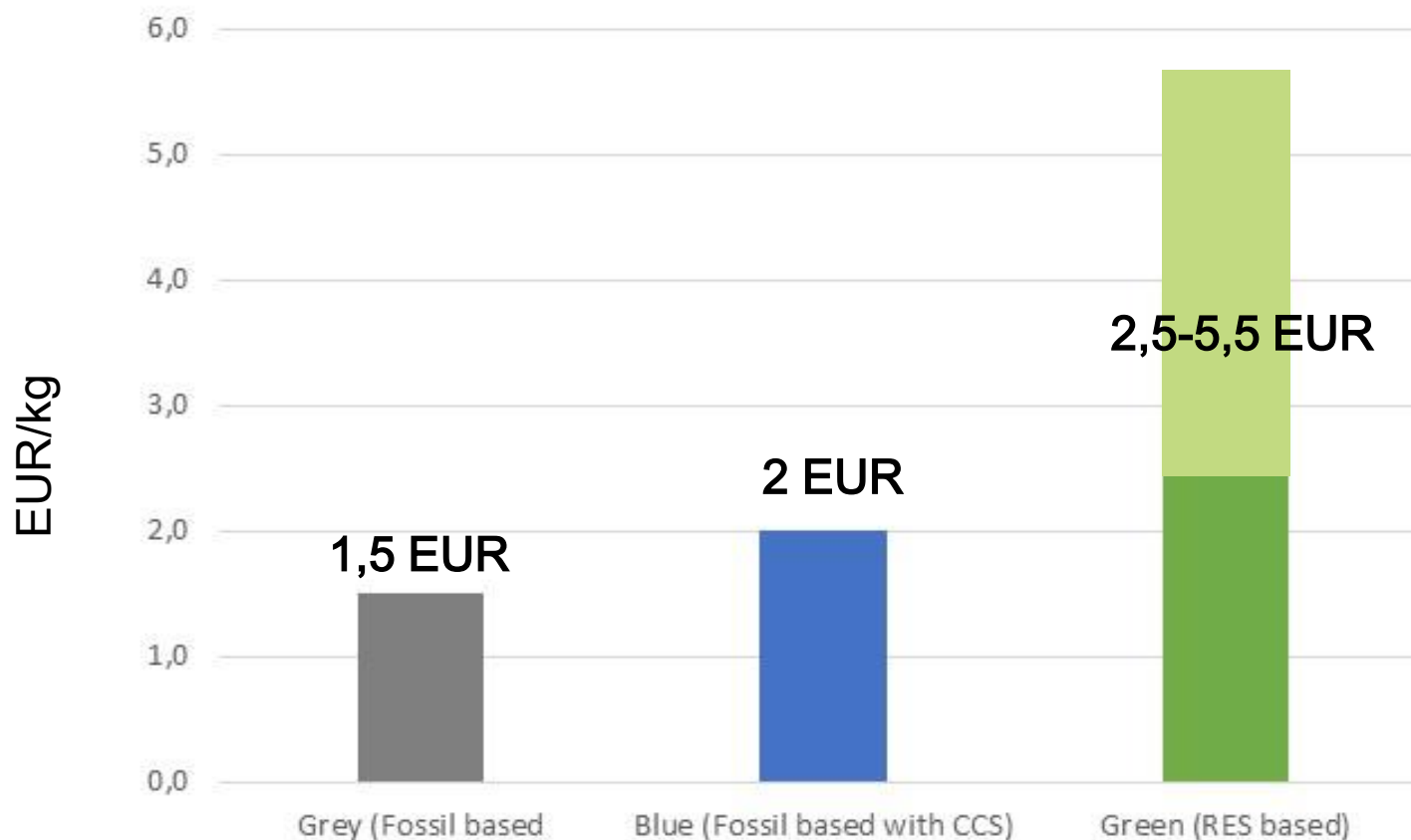
Hungary

- Hydrogen production plants in Hungary mostly serve chemical and petrochemical processes. The most important hydrogen producers are the MOL Danube oil refinery and a chemical raw material manufacturer BorsodChem. **They use grey hydrogen (from gas).**
- **One P2G project already in operation:** The project is operated by Power-to-Gas Hungary Kft., and it employs a power-to-gas technology based on biological methanation that is unique in the world and was developed by Electrochaea (P2M type).

Poland

- **Poland is the fifth largest hydrogen producer in the world,** producing about 14% of Europe's hydrogen demand. (**grey H2**)
- The companies Azoty, the largest chemical company in Poland, and Lotos, an oil and gas company involved in oil refining, are responsible for over a half of H2 produced in Poland.
- Another important player in H2 production is PKN Orlen, the biggest player in the Polish fuel market.
- These companies use hydrogen in the internal chemical processes of their plants, for fuel production, production of ammonia, chlorine and polyvinyl chloride.

Green Hydrogen – Cost estimation



- 60% decrease in the last ten years
- Further 50% estimated by 2030, will be competitive with fossil H₂
- Hydrogen produced from natural gas using CCS might be a transition step according to some authors

Source: EU H₂ Strategy

Planned P2G investments in the Visegrad Countries

Country	2020	2024	2025	2030	Source
Czech Republic				0,4-1,7 GW	NECP, Clean Mobility Action Plan
Hungary	10 MW (1 project)			0,6 GW	NECP
Slovakia					NECP
Poland				2 GW	NECP, Draft Hydrogen Strategy
Germany	0,8 GW (40 projects)		5 GW		Hydrogen Strategy
EU Total	1 GW	6 GW		40 GW	Hydrogen Strategy

- Share of hydrogen in the EU energy mix remained under 2% until 2018
- The planned total energy will equal to 12-15 bcm natural gas' energy content vs 400 bcm total natural gas usage in Europe in 2030 (OIES)

Sector coupling models

1. Energy storage

- Storing surplus RES-E from wind and solar
- The most cost-efficient technology for long-term storage
- Linking electricity and gas sector

2. Gas sector decarbonisation:

- Power-to-gas can help to decarbonise the gas sector and continue the use of the gas infrastructure by synthetic methane and biomethane or hydrogen via blending
- However, as the V4 countries together with Bulgaria, Greece, Lithuania and Romania stated in a joint non-paper, in order for the gas infrastructure to be able to adequately and safely serve the needs of a low-carbon and RES intensive energy mix, the gas infrastructure needs to be properly maintained and further developed.

3. Transport sector decarbonisation

- Transport sector proved to be really hard to decarbonise -> Plans for H2 fuelled vehicles
- Electricity-Transport sector coupling

4. Decarbonisation of the fossil based H2 production

- Huge potential for GHG reduction

Role of P2G in the V4: Preferred sector coupling models

- H2 technology and its usage in transport has been identified as strategic goal

- Gas sector decarbonisation
- H2 usage in transport (RES-based)



- North-South hydrogen highway' to transport offshore wind energy to the industrial area in the South -> replacing grey H2 by Green H2
- Also in Transport

- Plans for hydrogen in the transport sector from RES-E

Open regulatory issues – Numerous questions to answer

1. Establish Hydrogen Market:

- a) Gas Directive is *not valid* for Hydrogen (CEER-ACER White Paper, Febr 2021)
- b) The Hydrogen Strategy of the EU emphasises the need to develop an enabling regulatory framework for a well-functioning hydrogen market, however, it leaves key questions unanswered such as market rules, the role of different market players (mainly the network operators), unbundling, third party access, and tariff formulations. Relevant targets and objectives based on the National Energy and Climate Plans and Hydrogen Strategies;
- c) This is not clear however how could be a market-based hydrogen market established when the projects will be realized based on supports and subsidies

2. Guarantee of origin (from RES)

- Who will issue certificates for Green Hydrogen?
- What about H₂ produced from the grid or mixed sources?

Open regulatory issues

3. How to subsidize?

1. Tax allowance
2. Tax exemption (in Austria)
3. Investment support (EU Funds) – TEN-E on the PCI list H2 instead of natural gas
4. Innovation support (EU Funds)
5. Funding available for blue Hydrogen or not?
6. Obligations / Quotas
 - In transport
 - Blending (2%- 10%-20%)

Open regulatory issues

4. Regulatory environment update:

1. Blending – Poland is the only V4 country when it is already allowed
2. TPA
3. Wholesale H2 price regulation?
4. How to evaluate nuclear based H2 production from climate perspective (plans in Czech Republic, Hungary)
5. Safety regulations: Already existing but should be extended
6. ...

Regional conclusions

- Not competitive, but might be the missing puzzle in long-term decarbonisation
- **Step-by-step approach proposed for the region:**
 - **Stage 1 – Decarbonising current fossil based H2 production**
 - **Stage 2 – Producing green hydrogen from RES-E and usage in local environment (industry, especially steel-making, transport)**
 - **Stage 3- Decarbonising sectors where other ways of decarbonisation and electrification is not feasible – reach all hard-to decarbonize sectors (heating etc)**
- Not profitable on market based terms -> role of subsidies and clear regulatory incentives is important
- **Region depending on natural gas – opportunity for gradual decarbonisation of the gas sector: *Blending ratio cooperation, H2 pipelines cooperation***

Thank you for you attention!

V4ETTP

Green Hydrogen ambitions – Czech Republic I.

ELECTROLYSER CAPACITY

- ▶ No specific target, consider support

The **development of hydrogen technology and its usage in transport has been identified as one of Czech Republic's strategic goals.**

NECP / Clean Mobility Action Plans:

- install 15 hydrogen refuelling stations by 2025, 80 by 2030
- tax breaks for hydrogen-powered vehicles
- 95 hydrogen buses in the public transport infrastructure by 2025 and 870 hydrogen buses by 2030
- the number of fuel cell vehicles operating should be between 40.000 to 50.000 by 2030

The Orlen group began construction of two hydrogen refuelling stations in Prague and Litvinov. The points will be constructed by the end of the year and should be available to motorists in 2021. Plans to use as a fuel in Czech public transport. [Refuelling stations] will be supplied with hydrogen produced during crude oil processing at UNIPETROL's refineries in Litvínov and Kralupy nad Vltavou



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Green Hydrogen ambitions – Czech Republic I.

GAS SECTOR DECARBONISATION SURPLUS RES STORAGE

▶ n.a.

▶ No specific target

INDUSTRY

Hydrogen is used in production of components for automotive petrol, motor gasoline, kerosene and diesel fuels and for hydrogenation of vegetable oils and animal fats. A significant share of hydrogen production in Czechia is used for production of ammonia -

> **Possibility for decarbonising H2 production**

OTHER

▶ ÚJV Řež, a. s. (a member of the Czech energy group headed by ČEZ, a.s.). has developed and offers to potential customers hydrogen energy storage systems which are capable of serving as back-up power sources, stabilizing power supplied to the grid from renewable sources, or facilitating the operations of energy self-sufficient facilities/buildings.

Key ambitions – Hungary

ELECTROLYSER CAPACITY



Innovation Fund – 3-4 pilot projects:

- Energy storage technology for Bükkábrány PV
- Power-to-gas seasonal storage methanasition for local sewage company

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Role in Transport: 51 ktoe hydrogen usage in transport sector is planned to be realized fully from renewable sources by 2030

Gas sector decarbonisation is in the focus of the NECP/NES

Blending of hydrogen to existing gas network is studied:

GAS SECTOR DECARBONISATION



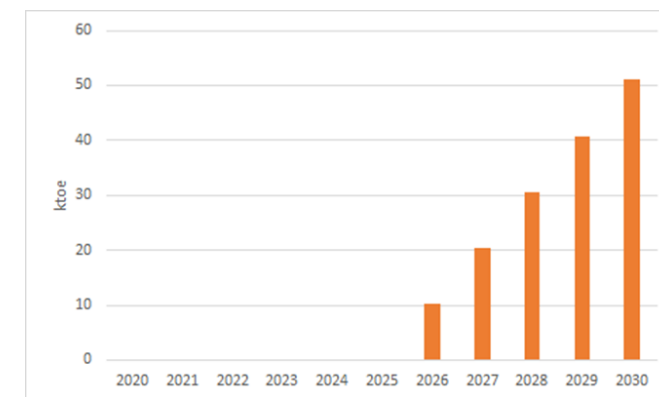
- FGSZ is planning options to use H2 and SNG in the existing network
- Storing in the underground gas storage – MFGT innovation project: Akvamarin Projekt – Hydrogen storage at Magyar Földgáztároló Zrt

Biogas + P2G project

SURPLUS RES STORAGE



see tranport



Key ambitions – Slovakia

P2G CAPACITY

- ▶ In terms of P2H, there are projects only at their beginnings.
Slovakia plans for hydrogen to play an important role in the transport sector
Hydrogen Technology Research Centre in cooperation with the Technical University of Košice (announced / established in September 2020) should focus on hydrogen production, storage and development in automotive transport

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- ▶ The city aims to reach at least 60% of its public transport fleet to consist of zero-emissions vehicles by 2025. In April 2020, the Ostrava Public Transport Corporation announced a tender for planning documentation for the project "Development of hydrogen mobility in Ostrava (Phase 1)"

GAS SECTOR DECARBONISATION



SURPLUS RES STORAGE



- ▶ Duslo Šaľa company plans for wind farms that would produce green hydrogen, but the timeframe has not been indicated yet.

INDUSTRY

- ▶ The Moravian-Silesian Region plans to invest in hydrogen and make the region the first "hydrogen valley" in Central Europe.

Key ambitions – Poland

- P2G CAPACITY** ▶ 2GW in electrolyser capacity to produce green hydrogen from renewable energy, mainly from off-shore wind. Poland wants **to build a 'hydrogen highway' to transport future offshore wind energy from the Baltic Sea in the North to industrial and consumer centres** in the South of the country.
„A sister strategy for offshore wind is hydrogen strategy, we must move both tracks in parallel” (Climate Minister Kurtyka)
- TRANSPORT** The first two hydrogen refuelling stations will be built in Warsaw and Gdansk by Lotos, Poland’s leading oil company and a member of Hydrogen Europe, by the end of 2021.
- GAS SECTOR DECARBONISATION** ▶ PGNiG’s new hydrogen program which consists of several projects – from the **production of green hydrogen through its storage and distribution, through introducing hydrogen as a blend into the gas network**, to its use in industrial energy. Over the next four years, PGNiG plans to spend over \$8 million on research related to the new program
- SURPLUS RES STORAGE** ▶ Green hydrogen production using solar panels (InGrid – Power to Gas project)
Due to its substantial market share in ammonia production and refinery capacity, Poland has a considerable opportunity to help decarbonise its economy by deploying renewable or low-carbon hydrogen in the industry sector.
- INDUSTRY** H2 role in industry – base in South – North-South Hydrogen corridor, but It is still unclear, whether the government will opt for strengthening already existing north-south power transmission lines and then produce hydrogen locally adjacent to southern industrial centres, or rather “build a completely new system dedicated to hydrogen

EU funds available for Green Hydrogen project funding

- IPCEI
- NextGenEU
- REACT-EU
- CEF
- ETS Innovation Fund
- InnovFin Energy Demonstration Projects

Sources & Further readings

- EU Hydrogen Strategy & EU Energy Sector Integration Strategy
- ACER & CEER Joint White Paper on Hydrogen Regulation
- OIES
- Poland Hydrogen Strategy (Draft, published on 14 January 2021)
- NECPs of the Visegrad Countries