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DANUBE REGION
strategy
Energy

MINISTRY OF
FOREIGN AFFAIRS AND TRADE
OF HUNGARY

Study on the hydrogen markets of the DRS countries

The Study was prepared for the Ministry of Foreign Affairs and Trade of Hungary

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KPMG

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Prosperity through Diversity

Table of Contents

1 Executive summary

KPMG has prepared a state -of-art study on the hydrogen economy in the Danube Region, with the aim to identify synergies and cooperation opportunities between countries in the Danube Region (hereinafter referred to as the Danube Region Strategy (DRS) countries) and their hydrogen markets as well as to analyse prospects for regional hydrogen sector development (hereinafter referred to as the Study) with the contents detailed in the contract with the Ministry of Foreign Affairs and Trade (later on KKM).

As part of the assignment, KPMG

1. Analysed hydrogen market indicators
2. Reviewed local climate and hydrogen strategies
3. Presented an outlook of expected hydrogen market developments projects until 2040
4. Introduced regional research and development (R&D) projects and partnerships
5. Assessed regulatory considerations regarding the hydrogen value chain
6. Explored and identified potential cooperations and synergies within the Danube Region

Information on the hydrogen markets of DRS countries highlighted that there are **significant differences in hydrogen production, consumption, regulation,** and **infrastructure development** initiatives among the countries – especially when it comes to comparing EU and non-EU DRS countries' hydrogen markets.

The **top three hydrogen producers** in the region are **Germany, Hungary**, and **Slovakia**, with **Germany far ahead of the others** in **both production capacity**, **actual output and consumption**. The country's annual hydrogen demand is significantly higher than that of all other countries in the region combined.

Germany is also **leading** the way in **hydrogen infrastructure plans** with 90 new production projects in development along with the ambitious plans to repurpose already existing gas pipelines and to establish new hydrogen pipelines. Austria follows with 10 planned production projects, while all other countries in the region have less than

10 planned market development infrastructure projects. Hydrogen storage projects are currently being developed only in Germany, Austria, and Slovakia.

Accordingly, **Germany** has the **most regulatory** and **financing mechanisms** to support hydrogen market development. Through its policies, the country provides **direct subsidies, investment funds,** and **state aid** to accelerate hydrogen adoption in heavy industry, mobility, and energy infrastructure. Meanwhile, **other EU DRS countries** have **limited regulatory framework** for supporting their respective hydrogen markets with policies (where they do exist) largely **limited to supporting hydrogen** adoption **in the transport sector** through incentives for refueling infrastructure and fuel cell vehicle deployment.

Among **non-EU DRS countries**, solely **Ukraine** emphasizes explicitly **hydrogen as a key component** of its decarbonization strategy. However, Ukraine along with all non-EU DRS countries **have yet to establish dedicated hydrogen-focused policies**, regulatory frameworks, or government-backed funding programs to support hydrogen market development.

Analysis result shows that there are several existing forms of cooperation between the DRS countries in the field of hydrogen. Most of these are focused on infrastructure development, but in addition to these there are also a number of research and innovation as well as knowledge sharing partnerships and initiatives – all of which could be extended in scope and/or through involving additional countries from the region.

Beyond existing initiatives, our research identified further potential forms of partnerships and cross-country collaboration opportunities that bear additional potential to develop and improve cooperation between DRS countries. Such potential lies in regulatory alignment, joint funding applications, industrial partnership, and common R&D initiatives. However, foundations for these initiatives are still to be laid down.

2 Background

The European Union's energy landscape has undergone major transformations in recent years, driven by both EU-wide policy commitments as well as external shocks. On an EU-wide level one of the most influential policy frameworks is the European Green Deal, introduced in 2019 that sets a legally binding target for the EU to achieve net-zero greenhouse gas emissions by 2050. With its ambitious objective the Green Deal necessitates a fundamental restructuring of the current energy system in Europe which is still largely dependent on fossil fuels. To achieve this, the scenarios prepared by the European Commission assume that the member states' current cumulative annual gas consumption of about 450 bcm will be reduced to 100 bcm which amount will also be replaced by decarbonised gases namely hydrogen, biogas, synthesis gas, etc.

However, geopolitical events have introduced new complexities to natural gas supply and energy security planning and thus increased the urgency of phasing out Russian gas. The 2022 Russian invasion of Ukraine placed the issue of gas supply security into focus, exposing the vulnerabilities of European countries – especially those in the Danube Region – that heavily rely on natural gas imported from Russia. As the conflict intensified, gas prices rose dramatically, raising affordability concerns for both industrial and household consumers across Europe. Within this overall picture, the Danube Region emerged as one of the most vulnerable macro-regions. Many of its countries rely on Russian natural gas to a greater extent than the EU average, making them disproportionately exposed to supply cuts and price hikes.

In response to these pressures, the European Commission introduced the REPowerEU plan in March 2022 which aims to reduce the European Union's reliance on Russian fossil fuels more rapidly. The plan includes measures designed to facilitate energy savings, increase the production of clean energy, and diversify energy supplies by strengthening gas storage requirements, developing new pipeline connections, and facilitating the uptake of low-carbon gases. Within this context, hydrogen has emerged as a potential key solution for many countries seeking to decarbonize their energy, transport, and industrial sectors. The potential for the versatile use of hydrogen represents a huge opportunity for

the Danube Region countries to decarbonise their energy systems in line with their national targets.

However, despite the promise it holds, the development of a hydrogen-based economy in the Danube Region remains uneven. While countries such as Germany and Austria have advanced National Hydrogen Strategies and pilot projects, several others in the region are just beginning to establish the necessary legal frameworks, infrastructure, and market incentives. Where strategies do exist in countries like the Czechia, Slovakia, Croatia, and Hungary they often reflect national-level priorities rather than a coherent transnational approach. As a result, the region lacks a coordinated framework to ensure that national supply and demand are compatible and complementary at the macro-regional level. Potential synergies for instance, leveraging extensive gas pipeline networks for hydrogen transport or capitalizing on varying capacities for renewable hydrogen production remain underexplored due to limited collaboration among countries. Enhanced cooperation between DRS countries can help to reduce their dependence on natural gas more quickly and cost-efficiently. Examining which sectors are capable of substitution and the potential and cost of these actions in terms of gas savings can provide a basis for setting priorities and allocating resources efficiently.

Consequently, the Ministry of Foreign Affairs and Trade would like to examine and analyse in detail the entire hydrogen value chain (production, transport, storage, end-use, along with regulatory and financial issues), with the ultimate objective of developing a Danube Region Hydrogen Strategy, focusing on synergies between national efforts.

To this end, the KPMG has carried out the first step, i.e. the development of a state-of-art study that analysed the Danube Region countries' hydrogen strategies and development visions, their alignment with national energy strategies and EU expectations, as well as the DRS countries’ most important planned and existing hydrogen projects.

3 Our approach

As a first step, KPMG began the analysis by comprehensively collecting **data** on **hydrogen supply, demand,** and **production capacities** in the DRS countries, as well as examining **existing** and **planned infrastructure projects and initiatives** needed to support hydrogen transportation and storage in the Danube region. In this initial phase, we reviewed **national strategic goals** set by governments of DRS countries in their respective **National Energy and Climate Plan** and (where available) their **National Hydrogen Strategy**. We equally compiled information about **ongoing** and **planned hydrogen projects** including the establishment of new hydrogen production and the development of storage facilities and of hydrogen pipelines (including both the repurposing of existing natural gas pipelines and the development of new hydrogen pipelines). Additionally, to validate our findings we contacted country representatives ensuring that our assessment accurately presents the most up-to-date information on hydrogen markets in each DRS country. Following, we carried out thorough assessments of current market characteristics and trends with a particular focus on green and blue hydrogen–related aspects. During this step, we looked for potential synergies in infrastructure development, identifying opportunities where new projects or shared facilities efforts and cooperations might increase efficiency and accelerate market growth within the Danube Region.

Next, we conducted a high-level regulatory overview to map main policy instruments, incentives, and frameworks that support and drive the development of hydrogen markets in the DRS countries.

Finally, the collected information, data, and local insights were integrated into a comprehensive overview of hydrogen markets in the Danube Region, providing both a detailed analysis and a high-level future outlook. We integrated key messages that underscore major trends and highlight areas of potential cooperations and synergies between DRS countries given the current state of their hydrogen markets.

Figure 1. Research methodology

Our analysis draws on a wide range of publicly available data sources to provide a detailed and comprehensive understanding of hydrogen production and consumption, infrastructure, storage and means of applications. One of the key datasets used in this research is the International Energy Agency's (IEA) Hydrogen Production and Infrastructure Projects Database, which provides project-level data on low-emissions hydrogen production and transmission pipelines across the globe.[1] This database, created to complement the Global Hydrogen Review 2023, includes a comprehensive list of operational and announced hydrogen projects, classified by technology types and statuses, from initial concept to full operation. In addition, we leveraged resources from the Clean Hydrogen Partnership initiative including the European Hydrogen Observatory (EHO) platform, that provides in-depth and up-to-date data on the entire hydrogen value chain in Europe.[2,3] Additionally, information on key regulatory considerations and strategic goals in the DRS region was primarily drawn from the NECPs and National

[1] *IEA (2024) Hydrogen Production and Infrastructure Projects Database*
[2] *Clean Hydrogen Partnership: European Partnership for Hydrogen Technologies*
[3] *European Hydrogen Observatory platform*

Hydrogen Strategies of the respective countries included in this study.4 However, it is important to note that as this study relies on publicly available information and data regarding the hydrogen markets in the Danube Region, it does not necessarily mean the information is exhaustive. Furthermore, to enhance the accuracy and depth of our analysis, this was supplemented by conducting written data collection with DRS country experts and representatives to validate our findings and provide additional insights into the region-specific challenges as well as the development prospects of hydrogen markets across the DRS countries.

[4] *European Commission: EU countries' 10-year national energy and climate plans for 2021-2030*

4 Current state of the hydrogen markets in the DRS countries

This chapter provides a comprehensive summary of the hydrogen markets in the **DRS countries**, covering key aspects of **production, consumption, infrastructure,** and **trade**. The objective of this analysis is to assess the **current state of hydrogen markets** in the region, **highlight national-level strategies,** and **identify trends in future hydrogen demand, consumption**, and **infrastructure deployment**. To achieve this, we have gathered and synthesized data on **existing and planned hydrogen production capacities, hydrogen demand, ongoing and planned infrastructure projects, trade flows** – depicting each DRS countries' imports from and exports to countries within the EU and the rest of the World (RoW) – **and future consumption and production projections**.

Our study compiles the most recent publicly available data on most significant hydrogen production and infrastructure projects, offering insights into each country's strategic approach to hydrogen deployment. Data on hydrogen **consumption, production,** and **trade** for 2023 was sourced from the **European Hydrogen Observatory**.[3] Information on announced **hydrogen production and infrastructure projects** was collected from multiple **databases published by the IEA**.[1] Future hydrogen consumption and production projections were extracted from **each country's NECP** and **NHS**.[4] Where such estimates were unavailable, publicly accessible reports and research papers were used to provide the most accurate projections.[5,6,7] In addition to these sources, we also **contacted hydrogen industry experts** and **representatives** from the countries included in this research. In cases where information provided by these national experts differed from those found in the IEA or the European Hydrogen Observatory databases, we **prioritized the insights from country-specific experts** to ensure the most up-to-date and contextually accurate representation of the hydrogen market in each region.[8]

[5] *Leonhard Povacz and Ramchandra Bhandari (2023): Analysis of the Levelized Cost of Renewable Hydrogen in Austria*
[6] *European Hydrogen Backbone (2021): Analysing future demand, supply, and transport of hydrogen*
[7] *Gas Connect Austria (2022): Hydrogen import opportunities for Austria 2030*
[8] *Information from hydrogen industry experts and country representatives of the analysed DRS countries*

Furthermore, maps showcasing planned hydrogen pipeline projects are included in the Study for each DRS country which were adapted from maps published by the European Hydrogen Observatory. However, there are certain pipeline projects that have been announced after the publication of the maps by the European Hydrogen Observatory, and hence do not appear on these maps but are mentioned in the NECP and/or NHS of the respective countries**.** Consequently, while these projects may not be visible in the mapped visualizations, they have been documented in our analysis, incorporating all available information from the respective NECP and NHS of the given country.

Initial comparisons (see Figure 2 and 3) of hydrogen production capacity and actual production as well as annual hydrogen demand across the DRS countries reveals significant disparities. **Germany** stands out as the **most dominant hydrogen producer in the region**, with a production capacity of nearly 2,000 kt per year and actual output of 1,395 kt – far exceeding all other DRS countries. This reflects its well-established industrial base, significant hydrogen demand, and strong policy support for hydrogen development. **Hungary** and **Slovakia** follow as the **second** and **third-largest producers** in terms of actual output, with 198 kt and 170 kt, respectively, with Hungary also having the highest production capacity after Germany, at 258 kt per year. **Romania**, despite having the third-highest hydrogen production capacity in the DRS region at 248 kt per year, has a relatively low actual production of only 96 kt, thus a significant portion of its potential remains untapped**. Bulgaria** and **Austria** exhibit a similar pattern, with production capacities of 183 kt and 173 kt, respectively, but lower actual production levels. **Croatia** and **Czechia** have moderate production capacities of 150 kt and 130 kt, yet their actual hydrogen production remains below 100 kt. **Slovenia**, has the lowest production capacity in the region (3 kt per year) and an actual production of just 2 kt, remaining in the early stages of hydrogen market development.[3]

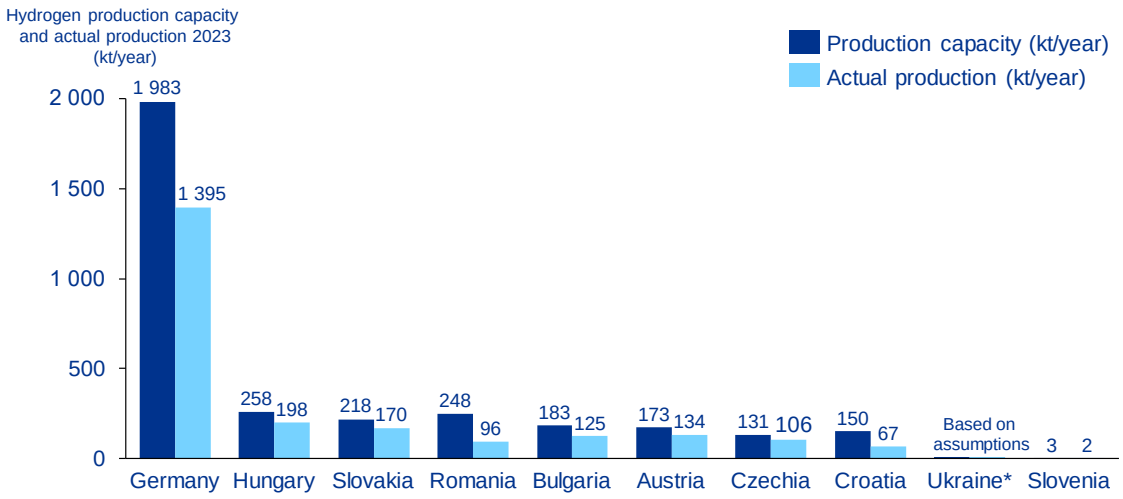


Figure 2. Comparison of hydrogen production capacities and actual annual hydrogen production of DRS countries (kt/year)

Source: European Hydrogen Observatory platform[3]

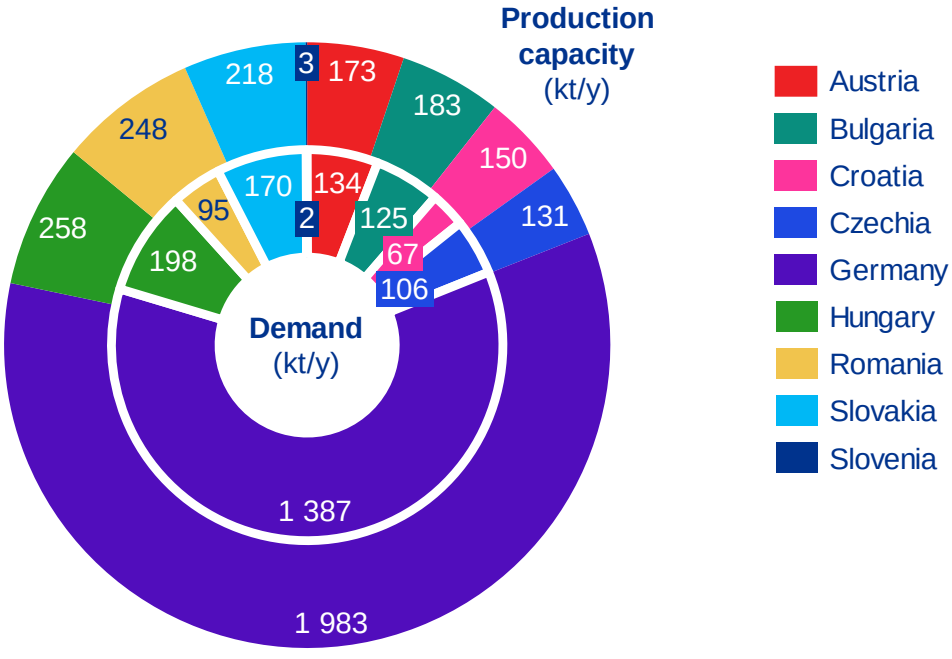


Figure 3. Total hydrogen production capacity and demand in DRS countries (kt/year)

Source: European Hydrogen Conservatory platform[3]

Table 1. Summary table of hydrogen trade information for EU DRS countries in 2023
Source: European Hydrogen Observatory platform[3]

Country	DRS import (t/year)	Total import (t/year)	DRS export (t/year)	Total export (t/year)	Total consumption (t/year)	% of import from DRS countries	Net import/export (t/year)	% of import in relation to demand
Austria	597.3	616.1	58.2	58.3	133,946	97%	Importer	0.46%
Bulgaria	0.7	30.4	-	0.8	124,950	2%	Importer	0.02%
Croatia	3.9	7.7	0.0	0.3	66,874	50%	Importer	0.01%
Czechia	231.0	446.5	23.9	80.8	106,249	52%	Importer	0.42%
Germany	49.3	1,724.5	314.9	1,146.4	1,387,075	3%	Importer	0.12%
Hungary	9.6	11.5	119.7	168.2	197,860	83%	Exporter	0.01%
Romania	40.5	50.2	0.5	0.5	95,253	81%	Importer	0.05%
Slovakia	18.4	95.5	431.4	443.4	169,908	19%	Exporter	0.06%
Slovenia	1.1	30.2	2.9	10.2	1,777	4%	Importer	1.70%

As per the available import-export summary data (Table 1), **hydrogen trade** is not considered to be a liquid market in the **DRS countries**, indicated by **merely visible trade volumes** across the region. Among the nine countries **Hungary** and **Slovakia** are the **only net exporters**, with net import-export balances of **156.7 t and 347.9 t**, respectively. Accordingly, the other 7 **countries are net importers**, relying on external supply sources to meet their domestic hydrogen demand.

In 2023, the **average share of imports** in relation **to total demand** across the EU DRS countries was **0.32%**. Among the countries, **Slovenia** had the **highest import reliance**, with **1.7%** of its total hydrogen demand met by imports.

Although the overall import dependency across the region remains low, and data demonstrate a moderate level of intra-regional trade, on average **43% of the imported hydrogen** in the region originates **from other DRS countries. Austria, Hungary,** and **Romania** stand out with **the highest shares of hydrogen imports** – 97%, 83%, and 81% respectively – **imported from within the Danube region**.

These figures further underscore the fact that, while some hydrogen trade exists within the EU DRS countries, the **market remains highly fragmented** and **underdeveloped**, lacking the liquidity needed for a dynamic trading environment.

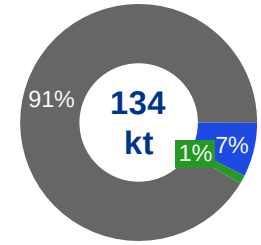
The following sections will delve into each country's hydrogen production, consumption, and trade landscape in greater detail, along with key infrastructure, production and storage projects driving future growth, and national strategies aimed at developing hydrogen markets.

4.1 Austria

Production

172.8 kt
Total annual hydrogen production capacity in 2023

133.5 kt
Total hydrogen produced in 2023

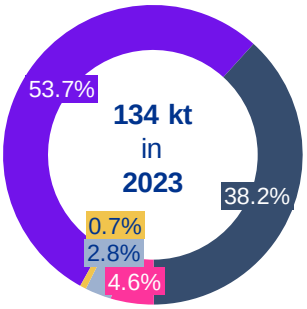


Reforming
By-product
Electrolysis using RES

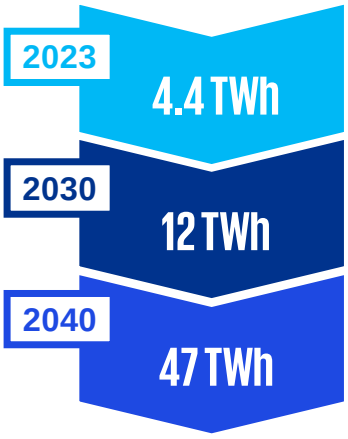
13
Operating hydrogen production plants

10
New production projects in the pipline with capacities ranging 2 – 300 MW

Consumption



Refining
Ammonia
Other chemicals
Industrial heat
Other



Ammonia production was the most prominent hydrogen end-use sector in 2023, overall **accounting for over half (53.7%)** of the **final consumption**

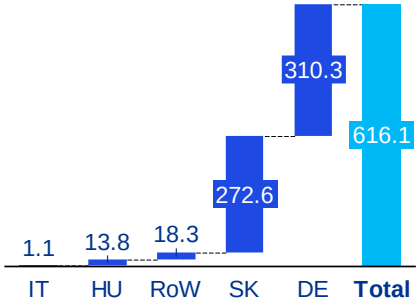
Pipelines

720 km

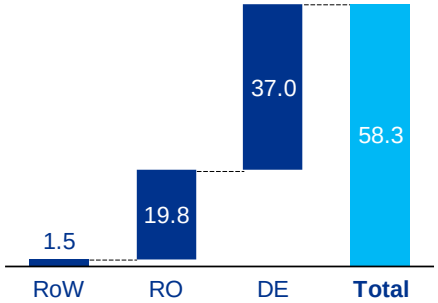
Austria has plans in place to develop a total of **720 km of hydrogen pipelines by 2030,** consisting of **380 km of repurposed natural gas pipelines** of the Trans Austria Gas (TAG) network (168 GWh/day capacity) and the **H2 Backbone WAG + Penta-West** (150 GWh/day capacity) which includes **140 km repurposed pipelines** and **200 km new pipelines**

Trade

Imports in 2023 (t/year)



Exports in 2023 (t/year)



Austria is one of Europe's leading countries in hydrogen production with its advanced industrial base and well-developed energy infrastructure. With a focus on decarbonizing energy-intensive industries and expanding renewable hydrogen, Austria continues to prioritize hydrogen's integration into its energy system as per its NECP and National Hydrogen Strategy.[9,10]

In 2023, Austria's aggregated hydrogen **PRODUCTION** capacity was **172.8 kt/year** across **13 operational production plants**, with **actual production** reaching **133.5 kt/year**. The majority of hydrogen (91%) is produced through fossil fuel-based reforming processes, with 7% coming from industrial by-products and 1% from electrolysis using renewable energy.[3]

On the demand side, the Austrias's annual hydrogen **CONSUMPTION** was around **134 kt.** Ammonia production was the most significant end-use sector, accounting for 53,7% of total consumption, followed by refining, which made up 38.2%.[3]

A central goal in Austria's NECP, as well as in its National Hydrogen Strategy, is the **installation of 1 GW** of **electrolyser capacity by 2030**, enabling the large-scale production of renewable hydrogen. To decarbonize energy-intensive industries, the strategy aims to **replace 80%** of **fossil-based hydrogen** with **climate-neutral hydrogen by 2030**, supporting Austria's broader climate neutrality objectives. The strategy emphasizes the development of a robust network of hydrogen refuelling stations to facilitate the growth of hydrogen-powered mobility, while simultaneously fostering research and innovation. To strengthen its hydrogen ecosystem Austria is establishing the **national hydrogen platform Hydrogen Partnership Austria**, designed to enhance international partnerships, promote collaboration, and support the advancement of hydrogen technologies.[9,10]

To enable the further development of its hydrogen market Austria is focused on building a robust hydrogen **INFRASTRUCTURE** that incorporates both new hydrogen pipelines and repurposed natural gas pipelines (see Figure 4).[1,11] Among the key projects are:

[9] *Federal Ministry Republic of Austria (2022): Hydrogen Strategy for Austria*
[10] *European Commission (2024): Integrated National Energy and Climate Plan for Austria*
[11] *European Hydrogen Backbone: Hydrogen Infrastructure Map*

- the H2 Backbone WAG (West Austria Gasleitung) & Penta West which envisions the installation of 200 km of new hydrogen pipelines along with 140 km of converted existing pipelines. This network is expected to have a transmission capacity of 150 GWh/day and is set to be completed by 2030, forming a cornerstone of the country's new hydrogen network.
- The H2 Collector Ost project is envisioned to supply regionally produced hydrogen to industrial consumers in the eastern region of Austria. It involves the construction of 68 km of new hydrogen pipelines with a transmission capacity of 2.1 million kWh/h, with commissioning planned from 2026 onwards.
- The Startnetz Oberösterreich project focuses on repurposing 135 km of existing natural gas pipelines to integrate hydrogen into Austria's energy system. The initiative is currently in the feasibility study phase with no specific commissioning date determined.[8]
- In parallel, Austria is conducting feasibility studies to repurpose a 380 km section of its existing natural gas infrastructure of the TAG (Trans Austria Gasleitung) network, with an expected capacity of around 168 GWh/day by 2030.
- Additionally, Austria is developing a H2 Roadmap project which is a High-Pressure Distribution network concept connecting multiple locations across the country. Within this framework the development of a hydrogen grid is being driven forward to transition to a renewable grid. A hydrogen network will be parallel to a methane network, while the latter is to be gradually repurposed by 2050.

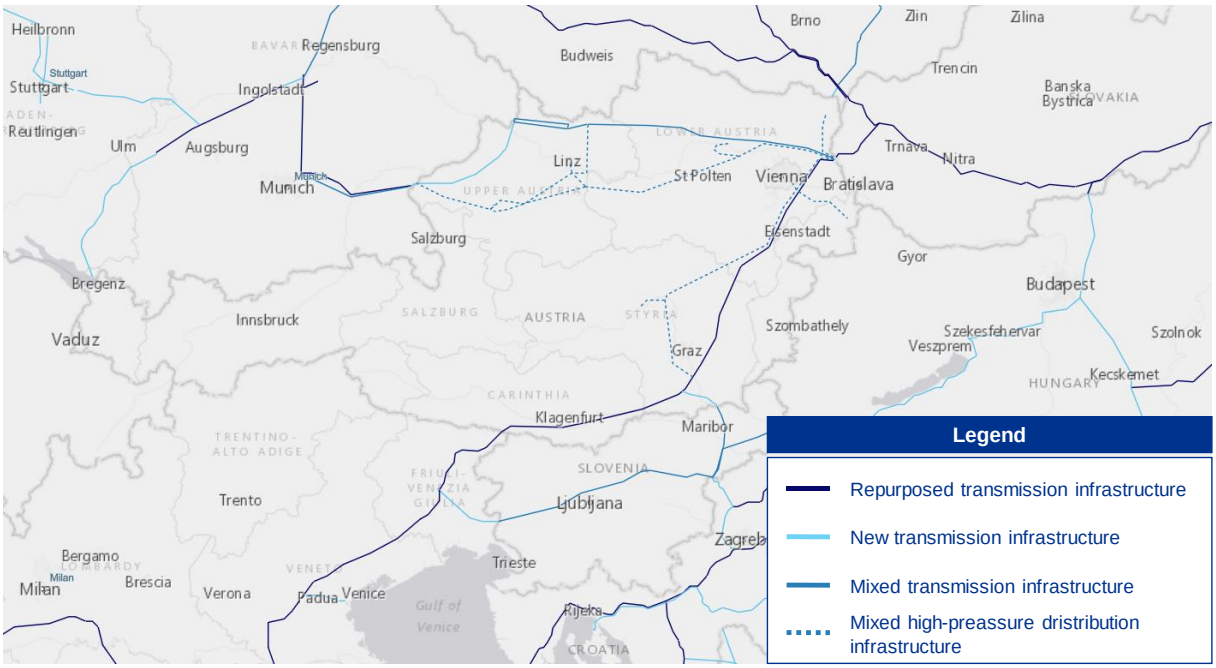


Figure 4. Hydrogen pipeline infrastructure projects in Austria

Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[11]

Moreover, to complement its pipeline network, Austria is developing significant **hydrogen storage capabilities**. There are two hydrogen research storage facilities in place testing the utilization of pure hydrogen in depleted gas fields with an aim to be integrated into the country's hydrogen pipeline network in the future:

- The **Underground Sun Storage**, commissioned in 2023, is a new large-scale hydrogen storage project designed for the safe, seasonal storage of 100% hydrogen in underground reservoirs. With a capacity of 4.5 GWh, it enables the long-term storage of renewable energy in the form of pure hydrogen, helping to balance fluctuations in renewable energy production and demand throughout the year.[12,13]
- The **Underground Sun Conversion – Flexible Storage** project, in place since 2020, is a pilot for exploring the potential for the biological conversion of CO_2

[12] *Underground Sun Storage 2030 (USS) – 2023*

[13] *Underground Sun Storage 2030 (USS) – 2023 – Underground Sun Storage: World's first geological hydrogen storage facility goes into operation*

and hydrogen to methane as flexible energy storage solutions. Having a total storage capacity of 0.33 GWh, the facility can store up to 20% hydrogen.[14]

The above-mentioned existing facilities are planned to be complemented by two big hydrogen storage projects, both utilizing a mix of newly developed infrastructure and repurposed underground natural gas storage. The two projects are the following:

- **2030 H2 Storage Scale-Up project** of RAG Austria, which aims at developing a storage facility in Upper Austria with a planned hydrogen capacity of 3,200 GWh by 2030
- **2050 H2 Storage Scale-Up project** of RAG Austria, also to be located in Upper Austria and Salzburg, aiming for a total storage volume of 26,800 GWh by 2050

Parallel to advancing its hydrogen transportation network Austria is also expanding its hydrogen production capabilities. There are currently **10 new hydrogen production projects** in the pipeline each with capacities ranging from 0.1 to 41.6 kt per year (see Table 2 below).[1,11]

[14] *Underground Sun Storage 2030 (USS) – 2023 – Underground Sun Conversion – Flexible Storage": sustainable storage for the renewable energy system of the future*

Table 2. Announced hydrogen production projects in Austria

Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

Project name	Status	Technology used	Commission date	Capacity (MW)	Capacity (kt / year)
Innio Jenbach - H2 Ready	Under construction	Unknown	2025	2	0.3
Plansee Group - Breitenwang	Under construction	Electrolyser (Grid)	2025	4	0.7
TIWAG Power2X (Phase 1) (within "Power2X Kufstein")	Under construction	Unknown	2025	5	0.1
WIVA P&G Hydrogen Region	Under construction	Electrolyser (RES)	2025	-	3.7
PanHy, phase 1	Feasability study	Electrolyser (RES)	2027	60	10.4
TIWAG Power2X (Phase 2) (within "Power2X Kufstein")	Feasability study	Unknown	2027	1	0.7
PanHy, phase 2	Planned	Electrolyser (RES)	2030	300	41.6
P2G4A	Under construction	Electrolyser (Grid)	2030	50	-
Energie Steiermark plant in Styrua, expansion	Planned	Unknown	-	150	25.8
IPCEI Green Hydrogen @ Blue Danube initiative (RO, BG, SR, HR, HU, SK, AT, DE)	Planned	Electrolyser (RES)	-	-	-

Notably, Austria is the lead country of the **Green Hydrogen @ Blue Danube initiative** – a major hydrogen project with the potential to foster regional cooperation in establishing a trans-European green hydrogen value chain (discussed in more detail in Section 5.1.6).[15,16,17,18]

Austria is also engaged in numerous other international hydrogen cooperation initiatives aimed at strengthening its role in the European hydrogen market and fostering cross-border collaboration. The country is a participant in the **EU Hydrogen Bank**, a financing

[15] *CEEnergy News (2020): Romania's Hidroelectrica takes part in multi-stakeholder European green hydrogen project*

[16] *Hydrogen Central (2024): IPCEI Green Hydrogen @ Blue Danube: Federal Minister of Economic Affairs Robert Habeck and Bavarian State Minister Hubert Aiwanger visit Hydrogenious LOHC Technologies*

[17] *Hydrogenious (2024): Hydrogenious LOHC receives official notification by European Commission for IPCEI Project "Green Hydrogen@Blue Danube"*

[18] *Messe Düsseldorf (2024): IPCEI funding for LOHC project "Green Hydrogen@Blue Danube"*

instrument established by the European Commission to accelerate the development of a renewable hydrogen market within the European Union.[19]

Additionally, Austria is a member of several **multilateral hydrogen-focused organizations**, including the International Hydrogen Trade Forum (IHTF), the IEA, the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE), Hydrogen Initiative (H2I), and the International Renewable Energy Agency (IRENA), reflecting its commitment to global hydrogen development.[8]

Austria's largest producer of renewable electricity (Verbund) has also signed a Memorandum of Understanding (MoUs) in partnership with key stakeholders Sonatrach (Algeria), Sonelgaz (Algeria), VNG (Germany), Snam (Italy), and SeaCorridor (Italy) to advance joint conduct of necessary studies, throughout the hydrogen value chain. [8,20]

Furthermore, the country plays a key role in the **Pentalateral Energy Forum's working group on the Southern Hydrogen Corridor**, which aims to establish a supply route for low-carbon and renewable hydrogen from Southern Europe and North Africa to Central Europe.[8,21]

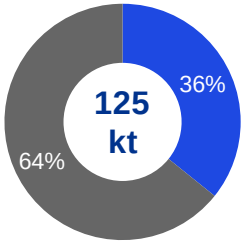
[19] *European Commission: European Hydrogen Bank*
[20] *Hydrogen Industry Leaders (2024): European Players Sign MoU On Green Hydrogen*
[21] *Italian Government (2025): Hydrogen: five States signed a declaration to continue the Southern Corridor works*

4.2 Bulgaria

Production

182.6 kt
Total annual hydrogen production capacity in 2023

124.9 kt
Total hydrogen produced in 2023

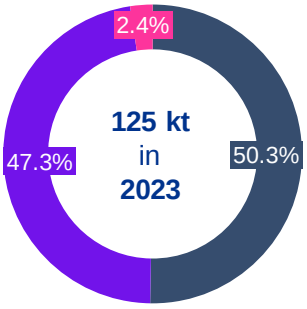


64% of Bulgaria's total **hydrogen production** is generated through **reforming activities,** the other **36%** is produced as **by-products**

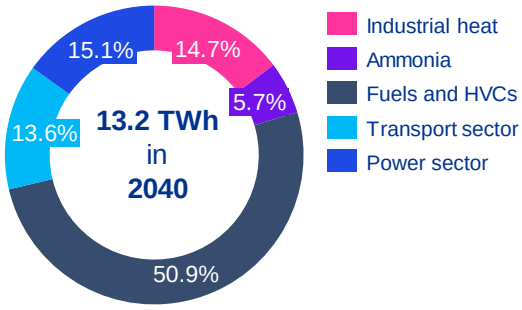
4
Operating hydrogen production plants

2
New production projects in the pipeline as part of the Blue Danube IPCEI initiative

Consumption



Refining was the most prominent hydrogen end-use sector in 2023, accounting for over half **of the final consumption**



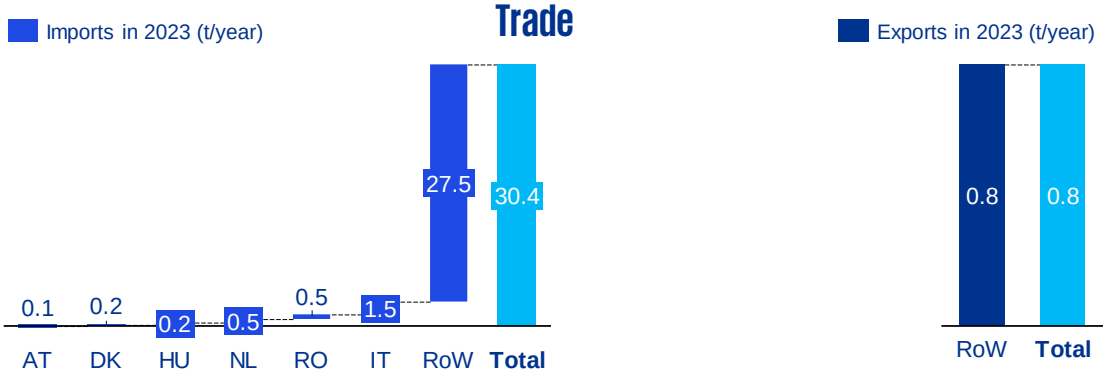
In **2040**, total hydrogen demand will reach **13.2 TWh**, with **fuels** and **high-value chemicals (50.9%)** as the dominant end-use sector

Pipelines

1,550 km

Bulgaria has plans in place to develop a **total hydrogen pipeline network** of approximately **1,550 km** consisting of **730 km repurposed existing pipelines** and **820 km of new pipelines.** Further projects under consideration include an H_2 pipeline from Sofia to Oltenia (Romania) by 2040.

Trade



General overview

Bulgaria's hydrogen market is growing steadily, supported by a national commitment to decarbonization and numerous initiatives to develop a well-connected hydrogen pipeline network. In 2023, the country's total hydrogen **PRODUCTION** capacity was **182.6 kt/year**, with **actual production** reaching **124.9 kt** across **4 production facilities**. Hydrogen is primarily derived from reforming processes (64%), while the rest (36%) is produced as by-products of other industrial activities.[3]

In 2023, the total annual hydrogen **CONSUMPTION** in Bulgaria was also around **124 kt**, with the refining sector accounting for over half the total consumption (50.3%), closely followed by ammonia production processes that had a share of 47.3%.[3]

Bulgaria is undertaking ambitious hydrogen **INFRASTRUCTURE** projects, including the development of a **1,550 km hydrogen pipeline network**, comprising 730 km of repurposed existing gas pipelines and 820 km of new hydrogen pipelines.[1,11] Key projects include:

- The Bulgaria-Greece H2 Interconnection, repurposing 250 km of pipelines to enable the transport of 100% hydrogen by 2029
- SmartSwitch project which aims to upgrade another 480 km of Bulgaria's gas transmission network for transporting hydrogen
- H2 Transmission System in Bulgaria (Phase 1 and 2), constructing a total of 580 km new pipeline for domestic hydrogen transport, scheduled for completion by 2029
- Building an additional 240 km pipeline branch to Kozloduy Region from the main hydrogen transmission system to support industrial hydrogen needs, planned by 2040
- Maritsa East Hydrogen-Ready Pipeline concept which would connect the Sofia region to the Bulgarian-Romanian border for 100% hydrogen transport, with completion targeted for 2030
- A cross-border pipeline concept from Sofia to Oltenia, with completion targeted for 2040

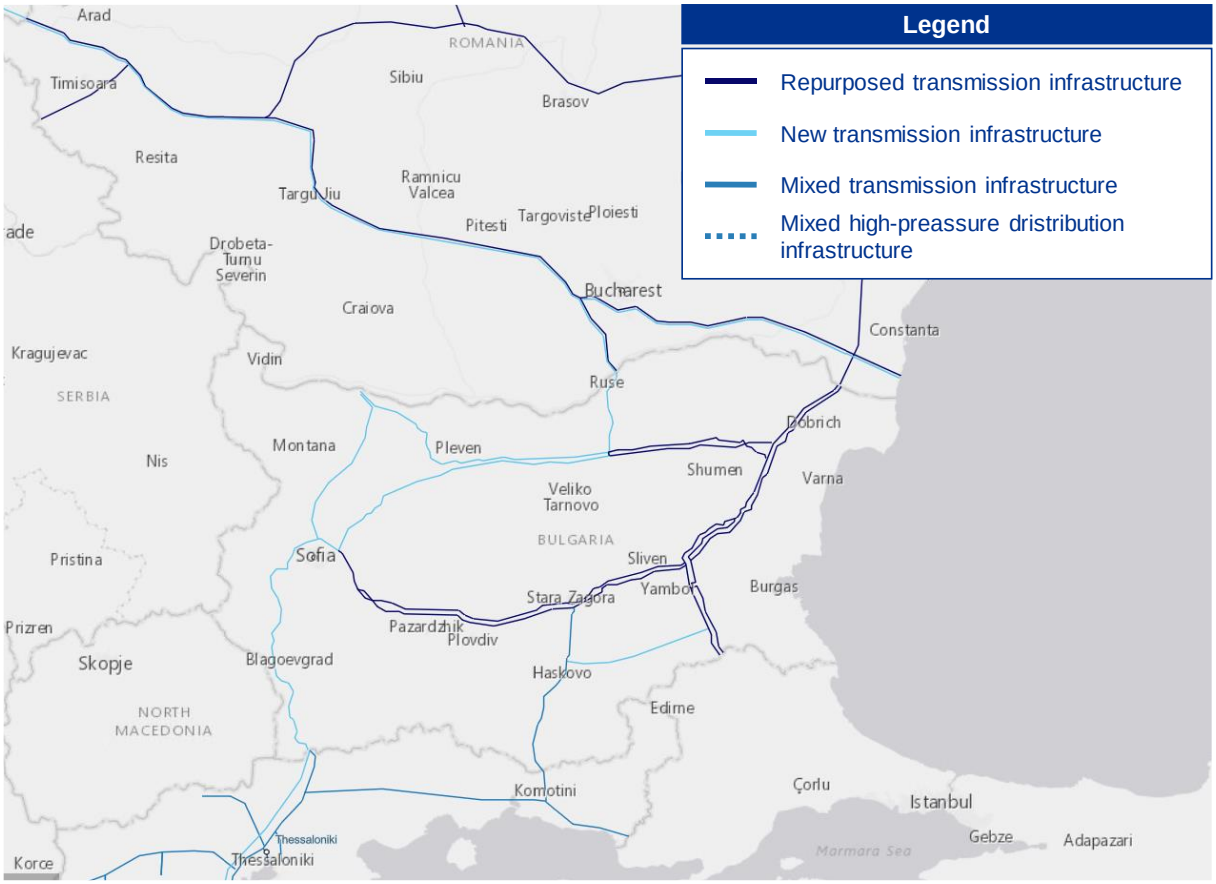


Figure 5. Hydrogen pipeline infrastructure projects in Bulgaria

Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[11]

Furthermore, Bulgaria's updated NECP and National Hydrogen Roadmap (2023–2026) both emphasise hydrogen as a key contributor to achieving climate neutrality by 2050 and thus establish ambitious targets to integrate hydrogen into the country's energy transition plans.[22,23] Key objectives of the Bulgaria's NECP include:

- Construction of electrolysers with aggregated capacity of 55 MW to produce 7,800 tonnes of green hydrogen annually by 2030
- A 20 MW hydrogen pilot project to analyse further capacity development after 2030

[22] *European Commission (2025): Bulgaria - Final updated NECP 2021-2030 (submitted in 2025)*

[23] *The Ministry of Innovation and Growth of Bulgaria (2023): "Hydrogen Future for Bulgaria"*

- Deployment of least 20 hydrogen refuelling stations, with a capacity of 2 tonnes/day along TEN-T corridors, supporting hydrogen mobility
- Upgrading the existing gas network to accommodate up to 10% hydrogen blending through projects like the SmartSwitch initiative

As per the NECP, the total planned **investment budget** for above-mentioned 55 MW electrolyser capacity is **BGN 136.9 million** (BGN 68.5 million provided by the Recovery and Resilience Fund and BGN 68.5 million coming from private co-financing).[22]

Furthermore, Bulgaria is advancing its hydrogen integration through the **Ruse Project**, a key initiative under the **Green Hydrogen @ Blue Danube** IPCEI (Important Projects of Common European Interest) which is discussed later in more detail in Chapter 6.1.6. Central to this project is the **construction of a new electrolyser facility powered by a photovoltaic park** near the city of Ruse, which will produce low-carbon hydrogen for various applications. This hydrogen will support the deployment of **twenty standard fuel cell buses** for public transportation and power a **retrofitted tugboat** operating on the Danube River. Additionally, the project includes a **mobile hydrogen refuelling unit at Port Ruse East**, aiding Bulgaria's commitment to decarbonizing both urban mobility and inland waterway transport.[24]

Table 3. Announced hydrogen production projects in Bulgaria

Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

Project name	Status	Technology used	Commission date	Capacity (MW)	Capacity (kt / year)
Ruse project (part of Green Hydrogen in the Blue Danube IPCEI)	Feasability study	Electrolyser (RES)	-	-	-

[24] *EU Commission Maritime Forum: The 'Green Hydrogen @ Blue Danube' project*

4.3 Croatia

Production

149.9 kt
Total annual hydrogen production capacity in 2023

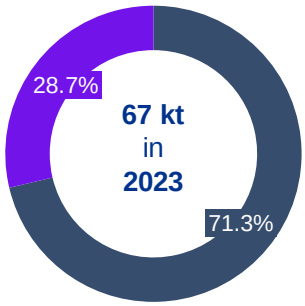
66.85 kt
Total hydrogen produced in 2023

100% of Croatia's total **hydrogen production** is generated through **reforming activities**

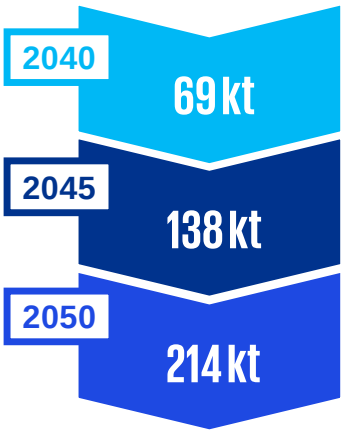
2
Operating hydrogen production plants

1
New production projects in the pipeline with 10 MW

Consumption



Refining was the most prominent hydrogen end-use sector in 2023, overall accounting for **71.3% of the final consumption**

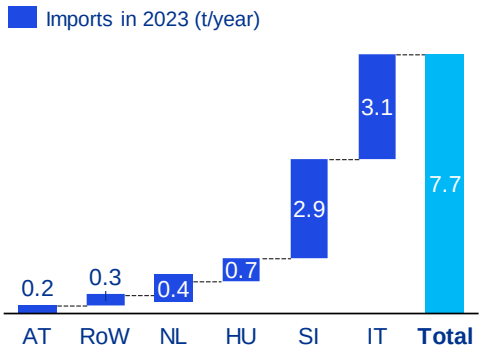


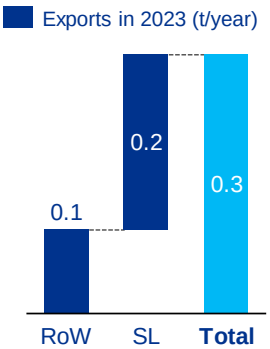
Pipelines

5 projects

Plans to **repurpose natural gas pipelines** for the **H2 Supply System Croatia South and North** project by 2045, and for the **Croatia-Slovenia interconnection** by 2026, forming part of the **Croatia-Slovenia-Austria H2 Corridor**. Additional plans include a **new H2-capable LNG evacuation pipeline** (Zlobin-Bosiljevo-Kozarac-Slobodnica) by 2027

Trade





General overview

Croatia is actively developing its hydrogen market, guided by both the country's Hydrogen Strategy until 2050 and its draft NECP which outline ambitious targets for hydrogen integration into Croatia's energy transition.[25,26]

In 2023, Croatia's had an aggregated hydrogen **PRODUCTION** capacity of **149.9 kt/year** across **2 operational production plants**, with **actual annual production** reaching **66.85 kt** – all of which is derived through reforming processes.[3]

In the same year, the country's hydrogen **CONSUMPTION** was also around **67 kt/year**, primarily driven by the refining sector, which accounted for 71.3% of total consumption, followed by ammonia production with a share of 28.7%. Looking ahead, the country's energy transition plans aim to diversify hydrogen use into transport, electricity generation, and industrial decarbonization.[3]

As per Croatia's Hydrogen Strategy and the corresponding sections of its NECP, the country aims to **scale up** its **electrolyser capacity** to **70 MW by 2030** and **2,750 MW by 2050**, focusing on renewable hydrogen. These installations will contribute to the **production of 46.2 kt of green hydrogen by 2030** and **266 kt by 2050**, enabling **hydrogen to constitute** about **3% of total energy consumption by 2030** and about **11% by 2050**. The NECP also emphasizes the deployment of at least 15 hydrogen refuelling stations by 2030 and scaling up to 100 stations by 2050, to support the adoption of hydrogen-powered vehicles. Croatia is also planning to install **a new hydrogen production plant in Rijeka** with PEM electrolysis technology (see Table 4) and a capacity of **10 MW** which will **serve as a pilot project** in order to evaluate future hydrogen capacity expansion opportunities beyond 2030.

Furthermore, a notable initiative is Croatia's involvement in the **North Adriatic Hydrogen Valley** (NAHV) project (later discussed in more detail in Chapter 6.1.7), which aims to **develop a cross-border hydrogen economy** in collaboration with **Slovenia** and **Italy's Friuli Venezia Giulia region.** Croatia will play a key role in the

[25] *European Commission (2025): Croatia - Draft Updated NECP 2021-2030*
[26] *Ministry of Economy and Sustainable Development of Croatia: HYDROGEN STRATEGY OF THE REPUBLIC OF CROATIA UNTIL 2050*

infrastructure expansion, and industrial applications, particularly by **leveraging** its **existing gas network** and **port facilities** for hydrogen transport and trade.[27]

Additionally, Croatia equally defined some performance indicators regarding research and innovation **targets** which include achieving **5 hydrogen-related patents by 2030** and **50 by 2050**, fostering advancements in hydrogen technologies.[25,26]

Table 4. Announced hydrogen production projects in Croatia

Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

Project name	Status	Technology used	Commission date	Capacity (MW)	Capacity (kt / year)
Rijeka Refinery	Planned	Grid electrolyser (partially powered by RES)	-	10	10
North Adriatic Hydrogen Valley (NAHV): SL, HR, and IT	Under construction	-	2029	-	-

To support future hydrogen production and distribution as well as to integrate the country into the European Hydrogen Backbone, Croatia has several **INFRASTRUCTURE** development plans, incorporating both repurposed natural gas pipelines and new hydrogen pipelines.[1,11] Key projects include[1,11]:

- H2 Supply System Croatia: Two major hydrogen corridors are planned, one in the south (IAP) and another in the north with a transmission capacity of 148 GWh/day, both targeted for completion by 2045
- H2 Interconnection with Slovenia which will be 160 km pipeline (Luko-Zabok-Rogatec) for cross-border hydrogen transport, set for completion by 2026
- Croatia-Slovenia-Austria H2 Corridor which will include the repurposing of 58 km of natural gas pipelines by 2025 (Phase 1) and the deployment of additional new pipelines (Phase 2) to be operational by 2030

[27] *HSE (2023): With the NAHV project, hse places slovenia on the hydrogen future map*

- H2 LNG Evacuation Pipeline connecting Zlobin, Bosiljevo, Kozarac, and Slobodnica, enabling hydrogen-ready transport, expected to be completed by 2027

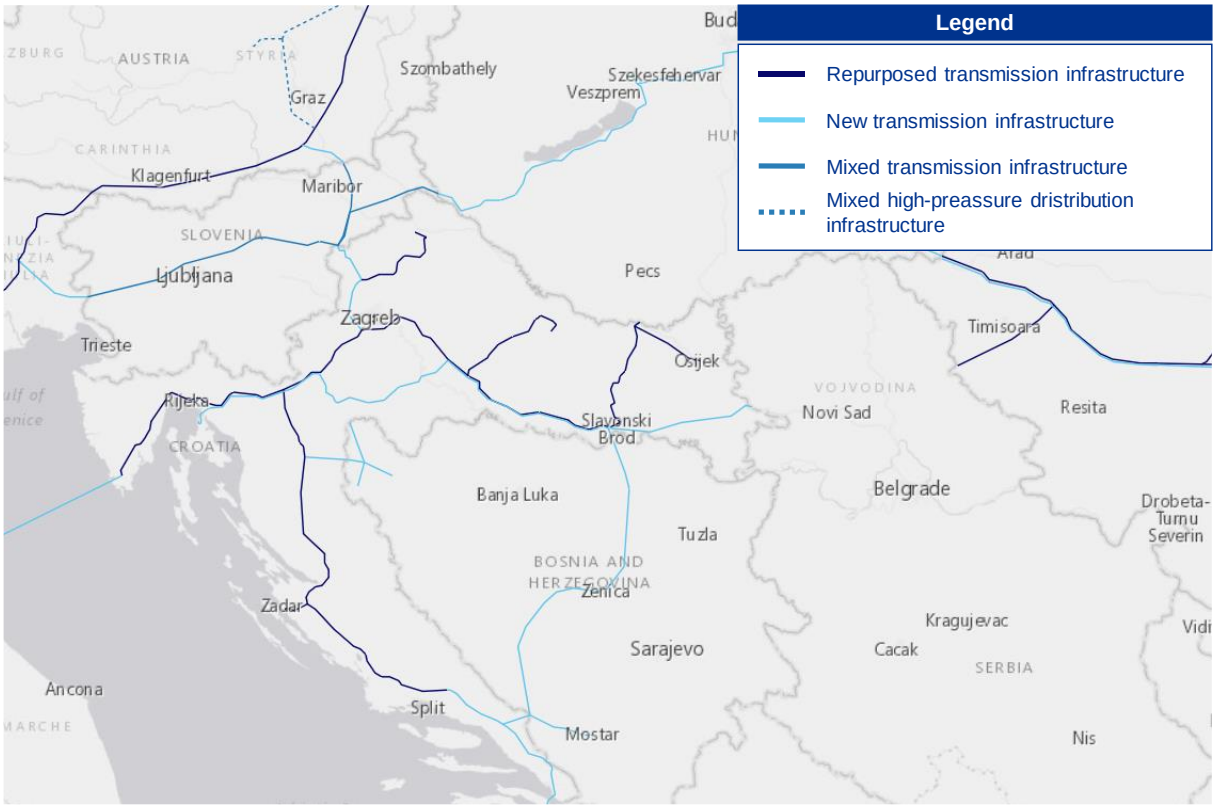


Figure 6. Hydrogen pipeline infrastructure projects in Croatia

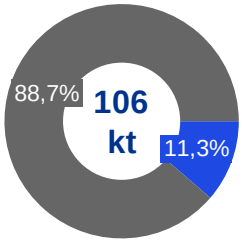
Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[11]

4.4 Czechia

Production

130.07 kt
Total annual hydrogen production capacity in 2023

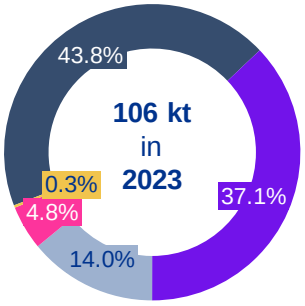
105.96 kt
Total hydrogen produced in 2023



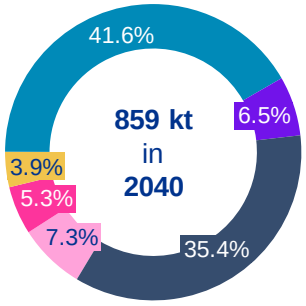
10
Operating hydrogen production plants

6
New production projects in the pipeline with capacities ranging 0.5 – 36 MW

Consumption



Refining and **ammonia production** were the most prominent hydrogen end-use sectors in 2023, overall accounting for **80.9 % of final consumption**



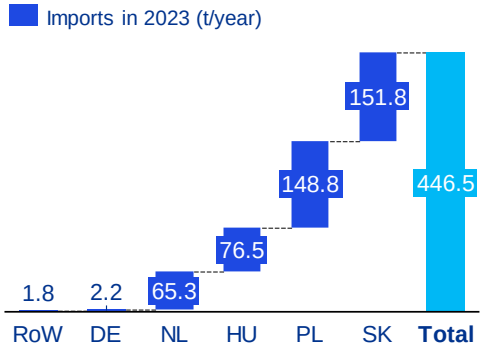
Annual low-carbon **hydrogen consumption** is projected to reach **859 kt/year by 2030** with **metal processing** and **transport** becoming the **leading end-use sector**

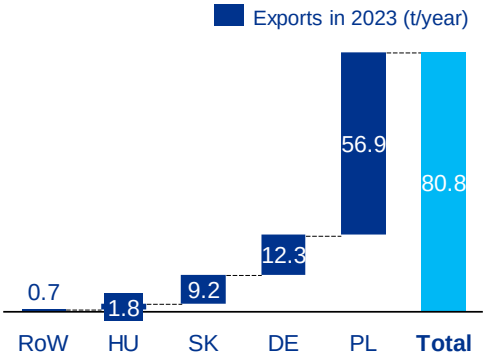
Pipelines

566 km

Total of 566 km of existing natural gas pipelines to be repurposed for hydrogen transport by 2029 as part of the **Czech-German Hydrogen Corridor** and **Interconnector** including the **Czech H2 Backbone NORTH** (403 km) and **WEST** (163 km), both with **distribution capacity of 144 GWh/days.**

Trade





General overview

Czechia's hydrogen market is steadily evolving, driven by national strategies and EU commitments to low-carbon energy. In 2023 the country had an annual hydrogen **PRODUCTION capacity** of **130.07 kt**, with **actual production** at approximately **105.96 kt** across **10 operational plants**. Most of the hydrogen (89%) is derived from fossil-based reforming, with the remaining 11% produced as industrial by-products.[3]

The country's hydrogen **CONSUMPTION** in 2023 was around **106.2 kt**, with refining and ammonia production being the most dominant end-use sectors, accounting for over 80% of total consumption. Projections outlined in Czechia's Hydrogen Strategy – published back in 2021 – indicate a rapid **surge in low-carbon hydrogen demand**, increasing to **859 kt by 2040** and reaching around **1,733 kt by 2050**. Throughout this trend transport and metal processing sectors are expected to emerge as the new leading end-users, overall accounting for about 77% of the total consumption in 2040.[3,28,29]

To support this transition, Czechia is making substantial investments to develop its hydrogen **INFRASTRUCTURE.** The country's Hydrogen Backbone plans to **repurpose** about **566 km** of **natural gas pipelines** for hydrogen transport **by 2029** (See Figure 7.). This includes 403 km of the Czech H2 Backbone North (which will form part of the Czech-German Hydrogen Corridor) and 163 km of the Czech H2 Backbone West (connecting Czechia to Germany). Each of these repurposing projects are in the feasibility study phase which the pipelines projected to have a transmission capacity of 144 GWh/day.[1,11]

[28] *Ministry of Industry and Trade of the Czech Republic (2021): The Czech Republic's Hydrogen Strategy*
[29] *European Commission (2024): Czechia - Final updated NECP 2021 - 2030 (submitted 2024)*

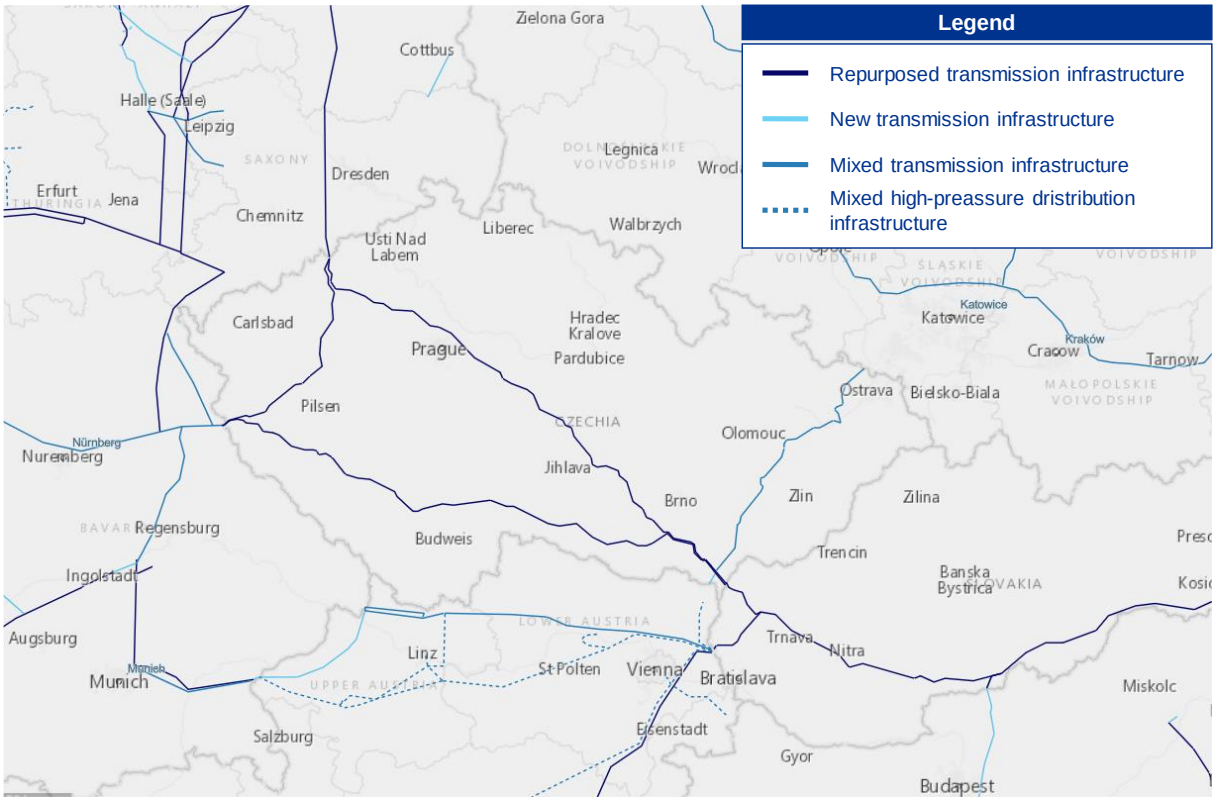


Figure 7. Hydrogen pipeline infrastructure projects in Czechia

Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[9]

In addition to infrastructure, Czechia is equally expanding its hydrogen production capabilities. Six new hydrogen production projects are underway (see Table 5), with capacities ranging from 0.1 to 5.2 kt/year. [1]

Table 5. Announced hydrogen production projects in Czechia

Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

Project name	Status	Technology used	Commission date	Capacity (MW)	Capacity (kt H2/y)
AEM Nexus for Unigranit	Under construction	Electrolyser (Grid)	2025	0.5 later 1	0.1
ČEZ	Under construction	Electrolyser (RES)	2025	18	3.1
E.ON	Under construction	Electrolyser (RES)	2025	1 later 2	0.1
Hydrogen Eagle (Spolana), phase 1	Feasability study	Electrolyser (RES)	2026	6	1.0
Hydrogen Eagle (Litvínov)	Under construction	Electrolyser (RES)	2028-30	30	4.5
Hydrogen Eagle (Spolana), phase 2	Feasability study	Electrolyser (Grid)	2030	18	5.2

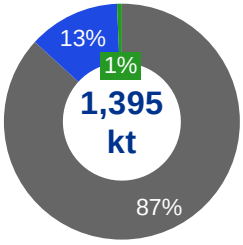
The Czech National Hydrogen Strategy prioritizes low-carbon hydrogen production through renewable energy, nuclear power, and advanced technologies such as plasma gasification. Further key strategic initiatives include strengthening R&D efforts in hydrogen technologies to stimulate economic growth, integrating hydrogen into the transport sector, expanding its role in industrial applications like metal processing, and using it as a flexible energy storage medium to stabilize the electricity grid. Further R&D efforts included the potential for the transition from steam methane reforming (SMR) to supply clean (green) hydrogen, are also central to the country's strategic planning.[28]

4.5 Germany

Production

1,983 kt
Total annual hydrogen production capacity in 2023

1,395 kt
Total hydrogen produced in 2023

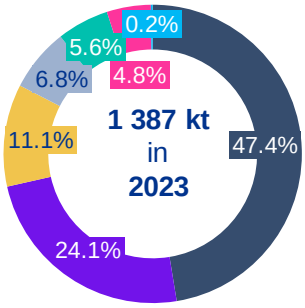


- Reforming
- By-product
- Electrolysis using RES

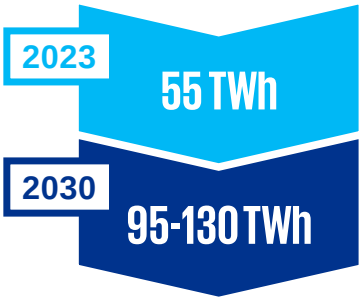
111
Operating hydrogen production plants

90
New production projects in the pipeline with capacities ranging 0.5 MW – 1.5 GW

Consumption



- Refining
- Ammonia
- Other chemicals
- Industrial heat
- Methanol
- Mobility & e-fuels
- Other



Refining and ammonia production were the most prominent hydrogen end-use sectors in 2023, overall accounting for **71.5% of the final consumption**

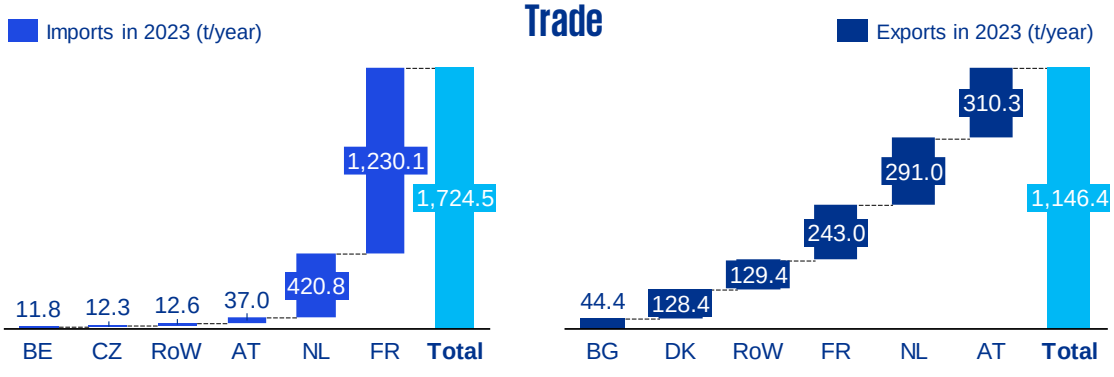
Germany's **total hydrogen demand** by 2030 is expected to **increase by at least 72%** to **around 95-130 TWh**

Pipelines

11,500 km

Germany plans to establish a **hydrogen start-up grid** of **over 1,800 km by 2027/2028** through repurposed and newly built pipelines. By 2032, a **hydrogen core network of approximately 9,700 km** will be developed, with **60% repurposed** gas pipelines and **40% new construction**, forming the backbone of Germany's hydrogen economy

Trade



General overview

Germany is one of Europe's top leaders in hydrogen production, innovation, and infrastructure development, driven by ambitious targets outlined in its National Hydrogen Strategy and NECP. Hydrogen plays a crucial role in Germany's transition to climate neutrality by 2045, serving as a key element in the country's energy and industrial strategy.[30,31]

In 2023, Germany's hydrogen **PRODUCTION** capacity reached **1,983 kt/year**, with **actual production** totalling **1,395 kt** across **111 operating production plants**. Hydrogen was primarily produced through reforming processes (87%), with 13% from by-products and a small share (1%) from renewable electrolysis.[3]

The country's annual hydrogen **CONSUMPTION** stood at **1,387 kt**. The largest end-use sectors were refining (47.4%) and ammonia production (24.1%), followed by methanol production and other chemical processes which overall accounted for 12.4% of the total consumption. In the next years, the country's hydrogen consumption is expected to increase significantly across industrial, transport, and energy sectors, projecting demand to rise to 95-130 TWh by 2030, including derivatives such as ammonia and synthetic fuels.[3,30,31]

Germany's National Hydrogen Strategy is underpinned by ambitious goals which are equally set out in the country's most recent NECP. **Electrolyser capacity** is set to **double**, reaching

10 GW by 2030, enabling large-scale renewable hydrogen production. Hydrogen will also be deeply integrated into industrial decarbonization, heavy-duty transport, aviation, and shipping, while ensuring energy system flexibility through the deployment of hydrogen-ready gas power plants.[31]

Looking for the next decades, Germany has a significant pipeline of over **100 hydrogen production projects** in various stages of development as summarised in Table 6 below. By 2025, 39 production facilities are expected to start operation, with 20 already under

[30] *European Commission (2024): Germany - Final updated NECP 2021-2030 (submitted in 2024)*
[31] *The Federal Government of Germany (2023): National Hydrogen Strategy Update*

construction, delivering a combined additional production capacity of 120.9 kt/year. In 2026, an additional 15 projects, including six under construction and seven in the feasibility stage, are set to add nearly 195 kt/year of capacity. Across the announced projects an **overall** hydrogen **production capacity** of around **3,700 kt/year** is expected to be **developed by 2035**.[1]

Table 6. Announced hydrogen production projects in Germany

Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

Planned date of commission	Status	Number of projects	Capacity (MW)	Aggregated capacity (kt H2/y)
2025	Planned	1	0.5	0.09
	Feasability study	18	362	62.25
	Under construction	20	Appx. 376	58.66
2026	Planned	2	80	12.69
	Feasability study	7	Appx. 910	159.91
	Under construction	6	Appx. 132	22.31
2027	Planned	2	Appx 300	155.93
	Feasability study	7	1 391	214.21
	Under construction	3	Appx. 600	46.93
2028	Planned	2	550	95.29
	Feasability study	3	1,270	170.66
	Under construction	2	330	5.64
2029	Planned	3	1,920	409.6
	Feasability study	-	-	-
	Under construction	-	-	-
2030-35	Planned	4	14,000	1,368
	Feasability study	3	2,210	365.91
	Under construction	-	-	-
No date specified	Planned	14	Appx. 3,370	453.87
	Feasability study	7	318.3	52.35
	Under construction	1	-	0.44

To support the integration of these new production facilities and the transportation of hydrogen, Germany is making significant efforts to extend its hydrogen **INFRASTRUCTURE** network through ambitious development plans for the coming years. By **2027/2028**, a **hydrogen start-up grid** of over **1,800 km** – consisting of repurposed and newly built hydrogen pipelines – will be established using IPCEI funding. This network will form part of the larger European Hydrogen Backbone, aiming to connect key industrial hubs, storage facilities, and consumers. Additionally, as per Germany's NECP, the country plans to **build a** hydrogen core network spanning approximately **9,700 km by 2032** – 60% of which consists of repurposed natural gas pipelines and the remainder of newly built sections – forming the backbone of Germany's

hydrogen economy. The proposal for this network was submitted by the country's transmission system operators (TSOs) to the Federal Network Agency (Bundesnetzagentur) on 22nd July 2024. Following examination and consultations, the Federal Network Agency is expected to approve and oversee the gradual implementation of this critical infrastructure.[30,31]

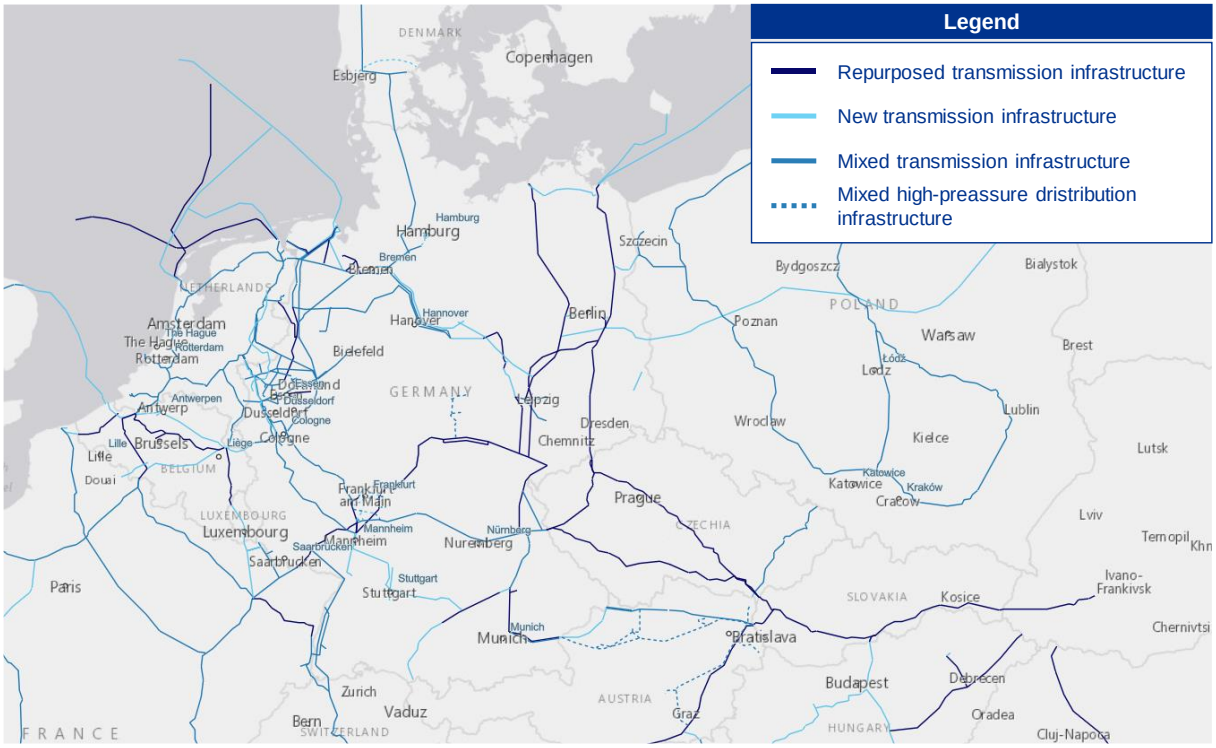


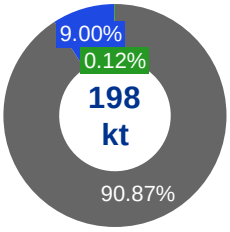
Figure 8. Hydrogen pipeline infrastructure projects in Germany

Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[11]

4.6 Hungary

Production

257.9 kt
Total annual hydrogen production capacity in 2023



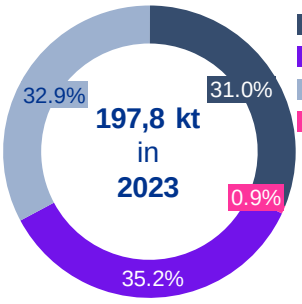
9
Operating hydrogen production plants

198.1 kt
Total hydrogen produced in 2023

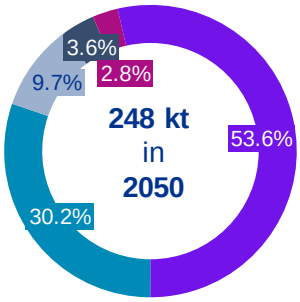
4
New green hydrogen production projects in the pipeline

Reforming
By-product
Electrolysis using RES

Consumption



Refining
Ammonia
Other chemicals
Industrial heat



Ammonia production
Other chemicals
Refineries
Iron & steel industry
Cement industry

Total hydrogen consumption in 2023 was **roughly evenly distributed** among **ammonia production, refining,** and **other chemicals**, with ammonia production being the largest end-use sector

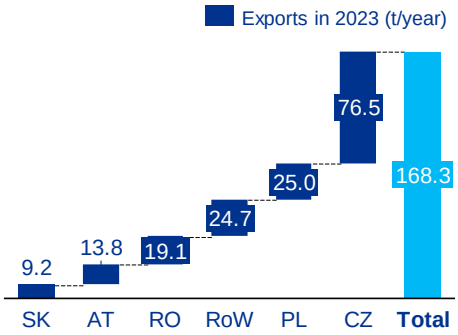
Annual **hydrogen consumption** is projected to reach **248 kt/year by 2050** with **ammonia production** remaining the **leading end-use sector,** while the **iron & steel industries** also became **prominent** users

Pipelines

921 km

Hungary plans to build out a network of **new hydrogen pipelines** for the **Hungary-Slovakia** (164 km, 100 GWh/day), **Hungary-Slovenia** (201 km, 30 GWh/day), and **Romania-Hungary corridors** (203 km, 76-100 GWh/day), plus 353 km of **repurposed pipelines** for the **Ukraine-Hungary corridor** (100 GWh/day)

Trade



General overview

Hungary currently stands as the fourth largest hydrogen producer amongst the DRS countries after Germany, Austria, and Slovakia based on available 2023 production data.[3] The country's NECP and National Hydrogen Strategy outline several plans to expand green hydrogen production, develop a comprehensive hydrogen infrastructure, and integrate hydrogen into its energy system to meet long-term decarbonization goals.[32],[33]

As of 2023, Hungary had a hydrogen **PRODUCTION** capacity of **257.9 kt/year**, with **actual** overall **production** of **198.1 kt/year** across **9 operational production facilities**. The vast majority of hydrogen is produced through reforming processes, accounting for 90.87% of total production while electrolysis processes only have a share 0.12%.[3]

In 2023, total hydrogen **CONSUMPTION** was approximately **197.8 kt** distributed across multiple sectors. Ammonia production was the largest end-use sector, accounting for 35.2% of total consumption, followed by refining (32.9%) and other chemicals (31%).[3] Hungary's hydrogen consumption is projected to grow significantly, reaching 248 kt annually by 2050. While ammonia production is expected to remain the dominant end-use sector, with a projected share of 53.6%, the iron and steel industry sectors are anticipated to emerge as key consumers, reflecting the diversification of hydrogen applications in Hungary's industrial landscape.[33]

Hungary's National Hydrogen Strategy (adopted in 2021) envisions **the installation of at least 240 MW** of **electrolyser capacity by 2030**, which will enable the production of green hydrogen using renewable energy sources – a strategic point equally mentioned in the country's NECP. The strategy targets the production of at least 36 kt of carbon-free and 16 kt of low-carbon hydrogen by 2030 including the **installation** of **240 MW** of **electrolyser capacity** for renewable hydrogen production. Furthermore, on the demand side, the NECP highlights the importance of integrating hydrogen into various sectors, including transport, industry, and energy storage, as part of Hungary's efforts to achieve carbon neutrality by 2050. Within this framework, the target is to deploy **20 hydrogen**

[32] *European Commission (2024): Hungary - Final updated NECP 2021-2030 (submitted in 2024)*
[33] *Magyarország Kormánya (2021): Hungary's National Hydrogen Strategy*

refuelling stations with overall **40 refuelling points** enabling the supply of around **4,800 fuel cell vehicles** (mainly buses and freight vehicles) on the roads.[32,33]

As part of its hydrogen **INFRASTRUCTURE** development plans Hungary aims to construct over 900 km of hydrogen pipelines, consisting of a mix of newly built and repurposed natural gas pipelines, to facilitate the transportation of hydrogen across key industrial and cross-border corridors. Key pipeline projects, which are all currently in the phase of feasibility study development include[1,11]:

- Hungary-Slovakia Corridor, a 164 km of new pipelines with a transmission capacity of 100 GWh/day to be completed by 2029
- Romania-Hungary Corridor with 203 km of new pipelines and capacity of around 76-100 GWh/day also envisioned to be commissioned by 2029
- Hungary-Slovenia Corridor, with 201 km of new pipelines with 30 GWh/day capacity, targeted for completion by 2035

Hungary is also investing in repurposing existing natural gas pipelines, such as the Ukraine-Hungary Corridor, including the repurposing of around 353 km pipeline network with capacities between 100-150 GWh/day. The planned commissioning date for the first segments of the pipeline is 2029, with full completion date envisioned by 2040.

These pipelines, once completed, will enable Hungary to integrate into the broader European Hydrogen Backbone.

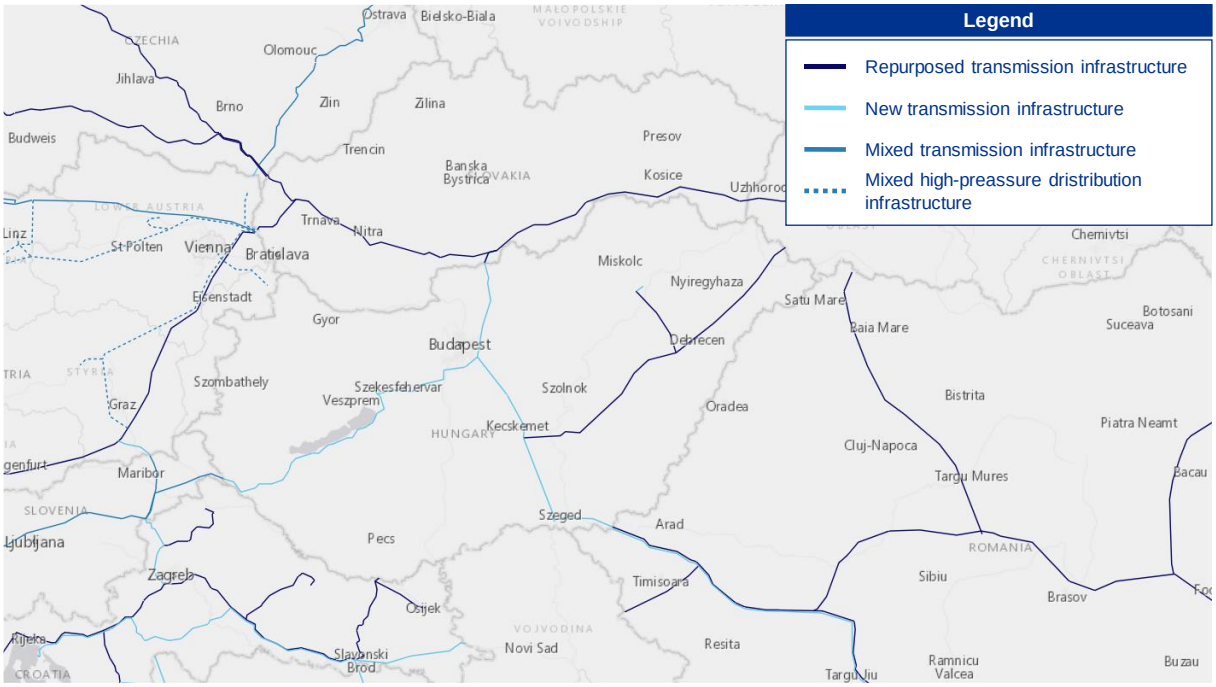


Figure 9. Hydrogen pipeline infrastructure projects in Hungary

Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[11]

In addition to infrastructure, Hungary also aims to advance its hydrogen production capabilities through a range of projects as outline in Table 7. A notable project is Hungary's involvement in the IPCEI Black Horse initiative (discussed in more detail in Chapter 6.1.1), which aims to establish 40 electrolyser production sites across Poland, Slovakia, and Hungary by 2030, advancing regional collaboration in hydrogen production and utilization.

Table 7. Announced hydrogen production projects in Hungary

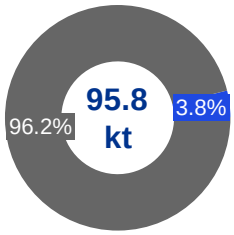
Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

Project name	Status	Technology used	Commission date	Capacity (MW)	Capacity (kt H2/y)
Hydrogen production for fuelgas at Mosonmagyarovar CS	-	Electrolyser (RES)	-	-	-
Hydrogen production for fuel gas at Varosfold CS	-	Electrolyser (RES)	-	-	-
Hydrogen production for fuelgas at Szreg-1 UGS (5% blend, mostly for internal use)	-	Electrolyser (RES)	2026	-	-
IPCEI Black Horse (40 electrolysis production sites across PL, SK, HU)	-	Electrolyser (RES)	2030	-	-

4.7 Romania

Production

247.61 kt
Total annual hydrogen production capacity in 2023



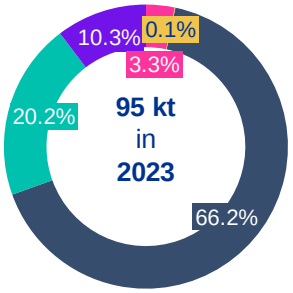
9
Operating hydrogen production plants

95.77 kt
Total hydrogen produced in 2023

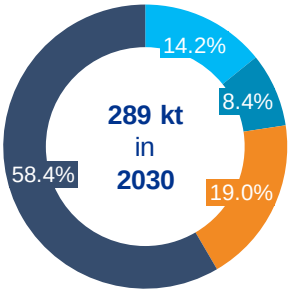
96.2% of Romania's total **hydrogen production** is generated through **reforming**, the remaining **3.8%** is produced as **by-products**

7
New production projects in the pipeline with capacities ranging 5 – 100 MW

Consumption



Refining
Ammonia
Methanol
Industrial heat
Other



Existing industrial application
New industrial applications (steel)
Blending for CCGT
Transport

Refining and **methanol production** were the most prominent hydrogen end-use sectors in 2023, overall accounting for **86.4% of final hydrogen consumption**

Annual **hydrogen consumption** is projected to **triple by 2030** reaching **289 kt/year** with **transport** becoming the **leading end-use sector**

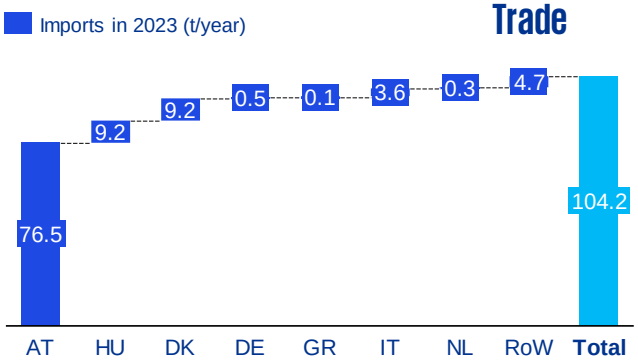
Pipelines

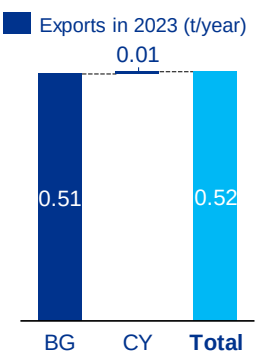
10 projects

8 projects to repurpose existing natural gas pipelines for hydrogen transmission including the **Coroi–Mediești Aurit corridor** (50.6 GWh/day by 2036), **Giurgiu–Nădlac corridor** (76.8 GWh/day by 2040), and others linking key regions and interconnections with Serbia.

Two new hydrogen pipelines planned by 2029: Black Sea–Podișor pipeline (2029) and the Giurgiu–Nădlac corridor with a new interconnector offering 100 GWh/day capacity.

Trade





General overview

Like other countries in the DRS countries, Romania's hydrogen market is projected to expand rapidly in the coming decades through numerous new production projects plans along with 10 new initiatives to build out a well-connected hydrogen pipeline network. In 2023 Romania's annual hydrogen **PRODUCTION** capacity was around **247.6 kt** across **9 operational plants**. Meanwhile, the **actual** total **hydrogen production** in **2023** was only around **95.8 kt**. More than 95% of Romania's total hydrogen production is generated through reforming, the remaining is produced as by-products.[3]

Hydrogen **CONSUMPTION** in 2023 was **95 kt** with refining account for about two thirds (66.2%) of total consumption, followed by methanol production with a share of 20.2% amongst end-use activities. According to Romania's National Hydrogen Strategy and Action Plan the country's **current hydrogen consumption** is expected **to triple by 2030**. It is also projected that the breakdown of end-users will alter with transportation becoming the most prominent sectors accounting for almost 60% of the total consumption by 2030. Looking even further ahead, as per Romania's NECP, one of the targets aimed at developing the country's transport sector is to increase the share of hydrogen-based fuels to at least 20% for passenger cars and 35% for heavy and light duty vehicles by 2050.[3,34,35]

To support this transition, Romania plans to enhance its hydrogen **INFRASTRUCTURE** through **repurposing several natural gas pipelines** for hydrogen transmission, including the following[1,11]:

- Coroi–Mediești Aurit corridor (50.6 GWh/day by 2036)
- Giurgiu–Nădlac corridor (76.8 GWh/day by 2040)
- Onesti - Ungheni corridor (25.3 GWh/day by 2040)
- and others linking key regions and interconnections with Serbia (27.76 GWh/day by 2035)

[34] *European Commission (2024): Romania - Final updated NECP 2021-2030 (submitted in 2024)*
[35] *Romania's National Hydrogen Strategy and Action Plan (2023-2030)*

Additionally, **two new hydrogen pipelines** are planned to be built out by 2029:

- the Black Sea–Podișor pipeline and
- the Giurgiu–Nădlac corridor with a new interconnector offering 100 GWh/day capacity

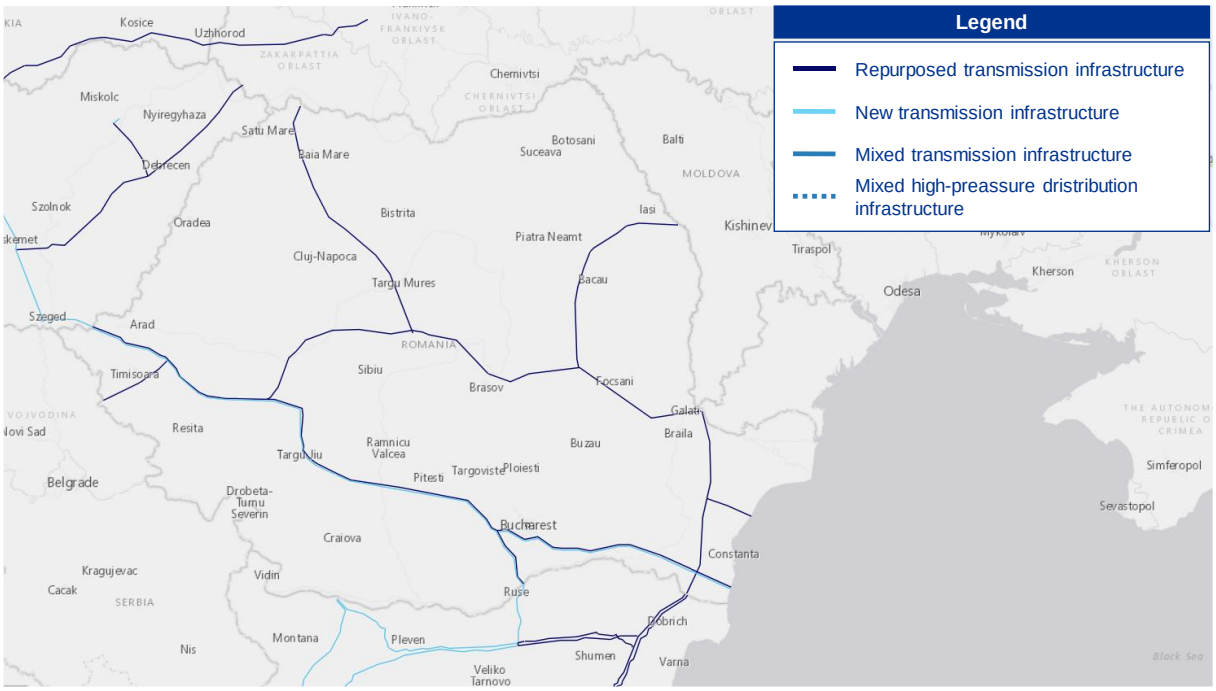


Figure 10. Hydrogen pipeline infrastructure projects in Romania

Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[11]

Romania is equally investing in extending its hydrogen production capabilities with the goal to build out **at least 100 MW** of **production capacity by 2030**, and an **indicative target** of reaching **500 MW** of **installed capacity by 2050**. To help realise these goals, as outlined in the country's Hydrogen Strategy, Romania allocated around EUR 148 million for 100 MW of electrolyser capacity made available to the companies interested in developing green hydrogen production capacities. Currently **5 new hydrogen production projects** are planned or are underway in the country with envisioned commission date of 2030 or sooner and with capacities ranging between 5 MW and 100 MW (see Table 8). Furthermore, **Romania** is also **part of** the notable **Green Hydrogen @ Blue Danube** initiative. A project that has potential to bring about regional collaboration regarding the creation of a trans-European green hydrogen value

chain is - which has been presented and discussed in more detail in section 5.1.6 of this Study.[34,35]

Table 8. Announced hydrogen production projects in Romania

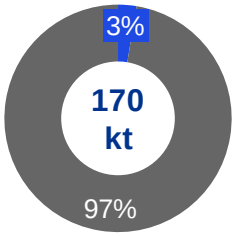
Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

Project name	Status	Technology used	Commission date	Capacity (MW)	Capacity (kt H2/y)
Ground Investment Corp - Green H_2	Feasability study	Electrolyser (RES)	2025	10	1.50
Hidroelectrica Ostrovu Mare	Feasability study	Electrolyser (RES)	2025	50	8.66
Petrobrazi Refinery – Green H_2	Under construction	Electrolyser (RES)	2025	55	9.53
Rompetrol Refinery	Planned	Electrolyser (RES)	2026	-	11.00
Nervia	Feasability study	Electrolyser (RES)	2030	5	0.85
Hidroelectrica - Sona	Planned	Electrolyser (RES)	2035	100	17.33
IPCEI Green Hydrogen @ Blue Danube initiative (RO, BG, SR, HR, HU, SK, AT, DE)	Planned	Electrolyser (RES)	-	-	-

4.8 Slovakia

Production

218 kt
Total annual hydrogen production capacity in 2023



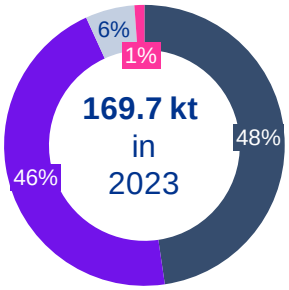
6
Operating hydrogen production plants

170.2 kt
Total hydrogen produced in 2023

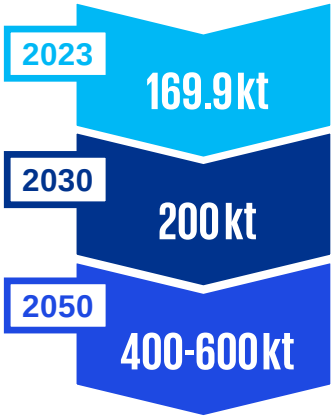
97% of Slovakia's total **hydrogen production** is generated through **reforming**, the remaining **3%** is produced as **by-products**

9
New production projects in the pipeline with capacities ranging 0.8 – 332 MW

Consumption



- Refining
- Ammonia
- Other chemicals
- Industrial heat



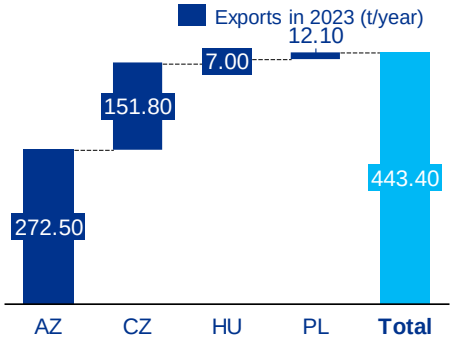
Refining and **ammonia production** were the most prominent hydrogen end-use sectors in 2023, overall accounting for **93% of final hydrogen consumption**

Pipelines

935 km

Total of 935 km of existing natural gas pipelines to be repurposed for hydrogen transport. **500 km from the border with Ukraine to Austria and the Czech Republic**; **19 km between Slovakia and Hungary**, and **266 km** (plus 50 km of connections) **to create three new high-pressure hydrogen routes** linking the H2-backbone to major industrial sites and cities

Trade



General overview

Slovakia's hydrogen market is evolving rapidly, supported by growing production capacities, rising demand, and an emerging infrastructure network. In 2023, Slovakia emerged as one of the largest hydrogen producers in the Danube Region with an annual hydrogen **PRODUCTION** capacity of **218 kt** and with **actual production** reaching **170 kt** across its **6 operational plants.** Most of this hydrogen (97%) is generated through fossil fuel-based steam methane reforming, while a small fraction is produced as a by-product in industrial processes.[3]

The country's annual hydrogen **CONSUMPTION** is around **170 kt per year**, largely driven by refining and ammonia production. Looking ahead, as per the country's National Hydrogen Strategy **by 2030** the annual hydrogen **consumption** is expected **to reach 200 kt**, which is projected to rise even further to around **400-600 kt by 2050**, with about 90% derived from low-carbon sources.[3,36]

One hydrogen-focused priority set out in Slovakia's NECP involves converting existing natural gas **INFRASTRUCTURE** to carry hydrogen, meeting a goal of enabling a 5% blend of hydrogen to be injected in the gas network by the end of 2025 (See figure 11).[1,11,37]

- Notably, the Slovak Hydrogen Backbone project envisions repurposing up to 500 km of existing natural gas pipelines by 2029, allowing the transport of an estimated

  218.4 GWh of hydrogen per day from the border with Ukraine to Austria and Czechia forming parts of the Central European Hydrogen Corridor SK part (hyd-N-1264).

- A further project will specifically focus on repurposing an additional 19 km pipeline between Slovakia and Hungary by 2029, enabling a transmission capacity of about 100 GWh per day.

[36] *Ministry of Economy of the Slovak Republic (2021): National Hydrogen Strategy: Ready for the Future*
[37] *European Commission (2023): Slovakia - Draft Updated NECP 2021-2030*

At the same time Slovakia is planning to build three new high-pressure hydrogen pipelines by repurposing existing methane routes to build hydrogen infrastructure from H2-backbone to the largest Slovak industrial customers and major Slovak cities:

- The H2–Fuel DN350 PN40 pipeline project involves the reconstruction of the older DN300 PN25 methane pipeline stretching 150 km (plus at least 50 km of connections)
- The new H2–Šaľa–Bratislava DN700/DN500 PN40 pipeline will rely on 84 km of the existing DN700/DN500 PN40 infrastructure, while
- Project H2–Košice–Prešov on envisions the reconstruction of 32 km segment of the DN500 PN40 pipeline leading to US Steel and continuing through Košice, eventually linking into Prešov.

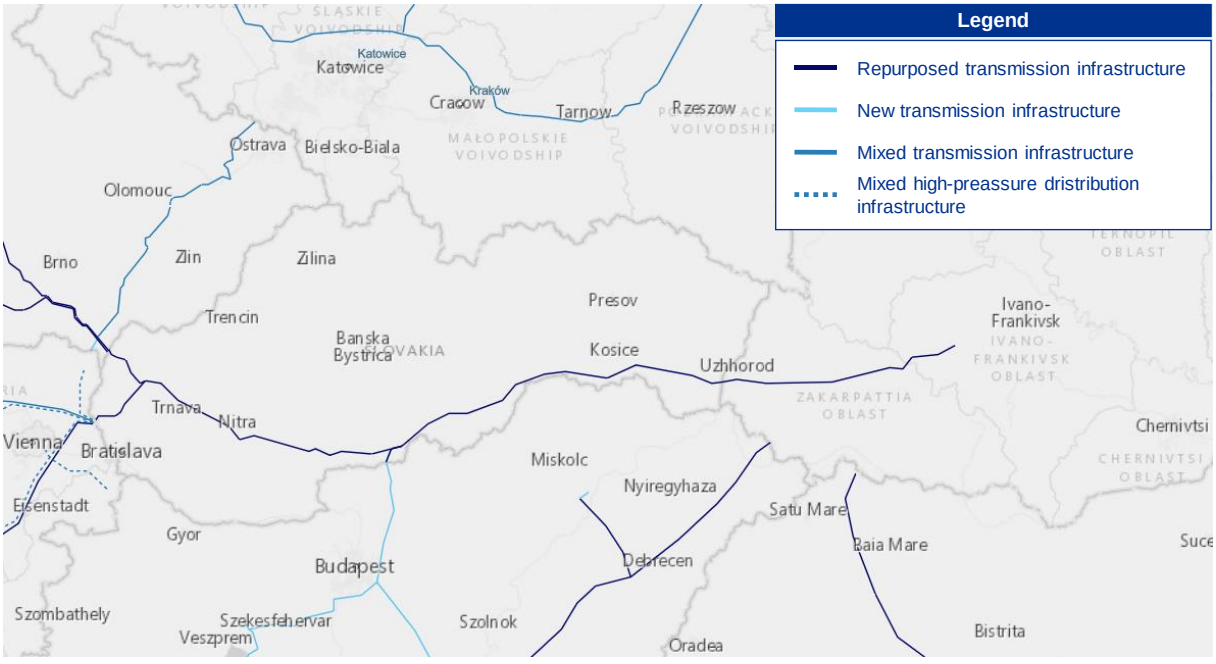


Figure 11. Hydrogen pipeline infrastructure projects in Slovakia

Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[11]

Slovakia's National Hydrogen Strategy "Ready for the Future" – approved in 2021 – defines strategic directions for hydrogen production, transport, distribution, storage, and end-use applications, outlining the country's goal to integrating hydrogen technologies across various sectors. To realise the NHS an Action Plan has been created (adopted in

2022) for the implementation of measures from 2023 to 2026 with a total funding of EUR 59.6 million. These funds are expected to be sourced from EU financial mechanisms and national budgets. After evaluating the implementation of the Action Plan from 2023 to 2026, an update will be elaborated for the 2027 to 2030 period.[36,38]

At the same time, several hydrogen production facilities are under consideration or construction, ranging from small-scale pilot plants focused on green hydrogen (via water electrolysis powered by renewable energy) to state-of-the-art blue hydrogen projects in eastern Slovakia that combine fossil-based production with carbon capture. There are currently **7 new hydrogen production projects** in the pipeline each with capacities ranging from 3.47 to 42.97 kt per year (see Table 9 below). Three of these projects are still in the initial "Planned" phase while the others are already under feasibility study, with three targeting commissioning in 2025 and one in 2030.[36,37]

In addition to the above-mentioned production projects, Slovakia also has ongoing plans to deploy three hydrogen storage projects in the pipeline:

- **UGS Lab - H2** storage project is planned to be built – through the conversion of existing infrastructure – close to the Austria-Slovak border near the existing gas pipeline network. It will aim to blend 5% hydrogen with natural gas, with an injection capacity of 8.09 GWh/day and a withdrawal capacity of 15.09 GWh/day by 2026.[11]
- **UGS Velke Kapusany** project is planned at a location near the Slovak-Ukraine border where the already existing gas pipeline passes through between the two countries. Its commissioning is expected by 2030 and will utilise a depleted field is assessing hydrogen storage potential through building new facilities. Its injection and withdrawal capacity are expected at 34.4 GWh/day. It will allow to promote sustainability via its readiness to store mixture of natural gas with hydrogen of 20% volume.[11]
- **HENRI (H2I-S&D)**, expected to be operational by 2028. The project involves 2 stages. In phase I, experts aim to identify an ideal site location and the appropriate

[38] *Ministry of Economy of the Slovak Republic (2022): Action Plan: Measures for the successful implementation of the national hydrogen strategy up to 2026*

underground geological structure for storing hydrogen mixed with natural gas. Following, research will be conducted to define the maximum permitted concentration of hydrogen. In Phase II, an electrolyser will be built, and hydrogen would be mixed with natural gas and stored underground.[11]

The strategic placement of UGS Lab – H2 and UGS Velke Kapusany is well-positioned to support future cross-border hydrogen trade, enhancing the development of the regional hydrogen market. These facilities will allow Slovakia to enhance its energy security, grid balancing and facilitate future large-scale hydrogen integration into the gas network.

Table 9. Announced hydrogen production projects in Slovakia

Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

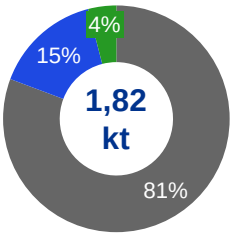
Project name	Status	Technology used	Commission date	Capacity (MW)	Capacity (kt H2/y)
H2MUCTYNIC	Feasability study	Electrolyser (RES)	2025	20	3.47
P2G Velke Kapusany	Feasability study	Electrolyser (RES)	2025	78	13.51
G2F - Gas to Future, phase 1	Feasability study	Electrolyser (RES)	2025	84	14.55
G2F - Gas to Future	Planned	Electrolyser (RES)	2026	0,8	-
Hydrogen Cifer CH4 reforming	Planned	SMR	2026	-	-
Hydrogen Eagle (various hubs)	Feasability study	Electrolyser (RES)	2030	60	10.40
G2F - Gas to Future, phase 2	Planned	Electrolyser (RES)	2035	332	42.97
IPCEI Green Hydrogen @ Blue Danube initiative (RO, BG, SR, HR, HU, SK, AT, DE)	Planned	Electrolyser (RES)	-	-	-
IPCEI Black Horse (40 electrolysis production sites across PL, SK, HU)	-	Electrolyser (RES)	2030	-	-

4.9 Slovenia

Production

2.75 kt
Total annual hydrogen production capacity in 2023

1.82 kt
Total hydrogen produced in 2023

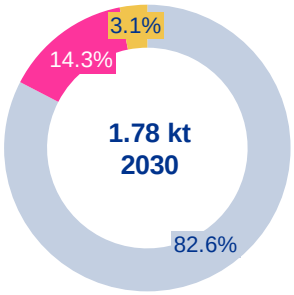


Reforming
By-product
Electrolysis with RES

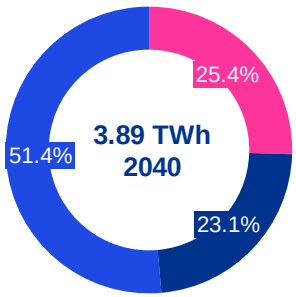
5
Operating hydrogen production plants

3
New production projects in the pipeline

Consumption



Other chemicals
Industrial heat
Other



Transport sector
Industrial heat
Power sector

Chemicals production (other than ammonia and methanol) was the most prominent hydrogen end-use sector in 2023, overall accounting for **82.6% of the final consumption**

Slovenia's expected **total hydrogen demand** by **2040** is **3.98 TWh** with the **power sector** accounting for the largest share at **51.4%**, while industrial heat and transport each represent roughly a quarter of total demand

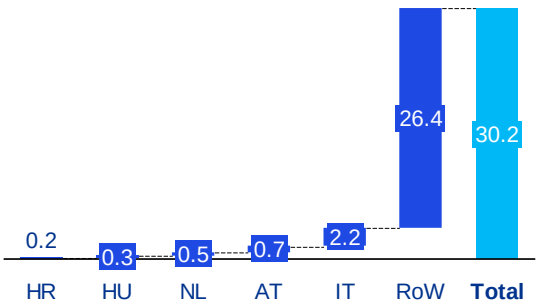
Pipelines

363 km

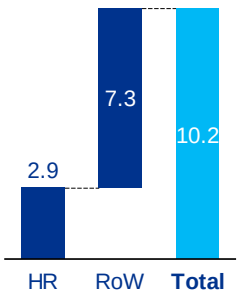
Slovenia plans to **repurpose** overall **187 km of existing natural gas pipelines** as part of **Phase 1 of the Croatia-Slovenia-Austria** and **Italy-Slovenia-Hungary H2 Corridor** projects **by 2025**. Furthermore, approximately **176 km of new pipelines** are planned to be built as part of **Phase 2 of the two H2 Corridor projects by 2035**

Trade

Imports in 2023 (t/year)



Exports in 2023 (t/year)



General overview

Compared to other countries in the DRS, Slovenia's hydrogen market is relatively in its early stages, with an annual **PRODUCTION** capacity of merely **2.75 kt** and **actual production** of **1.82 kt** in 2023 across **5 operational plants**. The majority (81%) of hydrogen is produced through fossil fuel reforming, with smaller shares from by-products (15%) and renewable electrolysis (4%).[3]

In 2023, hydrogen **CONSUMPTION** in Slovenia was **1.78 kt**. End-user concentrated in the chemical sector (excluding ammonia and methanol), which accounted for **82.6%** of total usage.[3]

To advance its hydrogen transportation **INFRASTRUCTURE**, Slovenia is planning to develop **2 two-way hydrogen corridors.** One between Slovenia, Hungary, and Italy and another between Slovenia and Croatia. Phase 1 of both initiatives will include the repurposing of around 187 km of existing gas pipelines with planned completion date by 2025. As part of phase 2 of the two hydrogen corridor projects at least 176 km of newly hydrogen pipelines are envisioned to be built.[1,11]

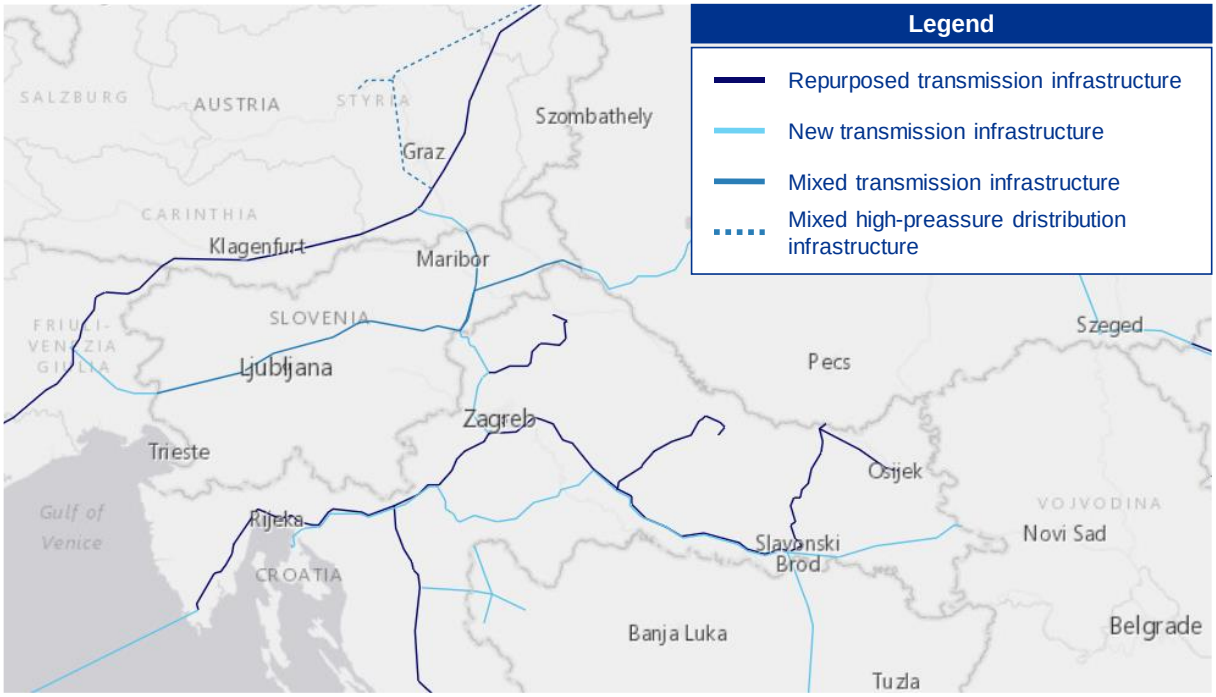


Figure 12. Hydrogen pipeline infrastructure projects in Slovenia

Source: European Hydrogen Backbone (Hydrogen Infrastructure Map)[11]

In comparison to other countries in the DSR, Slovenia has considerably less projects in place to increase its hydrogen production capacity (see Table 10). Currently, there is record of only two projects which include[1,11]:

- the Zero Emission Mobility Corridor with a 34 MW production capacity which is already under construction and is expected to be completed by 2026
- and the SLOP2G project through which a 10 MW capacity hydrogen production plant is envisioned to be built by 2028

Table 10. Announced hydrogen production projects in Slovenia

Source: IEA (Hydrogen Production and Infrastructure Projects Database)1

Project name	Status	Technology used	Commission date	Capacity (MW)	Capacity (kt H2/y)
Zero Emission Mobility Corridor	Under construction	Electrolyser (RES)	2026	34	5.89
SLOP2G	Feasability study	Electrolyser (RES)	2028	10	-
North Adriatic Hydrogen Valley (NAHV): SL, HR, and IT	Under construction	-	2029	-	-

Looking forward, Slovenia aims to increase the share of renewable and low-carbon gases, including hydrogen, to 10-30% of total gas supply by 2030, as outlined in its draft NECP. However, as of today Slovenia has not prepared a dedicated National Hydrogen Strategy which would set out more specific goals or targets for the development of this market.[39]

Meanwhile the **Slovenian government** supported the **formation of a low-carbon hydrogen consortium** which includes 18 companies, organizations, and municipalities, leveraging 6,500 experts **to develop a comprehensive hydrogen value chain**. The consortium focuses on demonstration projects, hydrogen blending, industrial applications, and energy storage, with support from the European Commission and

[39] *European Commission (2023): Slovenia - Final updated NECP 2021-2030 (submitted in 2025)*

Hydrogen Europe. It is also seeking international partnerships, particularly with Japan, to advance hydrogen technology and manufacturing capabilities.[40,41]

Furthermore, Slovenia plays a key role in the **NAHV project** – a cross-border initiative spanning **Slovenia, Croatia**, and **Italy's** Friuli Venezia Giulia (FVG) region – that aims to establish a sustainable **hydrogen economy** and drive regional cooperation (discussed further in Section 5.1.7).[27,39,40]

4.10 Non-EU DRS countries

The below section provides an overview of the hydrogen markets in the countries of Bosnia and Herzegovina, Moldova, Montenegro, Serbia, and Ukraine. These countries are at **varying stages of hydrogen market development**, with **Ukraine** being **the most advanced** given its significant production capacity and strong export potential. **Ukraine** also established clear hydrogen-related goals and strategies within its National Energy and Climate Plan which was approved by the Cabinet of Ministers of Ukraine in June 2024 for the period up to 2030.[42,43,44] In contrast**, Bosnia and Herzegovina Moldova,** and **Serbia** – in their respective Integrated National Energy and Climate Plan (INECP) – along with Montenegro in its latest energy policy document – the Annual Implementation Report published by the Energy Community Secretariat – only outline indicative measures or directions and future targets for developing their hydrogen markets.[45,46,47,48]

4.10.1 Bosnia and Herzegovina

Bosnia and Herzegovina has not yet developed a hydrogen strategy in its draft INECP. While the plan does not set specific hydrogen production or consumption targets, it states

[40] *Hydrogen Industry Leaders (2024): Slovenia on the Hydrogen Future Map*
[41] *Balkan Green Energy News (2024): Slovenia launches low-carbon hydrogen consortium*
[42] *Energy Community (2024): National Energy and Climate Plan of Ukraine 2025-2030 (draft)*
[43] *Energy Community (2024): Ukraine approves National Energy and Climate Plan as EU Accession Negotiations Begin*
[44] *EU Neighbours East (2024): Ukraine approves National Energy and Climate Plan developed with EU support*
[45] Energy Community (2023): *Bosnia and Herzegovina Integrated Energy And Climate Plan*
[46] *Energy Community (2023): Integrated National Energy and Climate Plan for the Republic of Moldova (draft)*
[47] *Energy Community (2023): Integrated National Energy and Climate Plan of the Republic of Serbia for the period 2030 with the projections up to 2050*
[48] *Energy Community (2023): Annual Implementation Report 2023 Montenegro*

that the country aims to reduce its dependence on the import of natural gas through measures to converting fuel usage in industry towards hydrogen and electricity, as well as reducing the consumption of oil and petroleum products by electrifying transport and using hydrogen. It is targeting an 8.4% share of energy from renewable sources in the transport sector by 2030, with hydrogen as a contributing factor.[45]

4.10.2 Republic of Moldova

In Moldova's draft INECP – developed by the Ministry of Energy with the support of the European Union – while **hydrogen is mentioned** as a possible long-term alternative fuel, development of the country's hydrogen market remains in its early stages. As per the INECP, one target for the period of 2030-2050 is the use of green hydrogen as an alternative to gas in transport and industry, but the extent of its integration remains unclear. However, there is growing interest in biomethane and green gas integration, which could eventually support hydrogen development.[46]

4.10.3 Montenegro

According to **Montenegro's Annual Implementation Report** (2023) published by its Energy Community Secretariat, the country's energy transition efforts focus primarily on expanding the utilization of renewable electricity sources, such as hydro, solar, and wind, while specific strategies towards developing its hydrogen market have not been specified.[48]

4.10.4 Serbia

Serbia has taken initial steps towards hydrogen development, as outlined in its **INECP**, which was adopted on 13 June 2023. The government is working on a **legislative framework for renewable hydrogen** and biomethane integration, with plans to introduce hydrogen demonstration projects before 2030, followed by large-scale deployment after 2030. Although, Serbia does not currently have significant hydrogen production, the NECP includes a **target of 87 ktoe** (kilotons of oil equivalent) **of renewable hydrogen** and biomethane in **pilot projects**. The country is also exploring hydrogen storage solutions and the potential integration of hydrogen into the national gas

network. Plans are underway to develop regulatory conditions for hydrogen transport and storage, which could support a future hydrogen economy.[47]

4.10.5 Ukraine

According to publications by the Fraunhofer Institute for Systems and Innovation Research and CMS International, Ukraine has strong potential to become one of Europe's largest exporters of green hydrogen – especially to the EU – given its favourable geographical location, having huge potential for generating electricity from renewable sources and extensive gas infrastructure.[49, 50] The Institute of Renewable Energy of the National Academy of Sciences of Ukraine estimated in 2024 that the country's annual hydrogen production potential is **44.96 million tonnes**. At present, Ukraine **produces** approximately **360,000 tonnes** of **hydrogen** annually, primarily for producing ammonia.[49]

Regarding future **PRODUCTION**, under the National Recovery Plan 2022, Ukraine aims to produce 1.5 million tons of hydrogen annually by 2032. Additionally, the Energy Strategy of Ukraine 2050 (ESU2050), set out within the country's NECP, forecasts hydrogen exports reaching 0.3-0.4 million tons by 2035 with the potential to increase to 1.5-2 million tonnes by 2050.[42]

Currently, there is no large-scale domestic hydrogen **CONSUMPTION** market in Ukraine. However, future hydrogen demand is expected to emerge in key sectors including industry, power generation, and transportation.

At present, Ukraine lacks a large-scale hydrogen production market, and dedicated hydrogen production (specifically green and low-carbon hydrogen) is expected to begin only by 2032. The ongoing war in Ukraine has significantly disrupted hydrogen production, with many facilities affected by the occupation of key industrial regions. Since 2022, no new hydrogen production facilities have been built, and production levels

[49] *CMS (2024): Hydrogen law, regulations & strategy in Ukraine*
[50] *Fraunhofer Institute for Systems and Innovation Research (2023): Global Hydrogen Potential Atlas: Working Paper 04/2023: Ukrainian Hydrogen Export Potential: Opportunities and Challenges in the Light of the Ongoing War*

have declined. However, Ukraine remains committed to expanding its hydrogen capacity, with several projects related to hydrogen being developed.[42,49]

One major initiative is the **H2U Hydrogen Valley**, led by LLC Gas Transmission System Operator (GTSO) of Ukraine under the global Mission Innovation initiative. This project aims to establish two hydrogen valleys:

1. The **First Valley** in **Odesa**, featuring a 100 MW electrolysis plant (with the potential to be expanded to 200 MW), powered by 120 MW of wind and 80 MW of solar capacity. Over the aim is to produce 7,000-8,000 tonnes of hydrogen per year, or 400-750 tonnes per month.
2. The **Second Valley** in **Zakarpattia** is expected to cover an area of 120 hectares and include a 1,100 MW electrolysis plant (with the potential to be expanded to 1,500 MW), along with a solar and wind energy facility. Hydrogen produced in this this valley is intended for supply to a nearby steel plant.

Furthermore, as part of the H2U Hydrogen Valley imitative Ukraine's Hydrogen LLC received a grant co-funded by the British Foreign Office to develop two export-oriented green hydrogen production facilities near the two valleys with a dedicated hydrogen pipeline planned. The location of the facility in the Odesa region was partly chosen due to its proximity to a seaport, facilitating future hydrogen transport by the Black Sea and the Danube to Central European countries.[42,49]

According to RBC Ukraine and CMS International, Ukraine's GTSO equally presents significant opportunities for hydrogen transport **INFRASTRUCTURE**.[49] Currently, the GTSO primarily facilitates natural gas exports to Europe, but as Ukraine's transit contract expired on 1 January 2025, this infrastructure could be repurposed for hydrogen transmission.[49,51]

The most prominent project in this regard is the **Central European Hydrogen Corridor**, a joint initiative between **Ukraine, Slovakia, Czechia,** and **Germany** to be established **by 2030**. This corridor would be designed to create a hydrogen "highway" through Central Europe, enabling the transportation of green hydrogen from Ukraine to high-

[51] *RBC-Ukraine (2025): Tap is closed. Ukraine stops Russian gas transit to EU and Moldova*

demand markets in the EU such as Germany. Additionally, the corridor would facilitate the transport of hydrogen from production facilities to consumers in Slovakia and Czechia. The project is being developed in partnership with GTSO of Ukraine LLC, Eustream (Slovakia), NET4GAS (Czechia), and Open Grid Europe (Germany). The corridor is expected to have a capacity of 144 GWh/day, with a total pipeline length of 1,446 km. A pre-feasibility study is set to be completed by June 2024, which will provide further insights into the feasibility and required investments for the corridor.[42,49]

Given the challenges associated with developing dedicated hydrogen pipelines, Ukraine is also exploring alternative transport methods. One potential solution is the use of LOHCs, which would enable hydrogen to be transported via existing oil infrastructure. The ESU2050 also mentions the feasibility of using the ammonia pipeline "Tolyatti-Odesa", which could be repurposed for the transportation of ammonia produced from hydrogen.

In terms of **STORAGE CAPACITY**, Ukraine is planning to establish underground hydrogen storage sites with a total capacity of 980 GWh. Additionally, large-scale hydrogen tank storage facilities with a combined capacity of 4,600 GWh are also being considered to support the country's future hydrogen market. These storage solutions will be critical in balancing supply and demand, particularly as hydrogen production scales up and export volumes increase.

However, despite its promising hydrogen potential, the ongoing war and geopolitical instability have made large-scale infrastructure investments highly uncertain, deterring international investors from committing resources to Ukraine's hydrogen market.

4.11 Comparative hydrogen market summary tables and figures

The table below summarises the targets and goals outlined in the NECPs and hydrogen strategies. The level of ambition regarding consumption, production capacity and infrastructure as well as the focus areas, as seen below, vary significantly for each country.

Table 11. Summary of NECP and hydrogen strategy targets on a national level

Source: NECP and NHS the respective DRS countries

Country	Consumption target	Production capacity target	Infrastructure related targets
Austria	Replace at least 80 % of fossil-based hydrogen consumption in energy-intensive industries by 2030 with climate-neutral hydrogen.	1 GW electrolyser capacity	
Bulgaria		55 MW electrolyser capacity	
Croatia	Hydrogen in Total Energy Consumption: • 2025: 0.1% • 2030: 0.2% • 2040: 3.0% • 2050: 11.0%	Electrolyser Capacity: • 2025: 35 MW • 2030: 70 MW • 2040: 900 MW • 2050: 2,750 MW	Hydrogen Refuelling Stations (HRS): • 2030: 15 stations • 2050: 100 stations
Czechia		Annual consumption of low-carbon hydrogen: • 2030: 97 kt • 2050: 1,728 kt	Hydrogen consumption in transport: • 2050: 845 kt/year
Germany		2030: 10 GW electrolyser capacity	2032: Hydrogen core network: 9,700 km
Hungary		2030: • 240 MW • 40 kt/year low-carbon hydrogen • 20 kt/year “green” and other carbon-free hydrogen	• Min. 2% volume hydrogen blending ratio in the natural gas system • 20 hydrogen refuelling stations • 40 refuelling points

			• 4.8 thousand HFC vehicles
Romania	2050: 500 MW electrolyser capacity	2030: 100 MW electrolyser capacity	2050: • 20% share of hydrogen as fuel in cars • 35% share in HGVs & LCVs
Slovakia			• By the end of 2024: 5 % blend of hydrogen with natural gas • Central European Hydrogen Corridor: 2030: 120 GWh/day
Slovenia			2030: 10%-30% of the share of gaseous RES fuels in the total gas supply

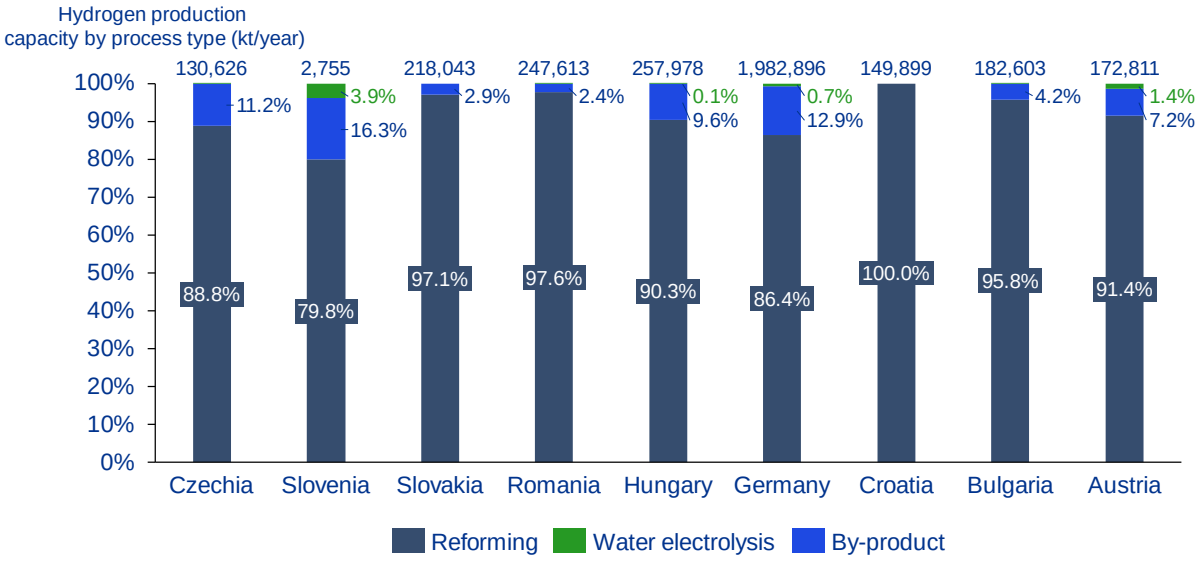


Figure 13. Hydrogen production capacity by process type (kt/year)
Source: Hydrogen Observatory Platform[3]

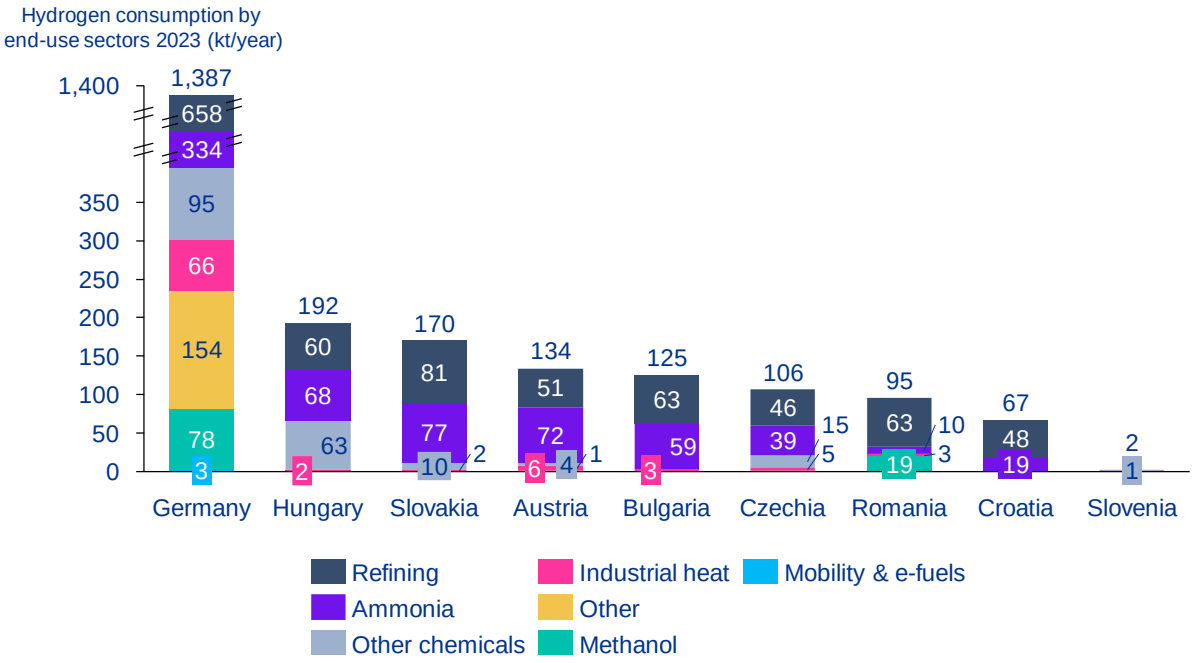


Figure 14. Consumption of hydrogen by end-use sectors (kt/year)
Source: Hydrogen Observatory Platform[3]

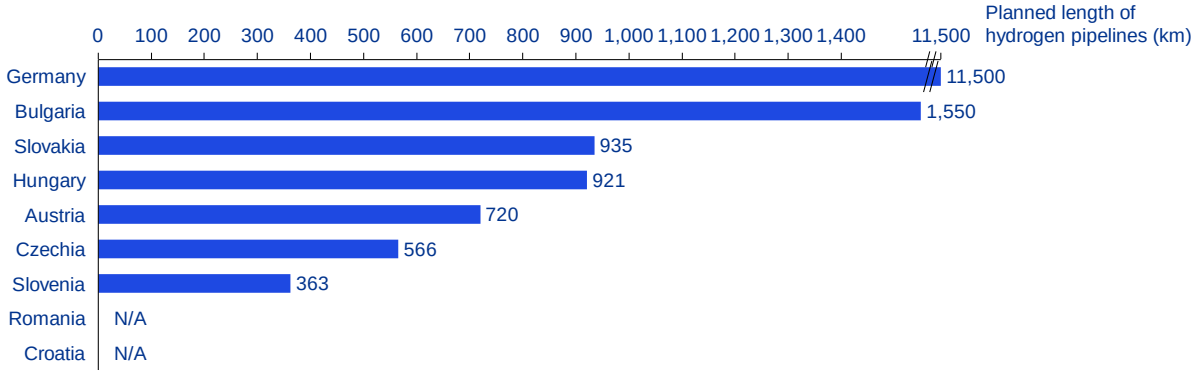


Figure 15. Planned length of hydrogen pipelines (including existing natural gas pipelines planned to be repurposed and newly built hydrogen pipelines)
Source: IEA (Hydrogen Production and Infrastructure Projects Database)[1]

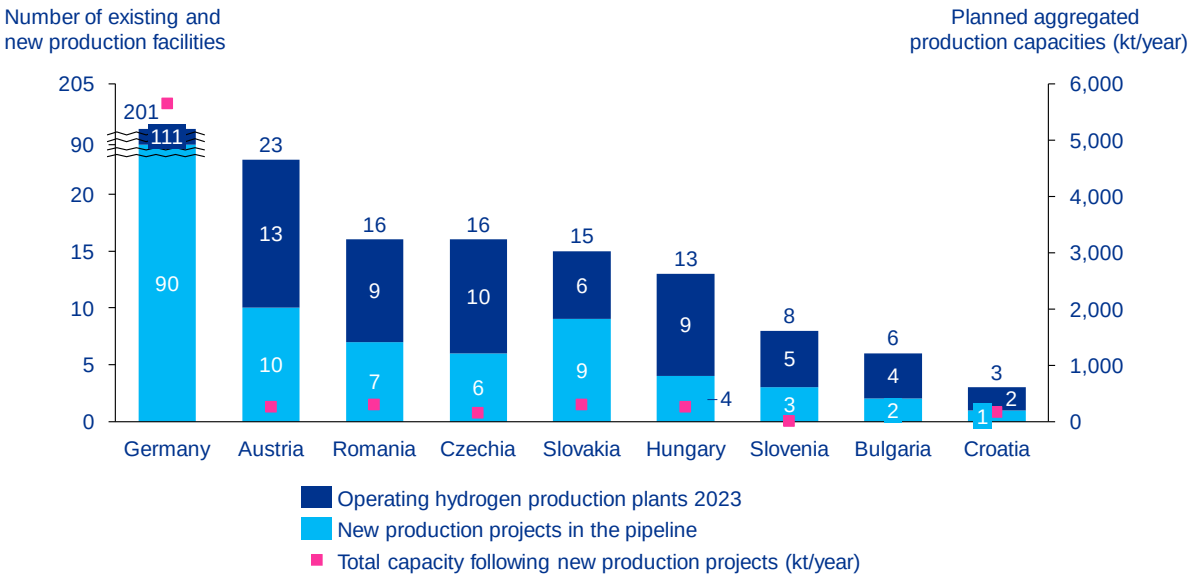


Figure 16. Number of existing production plants, new production projects and planned aggregated production capacities

Source: IEA (Hydrogen Production and Infrastructure Projects Database)[1]; Hydrogen Observatory Platform[3]

5 Regulatory overview

In addition to the national climate and hydrogen strategies (discussed in previous chapters of this Study), the regulatory landscape for hydrogen development across the DRS countries is shaped by a combination of **funding mechanisms** and **legislative frameworks** that aim to facilitate the transition towards a hydrogen economy. While most countries in the region have established hydrogen strategies with targets and policy measures, there are **differences** regarding **individual funding programs**, **pilot projects**, and **sector-specific incentives** – offered by governments of the involved countries – to integrate hydrogen into their energy systems. Table 12 below provides a summary of such hydrogen-related policy frameworks and support mechanisms across the DRS countries. It highlights whether a country has a broad climate strategy (NECP for EU-countries or INECP for non-EU countries) and/or a dedicated hydrogen strategy. It also notes whether these documents identify hydrogen as a key pillar in national decarbonization efforts as well as whether they highlight the support for the development of the respective country's hydrogen market, additionally, it notes the presence of legislations regulating hydrogen-related support.[52] It can be seen that while many countries' national climate strategy outlines support for hydrogen and its role in decarbonisation, they often lack corresponding concrete policies or enforceable measures.

[52] *IEA Policies database*

Table 12. Climate strategies, policies, and support mechanisms in the DRS countries for the development of their respective hydrogen market

Source: National climate strategies of the respective countries and the IEA Policies database[52]

	NECP - Supporting Hydrogen	NHS	INECP Supporting Hydrogen	Support decarbonization with Hydrogen	Government support
Austria	✓	✓		✓	✓
Bulgaria	✓	✓		✓	✓
Croatia	✓	✓		✓	
Czechia	✓	✓		✓	
Germany	✓	✓		✓	✓
Hungary	✓	✓		✓	
Romania	✓	✓		✓	
Slovakia	✓	✓		✓	
Slovenia	✓			✓	
Bosnia and Herzegovina			✓		
Republic of Molova			✓		
Montenegro					
Serbia			✓	✓	
Ukraine	✓		✓	✓	

	Funding programme	Funding for pilot/ infrastructure project	Industry sector-specific support	Transport sector-specific support	Other
Austria	✓	✓	✓		✓
Bulgaria					
Croatia				✓	
Czechia				✓	
Germany	✓	✓	✓	✓	✓
Hungary			✓	✓	
Romania		✓			
Slovakia					
Slovenia				✓	
Bosnia and Herzegovina					
Republic of Molova					
Montenegro					
Serbia					
Ukraine					

Germany is a leader in provision of regulatory and financial support, with a broad portfolio of hydrogen-focused policies. The **Special Climate and Transformation Fund (KTF)** encompasses multiple initiatives, including hydrogen use in industry, fuel cell applications in transport, international cooperation, and large-scale production projects.

The policy on **Hydrogen Core Network**, backed by EUR 3bn in EU-approved state aid, aims to create a national hydrogen transport system. Additionally, the **Carbon Contracts for Difference (CCfD) program** provides subsidies to decarbonize heavy industries using hydrogen. Germany equally established multiple bilateral agreements on hydrogen supply chains and related research and development initiatives with countries such as **Australia, Algeria,** and **Canada**, fostering international cooperation, facilitate knowledge sharing, and accelerate the global hydrogen transition. In addition, Germany announced the **KfW Hydrogen Funds**, with a total of EUR 550m to support green hydrogen projects in developing and emerging countries, helping these nations build local hydrogen value chains while also enabling European companies to expand their role in the global hydrogen economy.

Austria's regulatory framework is closely linked to its broader climate and energy policies. Within the framework of the **Austrian Recovery & Resilience Plan**, under Pillar 1 (Sustainable Construction) the **Renewable Expansion Act** allocates EUR 1bn annually towards renewables, with EUR 500m specifically for green hydrogen and industrial decarbonization projects. Furthermore, under Pillar 3 (Knowledge-based construction), EUR 250m has been allocated to support two IPCEIs, with EUR 125m (dedicated for each project) for the IPCEI on Hydrogen and IPCEI on Microelectronics and Connectivity.

Some notable funding measures include **Romania's EUR 148m state aid scheme** for green hydrogen projects, launched by the Ministry of Energy to provide grants of up to EUR 50m per beneficiary for the development of renewable hydrogen production capacity. Similarly, **Hungary**'s policy on **Hydrogen production, transportation, and refuelling stations**, introduced in 2024, directs state investment into hydrogen production infrastructure, hydrogen trucks, buses, and refuelling stations, while its **Industry decarbonization policy** supports the deployment of alternative gases, including hydrogen, in industrial processes. In **Czechia**, the **National Environment Program Call 3/2022: Ecomobility** provides financial support for hydrogen-powered vehicles and refuelling stations through the State Environmental Fund.

In **other DRS countries** aside from their respective NHSs – which have been discussed in detail in earlier chapters – there are **limited** additional **policy measures** aiming at accelerating hydrogen market development. In countries where hydrogen policies are still evolving, efforts are primarily focused on aligning with broader EU energy transition goals and exploring potential applications of hydrogen in industry and transport. As hydrogen technologies advance and market integration with the EU deepens, further policy refinements and investment frameworks are expected to emerge.

5.1 Austria

Policy name	Policy summary	Year	Status
Austrian Recovery & Resilience Plan / Pillar 1. Sustainable Construction / Climate neutral transformation - Renewable Expansion Act	▪ A total of EUR 1bn to be invested annually in the expansion of renewables by 2030, via market premiums and investment grants ▪ Of which EUR 500m to be invested in Green Hydrogen and for industries willing to become CO_2 neutral (e.g., steel production).	2021	In force
Austrian Recovery & Resilience Plan / Pillar 3. Knowledge-based construction / Strategic innovation (hydrogen)	▪ It includes a EUR 250m budget for two IPCEIs programmes (EUR 125m each) for cross-border cooperation on innovation: • IPCEI microelectronics and connectivity • IPCEI hydrogen	2021	In force
Climate and energy strategy "mission 2030"	▪ The main objectives are to (1) reduce the greenhouse gas emissions in Austria by 36% in 2030 compared to 2005; (2) increase the ratio of renewable energy to gross final energy consumption to 46-50% by 2030, and (3) improve the primary energy intensity by 25-30% compared to 2015. ▪ The strategy is broken down to 8 tasks and includes 12 flagship projects	2018	In force

5.2 Bulgaria

Aside from its NHS, adopted in 2023, Bulgaria has not yet developed any dedicated policy instruments or financial mechanisms to support its hydrogen market. Unlike DRS countries that have introduced governmental support based funding programs, Bulgaria's hydrogen sector is in the early stages of policy formulation. While the NHS sets broad strategic objectives, specific regulatory incentives, funding allocations, or pilot projects have not yet been introduced.

5.3 Croatia

Policy name	Policy summary	Year	Status
Establishment of a hydrogen-based economy through the North Adriatic Hydrogen Valley	▪ Allocation of new funds to projects contributing to decarbonise the transport sector of the North Adriatic region. ▪ Conversion of 5 diesel locomotives to hydrogen and setting up charging stations for buses, trains and/or maritime transport.	2024	In force

5.4 Czechia

Policy name	Policy summary	Year	Status
National Environment Program Call 3/2022: Ecomobility	▪ Introducing financial support for the purchase of vehicles with alternative propulsion, electric vehicles, vehicles with hydrogen propulsion, as well as charging points.	2022	In force

5.5 Germany

Policy name	Policy summary	Year	Status
Algeria- Germany - Declaration of Intent in green hydrogen cooperation	▪ In 2024, Germany and Algeria signed a declaration of intent to cooperate on a green hydrogen taskforce. The cooperation will be extended to the production, storage, and transport of green hydrogen and its derivatives. ▪ The full implementation of this cooperation will be based on the SoutH2 project, which is expected to be fully operational as early as 2030.	2024	Announced
Germany's Special Climate and Transformation Fund (KTF) – Hydrogen use in industrial production	▪ Government support for the increased use of hydrogen in industrial production	2024	In force
Germany's Special Climate and Transformation Fund (KTF) – Implementation of the National Hydrogen Strategy	▪ Introducing funds to develop the production and use of hydrogen	2024	In force
Germany's Special Climate and Transformation Fund (KTF) – International hydrogen cooperation	▪ Introducing funds to develop cooperation and hydrogen projects across its boarders.	2024	In force
Germany's Special Climate and Transformation Fund (KTF) – Application-oriented basic research on green hydrogen	▪ Introducing funds towards research on green hydrogen.	2024	In force
Germany's Special Climate and Transformation Fund (KTF) – Important Project of Common European Interest (IPCEI) Hydrogen	▪ Introducing funds to develop additional hydrogen capacity.	2024	In force
Germany's Special Climate and Transformation Fund (KTF) – Hydrogen and fuel cell applications in transport	▪ Introducing funds to promote vehicle and supplier industry for hydrogen and fuel cell applications in transport	2024	In force
Germany's Special Climate and Transformation Fund (KTF) – National power plant strategy	▪ Financial support for the conversion of coal-fired power plants to hydrogen-capable gas-fired power plants	2024	In force
Germany's Special Climate and Transformation Fund	▪ The funding aims to support the market ramp-up of buses with	2024	In force

(KTF) – Directive on the promotion of alternative drives for buses in passenger transport	alternative drives, approved by the European Commission in 2021. ▪ The funding contains two parts: 1. Procurement of buses with alternative drives based on battery and fuel cell technology as well as buses that run 100% on methane generated from biomass 2. Procurement of charging, and hydrogen and methane refuelling infrastructure for the operation of the buses and for the preparation of feasibility studies		
Germany's Special Climate and Transformation Fund (KTF) – Decarbonisation of the industry	▪ Subsidies to decarbonise the industry sector, through the development of the use of hydrogen and CCUS	2024	In force
Hydrogen Core Network	▪ Germany established a Hydrogen Core Network in June 2024, to be financed through network charges. The Network is meant to build and connect hydrogen production infrastructures. ▪ Allocation of initial financing - the European Commission approved the provision of EUR 3 billion under EU State aid rules to support the construction of the Hydrogen Core Network ('HCN').	2024	In force
Germany's 2nd Amendment to the Building Energy Act (GEG) - phase-out of fossil fuels	▪ Amending Building Energy Act for new heating systems to use at least 65% renewable energy from 2024 onwards and for fossil fuels to phase out from heating by Jan 2045 in line with its climate-neutrality target. ▪ The ban will initially apply to new buildings, existing buildings will still allow a gas system until the deadline for municipalities to submit a heat plan (2026 for large cities and 2028 for towns). ▪ New gas boilers will continue to be allowed to be installed, if these boilers are operated with renewable gas, including hydrogen and biomethane	2023	In force
Carbon Contracts for Difference (CCfD) program for energy-intensive industries	▪ Provision of funding to energy-intensive industries via a 'carbon	2023	Announced

	contracts for difference' (CCfD) program. ▪ All companies reducing CO2 emissions and converting their production to climate-friendly production will be eligible to benefit from this program and be able to receive grants independently from their production sizes, therefore including small and medium-sized companies. ▪ According to the CCfD concept, energy-intensive industries will be compensated by climate protection agreements for a period of 15 years to cover for their additional costs (OPEX and CAPEX) to convert their production. ▪ A double-digit billion budget is expected to be allocated by the federal government for this scheme		
CoalCO2-X	▪ A collaborative mechanism co-funding a project involving 3 German and 5 South African partners, coordinated by Germany's Fraunhofer Institute. ▪ The program focuses on converting CO2 emissions from South Africa's coal-fired power plants into various commodity chemicals and fertilizers using green ammonia and hydrogen. ▪ The project is planned to be conducted between September 2022 and August 2025.	2022	In force
KfW Hydrogen funds	▪ Announcement of two new funds (development and growth funds) to make EUR 550m available to support establishing green hydrogen projects in developing and emerging countries. ▪ The development fund is intended to help developing and emerging countries to build up their own local green hydrogen value chain. ▪ The growth fund will support German or European companies to ramp-up the global hydrogen market. Both funds will be managed by the German development bank KfW, which already launched a platform	2022	Announced

	where companies can apply for support		
International Projects on the topic of green hydrogen	▪ Germany and Canada have conducted a call for proposals for research and development grants focused on green hydrogen. ▪ The funded projects under this call will address various topics, including hydrogen production, storage, transport, infrastructure, logistics, and the integration of hydrogen value chains into national energy systems. ▪ Grants are awarded within the framework of project funding and usually with a maximum of EUR 750,000 per joint project for the German side.	2021	In force
German Development and Resilience Plan (DARP) / 1.2 Climate-friendly mobility	▪ The component 1.2 of the German Recovery and Resilience Plan is related to climate-friendly mobility and contains measures for the transport sector, to make it compatible with the country's climate protection targets. ▪ Aims to support the integration of new technologies in the long term and make the transport sector more energy-efficient and low-carbon. ▪ This component includes six investments in EV infrastructure subsidies, electromobility funding, EV purchase incentives, alternative energy buses and rail transport, and hydrogen vehicle applications, along with one reform extending tax exemptions for EVs.	2021	In force
Germany-Australia hydrogen supply chain projects	▪ A bilateral initiative to strengthen cooperation on the development of hydrogen technology between Australia and Germany. ▪ The Australian Renewable Energy Agency (ARENA) and German Federal Ministry of Education and Research will commit respectively AUD 50m and EUR 50m to fund HyGATE, a new joint Hydrogen Innovation and Technology Incubator.	2021	In force
Package for the future	▪ A programme designed to prepare Germany for upcoming challenges:	2020	In force

	climate change and growing digitalisation. ▪ Supports research and development in the field of quantum computing, artificial intelligence, hydrogen power and electric vehicles. ▪ The programme has an allocated budget of 50 billion euros and offers tax breaks for targeted sectors. ▪ Includes financial and fiscal support for: a new hydrogen strategy, renewable energies, building renovations promotion, a switch to electric vehicles, research into AI, and the expansion of digital teaching		
Package for the future - Expansion of renewable energies	▪ Measures to support additional expansion of renewable energy: (1) abolishing the cap on solar PV build-out (2) increasing the capacity targets for offshore wind energy from 15 GW by 2030 to 20 GW (3) option for minimal distance rules on sub-federal level (4) options for municipal participation in profits from wind power projects.	2020	In force
Package for the future - Research and development	▪ Increase of the tax research allowance for innovative companies in Germany, doubling the tax support for research by innovative German companies. ▪ The funding of the tax research allowance will be granted retroactively on the period 1.1.2020 - 31.12.2025, with up to EUR 4m per company. Budget estimated: EUR 1bn. ▪ Support for large non-university research organisations with additional funds. Budget estimated: EUR 1bn. ▪ Support to project-related research, with a focus on energy system upheavals linked to digitalisation and sector coupling. Budget estimated EUR 0.3bn	2020	In force
National Innovation Programme for Hydrogen and Fuel Cell Technology	▪ Funding the development and implementation of hydrogen and fuel cell technology to bring about market	2008	In force

	readiness of the respective technologies, creating value chains and value-added shares, contributing to considerable growth in experience, and contributing to the federal government energy- and climate-policy targets. ▪ The programme includes both transport sector-related and stationary applications. ▪ The total programme volume is EUR 1.4bn. A sum of EUR 500m is being provided by the BMVBS, EUR 200m by the BMWi, and the other half is being co-financed by industry.		
Integrated Climate Change and Energy Programme	▪ Enhance energy security, economic efficiency, and environmental protection by implementing Germany's commitments to the EU's climate and energy policy. ▪ Measures to expand renewable energy, improve energy efficiency, and regulate biofuels and emissions. ▪ The policy is being legally transposed through multiple legislative packages, with key reforms in power generation, transport, and industrial energy use.	2007	In force

5.6 Hungary

Policy name	Policy summary	Year	Status
Hydrogen production, transportation, and refuelling stations	▪ The Government of Hungary is investing in hydrogen-related measures which includes hydrogen production, hydrogen trucks, hydrogen buses and hydrogen refuelling stations.	2024	In force
Industry decarbonisation	▪ Application of green technologies for the decarbonisation of industry aims to encourage the deployment of green technologies for the decarbonisation of the industry. ▪ This includes carbon capture and digitalisation that indirectly contributes to GHG emission	2024	In force

	reduction; deployment of alternative gases such hydrogen and electrification and biomethane.		

5.7 Romania

Policy name	Policy summary	Year	Status
EUR 148 million for green hydrogen projects	▪ The Romanian Ministry of Energy launched a state aid scheme with a total budget of EUR 148m providing grants for the investment in renewable hydrogen production capacities. ▪ Eligible beneficiaries - natural gas producers, companies producing electricity, companies producing or consuming hydrogen and territorial units - can draw up to EUR 50m under the scheme.	2022	In force

5.8 Slovakia

While Slovakia has emerged as one of the largest hydrogen producers in the Danube Region, its regulatory framework remains limited to its NHS "Ready for the Future" and its accompanying Action Plan for 2023–2026. These documents only outline broad objectives for hydrogen production, transport, industrial integration, and end-use applications. Additional sector-specific policies and dedicated funding mechanisms are still to be developed in order to further accelerate hydrogen market development.[36,38]

5.9 Slovenia

Policy name	Policy summary	Year	Status
Promoting the deployment of alternative fuels infrastructure in transport	▪ Additional funding to decarbonise the transport sector. ▪ Financing the testing of electric or hydrogen-fuelled bus lines, implementing a zero-emission	2024	In force

	vehicle purchase subsidy scheme and funding the deployment of recharging and refuelling infrastructures.		

5.10 Non-EU DRS countries

Among the non-EU countries, all except Montenegro have some form of national energy and climate strategy that includes broad support incentives for hydrogen. However, only **Ukraine emphasizes** explicitly **hydrogen** as a **key element** in its **decarbonization strategy**. Beyond these strategic mentions, as per the latest available information published by the IEA, there are **no dedicated hydrogen-focused legislative frameworks** in place for government support, funding programs, or other mechanisms to drive the development of these countries' hydrogen markets.

6 Opportunities for collaboration

In the context of future cross-country DRS cooperation on hydrogen development, two key categories can be identified: **existing initiatives** and **projects** that have already been launched **and potential new forms of collaboration** that could further enhance regional integration. There are already several cross-border hydrogen-related cooperation projects in the Danube Region, spanning areas such as **infrastructure development** (e.g., European Hydrogen Backbone and Central European Hydrogen Corridor), **knowledge sharing, and research, development, and innovation** (**R&D&I).**

Furthermore, potential cooperation on underground hydrogen storage developments in the involved DRS countries could support developing a common mechanism to handle supply-demand issues, alongside enhancing energy security. Participation in EU funding mechanisms (e.g., Horizon EU, Innovation fund, IPCEI, etc.) could be strengthened by joint action to accelerate infrastructure deployment and economic benefits for the region.

The following section provides an overview of the main existing cooperation initiatives in the Danube Region, highlighting their **goals, participating countries**, and **key areas**. Additionally, it outlines **opportunities for expanding these collaborations** and proposes initial **starting points for new initiatives** that could further drive the region's hydrogen economy.

6.1 Expanding existing cooperation and initiatives

The already existing partnerships play a crucial role in enhancing hydrogen production, transport, and integration across multiple countries, contributing to the Danube Region's energy security and decarbonization efforts.

The majority of existing hydrogen cooperation initiatives are **primarily focused on infrastructure development** (see Table 13 below), emphasizing the expansion of hydrogen transport networks, repurposing of gas pipelines, and large-scale production projects.

The following section provides an overview of these ongoing initiatives, highlighting their scope, objectives, and potential for further expansion to strengthen regional cooperation.

Table 13. Summary of key hydrogen cooperation initiatives in the Danube Region

	DRS countries involved	Other countries involved	Type of cooperation	Summary
Black Horse under Hy2Infra IPCEI	Hungary Slovakia	Poland	Industrial cooperation	Develop a hydrogen value chain across the participating countries including production, infrastructure, storage, and transport to support regional decarbonization of the transport sector by 2030
Central European Hydrogen Back (CEHC)	Czechia Germany Slovakia Ukraine	-	Infrastructure development	Aims to establish a dedicated hydrogen pipeline network transporting low-cost hydrogen from Ukraine through Slovakia and Czechia to Austria and Germany, leveraging repurposed gas infrastructure to facilitate cross-border hydrogen trade and industrial decarbonization in Central Europe
Clean Hydrogen Partnership (CHP)	All EU DRS countries are involved in one or several initatives of the CHP	Majority of EU countries are involved in one or several initatives of the CHP	Knowledge sharing, and R&D&I	Drives the development and deployment of clean hydrogen technologies by funding research, supporting hydrogen valley projects, standardizing safety and certification, and fostering international collaboration
European Hydrogen Academy	Czechia Bulgaria Germany Romania	Belgium France Italy Netherlands Spain	Knowledge sharing	Aims to strengthen hydrogen workforce development through university networks, training programs, hands-on laboratories, and educational standardization across Europe
European Hydrogen Backbone	See Corridor A & E below			
North Africa & Southern Europe Corridor (EHB Corridor A)	Austria Hungary Slovenia	Algeria Italy Tunisia	Infrastructure development	Aims to transport cost-competitive green hydrogen from North Africa through Italy into Central Europe, leveraging existing gas infrastructure and new hydrogen pipelines to supply industrial demand in Italy, Austria, and Germany
East and South-East Europe Corridor (EHB Corridor E)	Austria Bulgaria Croatia Czechia Germany Hungary Romania Slovakia Slovenia Ukraine	Greece Poland	Infrastructure development	Envisions the connection of high-supply potential regions in Romania, Greece, and Ukraine with hydrogen demand centers in Bulgaria, Hungary, Slovakia, Austria, and Germany, utilizing renewable energy resources and repurposed gas pipelines to enhance regional energy security, boost industrial competitiveness, and support industrial decarbonization
Green Hydrogen @ Blue Danube	Austria Bulgaria Croatia Germany Hungary Romania Serbia Slovakia	-	Infrastructure development	Produce large-scale green hydrogen in Southeastern Europe - using the regions abundant renewable energy capacities - and transport it via Liquid Organic Hydrogen Carriers (LOHC) along the Danube to meet growing demand in Austria and Germany
North Adriatic Hydrogen Valley (NAHV)	Croatia Slovenia	Italy	Knowledge sharing and R&D&I	Developing 17 pilot projects for hydrogen technologies, production methods, and integration strategies across the participating countries

6.1.1 Black Horse under Hy2Infra IPCEI

The **Black Horse** project falls under the broader **Hy2Infra IPCEI framework**, a collaborative initiative among three of the Visegrád Group countries – Slovakia, Poland, and Hungary – aimed at advancing hydrogen infrastructure development. It focuses on supporting decarbonization of the transport sector through developing an integrated hydrogen value chain across the countries by 2030. The project focuses on establishing of 40 electrolyser production sites, the deployment of 10,000 heavy-duty hydrogen-powered vehicles, and the construction of 270 hydrogen refuelling stations along the TEN-T corridors. This initiative offers a significant opportunity for regional collaboration, advancing Central Europe's and hence the DRS countries' hydrogen economy.[53]

The Black Horse project also presents strategic opportunities for DRS countries to collaborate on scaling up their hydrogen mobility infrastructure and industrial supply chains. By **integrating additional countries** into the network, such as **Austria, Czechia**, and **Romania**, the project could expand hydrogen refuelling infrastructure and optimize cross-border transport corridors, enhancing connectivity across Central and Eastern Europe. Furthermore, **joint research**, regulatory harmonization, and **shared investment in hydrogen vehicle deployment** could accelerate the decarbonization of heavy transport.

6.1.2 Central European Hydrogen Corridor (CEHC)

A similar infrastructure cooperation initiative to the EHB is the Central European Hydrogen Corridor (CEHC) launched in 2021 by four gas TSOs including **OGE (Germany)**, **NET4GAS (Czechia)**, **EUSTREAM (Slovakia)**, and **GTSOU (Ukraine)**. The primary aim of the project is to **establish a so-called hydrogen highway** in Central Europe which facilitates the transportation of hydrogen from major production areas in

[53] *Clean Hydrogen Partnership: BLACK HORSE*

Ukraine, through Slovakia and Czechia to hydrogen demand clusters in Czechia, Slovakia, and Germany.[54,55,56]

The corridor is planned to span approximately **1,351 km**, utilizing a combination of repurposed existing natural gas pipelines and targeted investments in new hydrogen-specific infrastructure, including pipelines and compressor stations. Upon completion, the corridor is expected to have a **capacity of** transporting up to **144 GWh of hydrogen per day**, equivalent to about 1.5 million tonnes per year. The **estimated investment** for the segment from the Ukrainian-Slovak border to southern Germany ranges between **1,000 to 1,500 million EUR,** however funding sources are yet to be secured.[54,55,56]

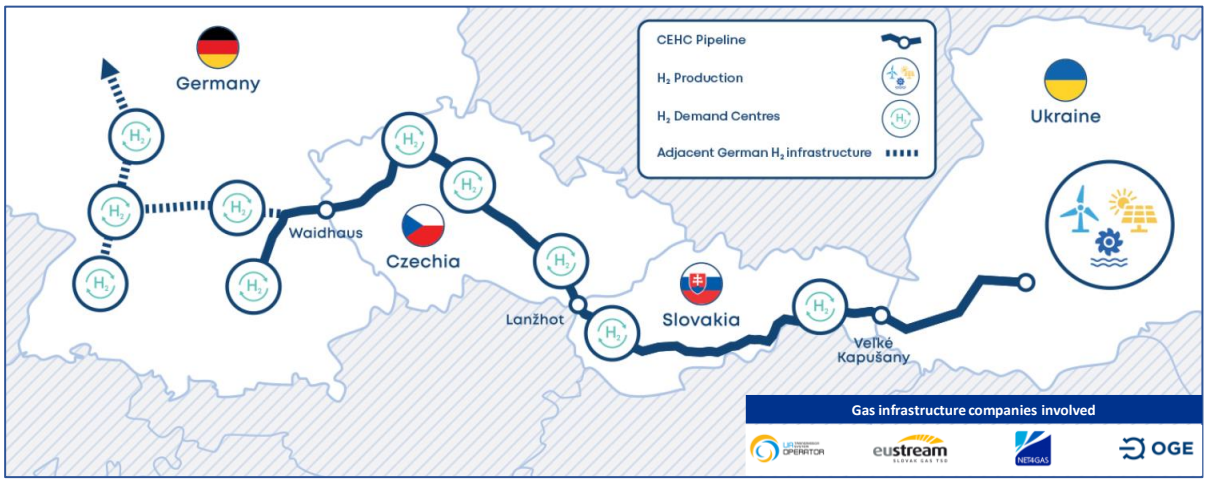


Figure 17. Countries and gas infrastructure operators involved in the Central European Hydrogen Corridor (CEHC) initiative

Source: CEHC[54,55,56]

The project is currently in the pre-feasibility study/feasibility study phase, scheduled to end by the end of 2026. It is expected to reach the Final Investment Decision stage by 2028, with commercial operations targeted to begin by the end of 2029/30.[54,55,56]

The CEHC could provide opportunities for DRS countries to collaborate on developing harmonized hydrogen regulations, cross-border infrastructure investments, and pipeline repurposing projects. Additionally, involving further DRS countries such as Austria and

[54] *CEHC: Project vision*
[55] *Gas Infrastructure Europe (GIE): Central European Hydrogen Corridor*
[56] *Three Seas Project: The Central European Hydrogen Corridor*

Hungary positioned along the corridor could enable these countries to explore integration opportunities by developing interconnections to the corridor, enabling access, and thus enhance their regional supply diversification.

6.1.3 Clean Hydrogen Partnership (CHP)

The Clean Hydrogen Partnership (a.k.a. Clean Hydrogen Joint Undertaking, the successor of the Fuel Cells and Hydrogen 2 Joint Undertaking) is a unique **public private partnership** supporting research and innovation activities in hydrogen technologies to accelerate the development and improvement of advanced clean hydrogen applications in Europe. The partnership is a collaborative effort between the **European Commission**, **Hydrogen Europe**, and **Hydrogen Europe Research**, bringing together stakeholders from industry, academia, and research organizations. The EU is supporting the Clean Hydrogen JU with 1bn EUR for the period 2021-2027, complemented by at least an equivalent amount of private investment (from the private members of the partnership), raising the total budget to over 2bn EUR.[57]

The main activities of CHP include:

- **Standardization efforts** through the **European Hydrogen Sustainability and Circularity Panel** and the **European Hydrogen Safety Panel**, ensuring best practices in sustainability, safety, and regulatory alignment.[58]
- **Establishing a transparent certification** system of renewable and low-carbon hydrogen via the **CertifHy** initiative for hydrogen producers and consumers. The main objective of CertfHy is to facilitate the EU-wide roll out of an efficient and harmonised hydrogen Guarantees of Origin market by closely cooperating with the Association of Issuing Bodies (AIB) and future EU Issuing Bodies.[59]
- **Data collection and infrastructure monitoring** through the **European Hydrogen Observatory,** compiling key databases on hydrogen production, infrastructure deployment, market trends, and regulatory frameworks to support policy and industry decision. Additionally, the **European Hydrogen Refuelling**

[57] *Clean Hydrogen Partnership: Who we are*
[58] *Clean Hydrogen Partnership: European Hydrogen Sustainability and Circularity Panel*
[59] *Clean Hydrogen Partnership: CertifHy*

Station Availability System offers real-time updates on the operational status of hydrogen refuelling stations across Europe intended to help overcome the challenges to the uptake of fuel cell electric vehicles (FCEVs).[60]

- **Providing funding through calls for proposals** for research, innovation, and deployment projects in hydrogen production, storage, distribution, and industrial applications. The aim is to promote international collaboration, policy coordination, and standardization efforts to align hydrogen development across Europe. Each call is issued with a defined budget (e.g. 184.5m EUR was allocated for 2025), specifying the types of projects eligible for funding and the expected impact on the European hydrogen market.[61]
- **Deployment of Hydrogen Valleys**, supporting both large-scale (over 4,000 t/year of hydrogen produced and used) and small-scale (over 500 t/year of hydrogen produced and used) hydrogen ecosystems. Altogether, the Clean Hydrogen JU has supported to date 18 hydrogen valleys projects across 17 European countries. Projects such as HEAVENN (Call 2019) and Green Hysland (Call 2020) have become pioneers and flagships of the Hydrogen Valley concept. Additionally, through these hydrogen valley projects the CHP collects data on technologies used, funding models, stakeholder involvement, and project success factors to enhance knowledge-sharing and replication.[62,63,64]

The CHP presents significant opportunities for **collaborative partnerships among DRS countries**. For instance, best practices and lessons learned from existing hydrogen valley projects in Slovenia, Croatia, Bulgaria, and Austria can be shared and replicated in other DRS countries, helping them accelerate their hydrogen initiatives.

Additionally, stakeholders – including universities, research institutes, private companies, industry associations, and public authorities – from multiple DRS countries, can form consortia to apply for upcoming calls for proposals in 2026 and 2027, targeting specific

[60] *Clean Hydrogen Partnership: European Hydrogen Refuelling Station Availability System*
[61] *Clean Hydrogen Partnership: Call for proposals 2025 – Open*
[62] *Clean Hydrogen Partnership: Hydrogen Valleys*
[63] *Clean Hydrogen Partnership: Mission Innovation Hydrogen Valleys Platform*
[64] *H2Valleys: Mission Innovation Hydrogen Valleys Platform*

research and technology challenges. Receiving funding through these calls would enable cross-border collaboration, joint research projects, and infrastructure development, strengthening the region's role in the European hydrogen economy.

6.1.4 European Hydrogen Academy

The European Hydrogen Academy (**HyAcademy.EU** project, EHA) is an EU-funded initiative under Horizon Europe's Climate, Energy, and Mobility programme, with a total budget of close to EUR 3m entirely funded by the EU. The project, coordinated by Vysoká Škola Chemicko-Technologická v Praze (Czechia), has been running **since January 2024** and is expected to **end in June 2028**. The EHA imitative receives financing through Horizon Europe's funding for Coordination and Support Actions (CSA). CSA projects receive financial support for activities such as **networking, best practice exchange, policy coordination, training**, and **standardization** but **excludes projects directed at research or technological development**.[65]

12 core participants are part of the EHA from **Czechia, Netherlands, Italy, Belgium, Romania, Bulgaria, France, Spain, and Germany**, including institutions such as universities, research and development organisations as well as industry and technical associations.[66]

The main objective of EHA is to address Europe's hydrogen workforce shortage by creating a large-scale, integrated education and training ecosystem for hydrogen technologies. It consolidates and enhances existing hydrogen-related training initiatives to ensure a skilled workforce aligned with EU energy transition goals. The key initiatives include:

- Establishing a network of 100+ universities and 500 schools offering hydrogen technology programs
- Developing hands-on laboratories for practical training
- Creating a multilingual educational portal and teaching materials

[65] *European Commission*
[66] *European Commission: The European Hydrogen Academy*

- Implementing innovative teaching methodologies to improve hydrogen-related skills
- Promoting public acceptance of hydrogen technologies

Similar to the CHP, the EHA also provides a strong foundation for enhancing cooperation among **DRS** countries **through knowledge sharing. Institutions in DRS countries already part of the EHA** (Czechia, Bulgaria, Germany, and Romania), could extend their collaboration by involving institutions from **Austria** and **Slovenia** that already offer some form of training or academic opportunities in hydrogen-related subjects.[67] Such partnerships could involve setting up **guest lecture programs, student exchange opportunities, and dual-degree collaborations** between the participating institutions.

Other DRS countries (e.g., Croatia, Hungary, and Slovakia) – where academic institutions only offer optional specification courses and classes in hydrogen-related subjects – could leverage the EHA initiative by **partnering with existing participants** and work together to **adopt academic curriculum** into their courses on relevant subjects or establish new specific hydrogen-focused programs.[67]

Further specific initiatives could include establishing cross-border hydrogen training centers, where universities and technical institutes collaborate on developing standardized curricula and certification frameworks to ensure workforce compatibility across national markets.

Through aligning educational and training efforts, DRS countries can position themselves as key players in the EU hydrogen economy, ensuring a skilled labour force that meets both industry demands and policy objectives.

6.1.5 European Hydrogen Backbone

The **European Hydrogen Backbone (EHB)** is a pan-European collaborative initiative framework aimed at developing a dedicated hydrogen infrastructure to support the continent's transition towards a decarbonized energy system. Comprising **31 major European gas TSOs**, the initiative envisions a **hydrogen pipeline network of**

[67] *European Hydrogen Observatory: Training Programmes*

approximately 28,000 km by 2030, expanding to **53,000 km by 2040**. The network will be a mix of **repurposed existing natural gas pipelines** and **newly built hydrogen infrastructure**, facilitating **cost-effective hydrogen transport** across borders.[68,69]

EHB's mission is to **accelerate the establishment of a European hydrogen market**, ensuring security of supply while promoting cooperation between countries and regions. By 2030, the EU aims to produce **10 million tonnes of renewable hydrogen domestically** and import another **10 million tonnes**, as outlined in the **RePowerEU strategy**. To support these goals, the EHB has identified **five large-scale hydrogen supply corridors** – each with a unique regional role – that will transport low-cost hydrogen from domestic and international sources to key demand centres across Europe. The five hydrogen supply corridors outlined by the EHB initiative are:

1. Corridor A: North Africa & Southern Europe
2. Corridor B: Southwest Europe & North Africa
3. Corridor C: North Sea
4. Corridor D: Nordic and Baltic regions
5. Corridor E: East and South-East Europe

Among the these corridors **Corridor A (North Africa & Southern Europe)** and **Corridor E (East and South-East Europe)** stand out as particularly significant for **the DRS countries**, offering numerous opportunities for cooperation in **infrastructure development.**[68,69]

6.1.5.1 North Africa & Southern Europe Corridor (EHB Corridor A)

Corridor A is envisioned to transport **large volumes of cost-competitive green hydrogen** from **North Africa** (Tunisia and Algeria) **through Italy into Central Europe** with industrial demand. It would leverage existing gas infrastructure and planned

[68] *EHB: EHB publishes five potential hydrogen supply corridors to meet Europe's accelerated 2030 hydrogen goals*
[69] *EHB (2022): Five hydrogen supply corridors for Europe in 2030, Executive Summary*

hydrogen pipelines, ensuring efficient and scalable hydrogen transport from regions with vast renewable energy potential.[69,68,69]

Key participating countries involved are:

- **DRS countries**: Austria, Slovenia, Hungary
- **Southern Europe**: Italy
- **North Africa**: Tunisia, Algeria

Additionally, it is envisioned to supports industrial decarbonization, particularly in heavy industries and transport, while providing opportunities for hydrogen storage and distribution in Austria and Hungary. **This initiative could also create potential for future cooperation such as integrating hydrogen storage hubs in Austria and Hungary with the deployed infrastructure, ensuring stable supply** [68,69]

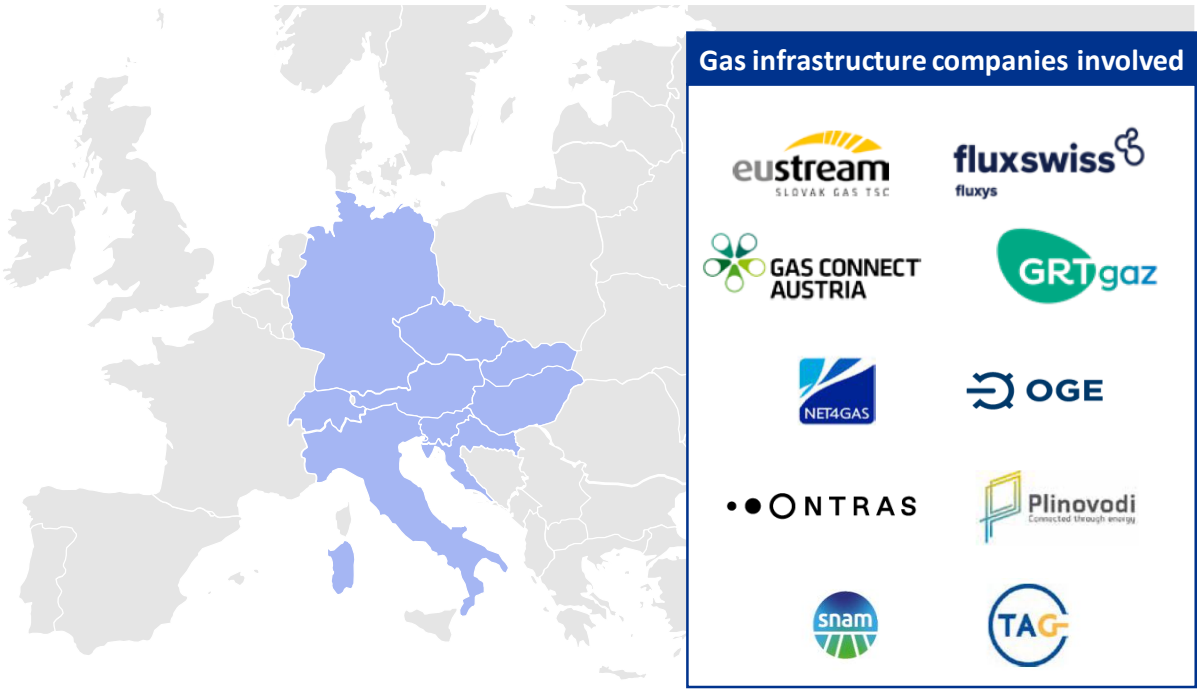


Figure 18. Countries and gas infrastructure operators in the North Africa & Southern Europe Corridor initiative (EHB Corridor A)

Source: EHB[68,69]

6.1.5.2 East and South-East Europe Corridor (EHB Corridor E)

Corridor E is expected to play a crucial role in connecting **high-supply** potential **regions** such as **Romania**, **Greece**, and **Ukraine** – leveraging vast land availability and high-capacity factors for solar and wind – with **major hydrogen consumers** in Central Europe and Germany. The corridor is expected to deliver hydrogen from Romania, Greece, and Ukraine to off-takers in **Bulgaria, Hungary, Slovakia, Austria**, and **Germany**, reinforcing East-West energy integration.[68,69]

Key participating countries involved are:

- **DRS countries:** Austria, Bulgaria, Croatia, Czechia, Germany, Hungary, Romania, Slovakia, Slovenia and Ukraine
- **Other countries:** Greece and Poland

For DRS countries, this initiative presents significant cooperation potential, particularly through the repurposing of existing natural gas infrastructure in Hungary, Slovakia, and Austria into dedicated hydrogen corridors, **reducing infrastructure costs** and **accelerating deployment.** Additionally, by diversifying hydrogen sources, including potential imports from Ukraine, the corridor **enhances regional energy security**. Moreover, access to low-cost renewable hydrogen will **boost industrial competitiveness** in the DRS, supporting the decarbonization of key sectors such as heavy industry, refining, and transport, potentially positioning the region as a strategic hub in Europe's emerging hydrogen economy.[68,69]

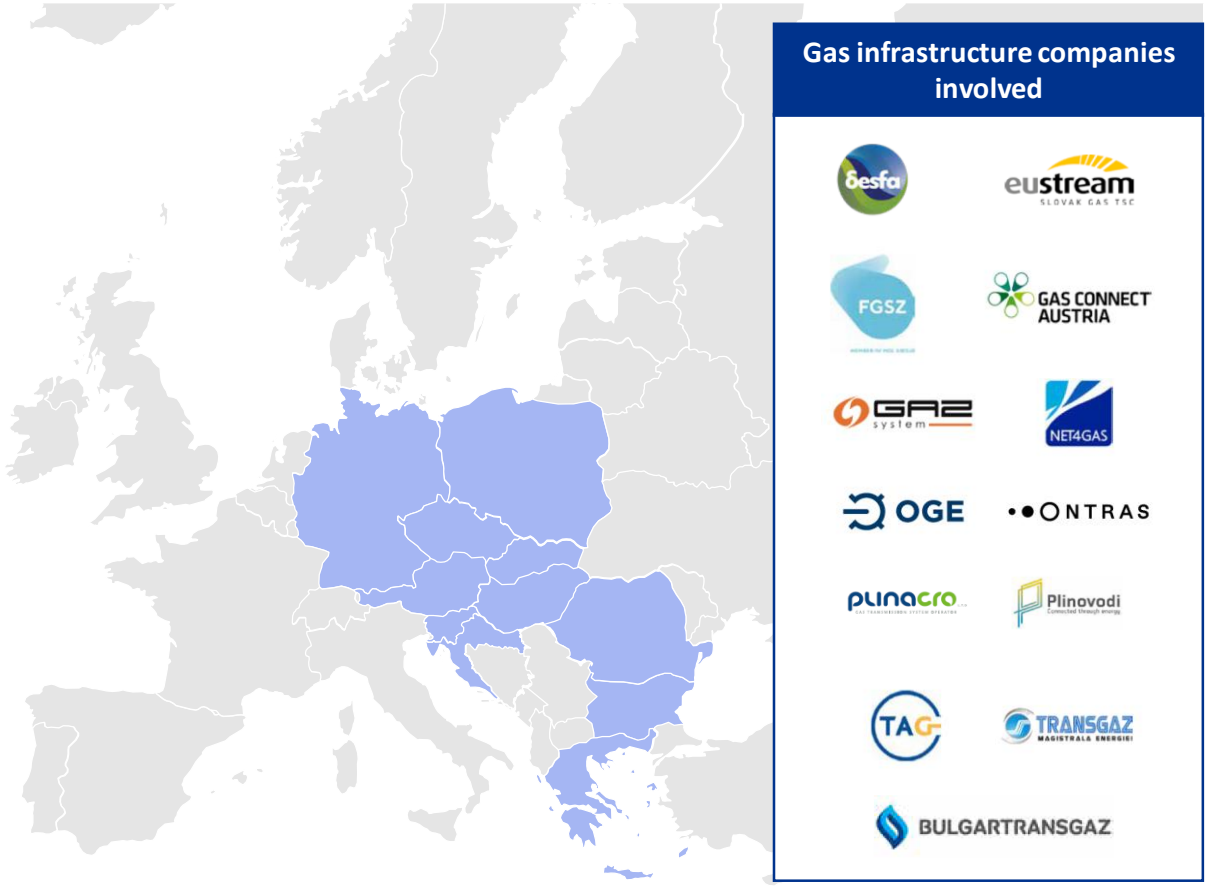


Figure 19. Countries and gas infrastructure operators involved in the East and South-East Europe Corridor initiative (EHB Corridor E)

Source: EHB[68,69]

6.1.6 Green Hydrogen @ Blue Danube under Hy2Infra IPCEI

The Green Hydrogen @ Blue Danube initiative is developed by **VERBUND** – Austria's largest producer of renewable electricity – in conjunction with partners and buyers of green hydrogen within the framework of the **IPCEI Hy2Infra** initiative. Green Hydrogen @ Blue Danube aims to connect the renewable energy capacities of Central and Eastern Europe with the growing demand for green hydrogen in Western Europe, particularly in Austria and Germany. The initiative is supported by a broad coalition of countries, including **Austria, Germany, Romania, Bulgaria, Serbia, Croatia, Hungary,** and **Slovakia**, underlining its regional significance. It has also received significant political support from Austria, Germany, Romania, the Netherlands, and the European Union. The project focuses on developing a large-scale green hydrogen production in Southeastern

European countries such as Romania, Bulgaria, Serbia, and Croatia leveraging their substantial renewable energy resources. To transport this hydrogen, the project employs LOHC and ships along the Danube River, utilizing the well-established TEN-T transport corridor. The project is planned to be implemented in two phases:

Phase I focuses on the deployment of the first electrolysers on an industrial scale to produce green hydrogen in Austria and Bavaria, Germany, establishing a foundation for industrial use and mobility applications. This phase will utilize 180 MW of renewable energy to produce 27 000 tons of green hydrogen.

Phase II aims to create a Europe-wide value chain by leveraging unused renewable energy potential in Southeastern Europe to produce large quantities of green hydrogen. This hydrogen will be transported along the Danube corridor to consumers in Central Europe, further enhancing cross-border collaboration and resource efficiency. Phase II will scale up production with 2 GW of renewable energy, generating 80 000 tons of green hydrogen.[15,16,17,18]

The Green Hydrogen @ Blue Danube initiative offers significant cooperation opportunities for DRS countries. Strengthening coordination on regulatory frameworks and hydrogen transportation standards could enhance the efficiency and scalability of hydrogen trade along the Danube corridor. Collaboration on hydrogen certification and market incentives could further facilitate trade between Southeastern and Western Europe. Additionally, the initiative provides a platform for joint investment in hydrogen storage, logistics infrastructure, and technological innovation, enabling participating countries to optimize resource utilization and accelerate the adoption of green hydrogen in industry and the mobility sectors.

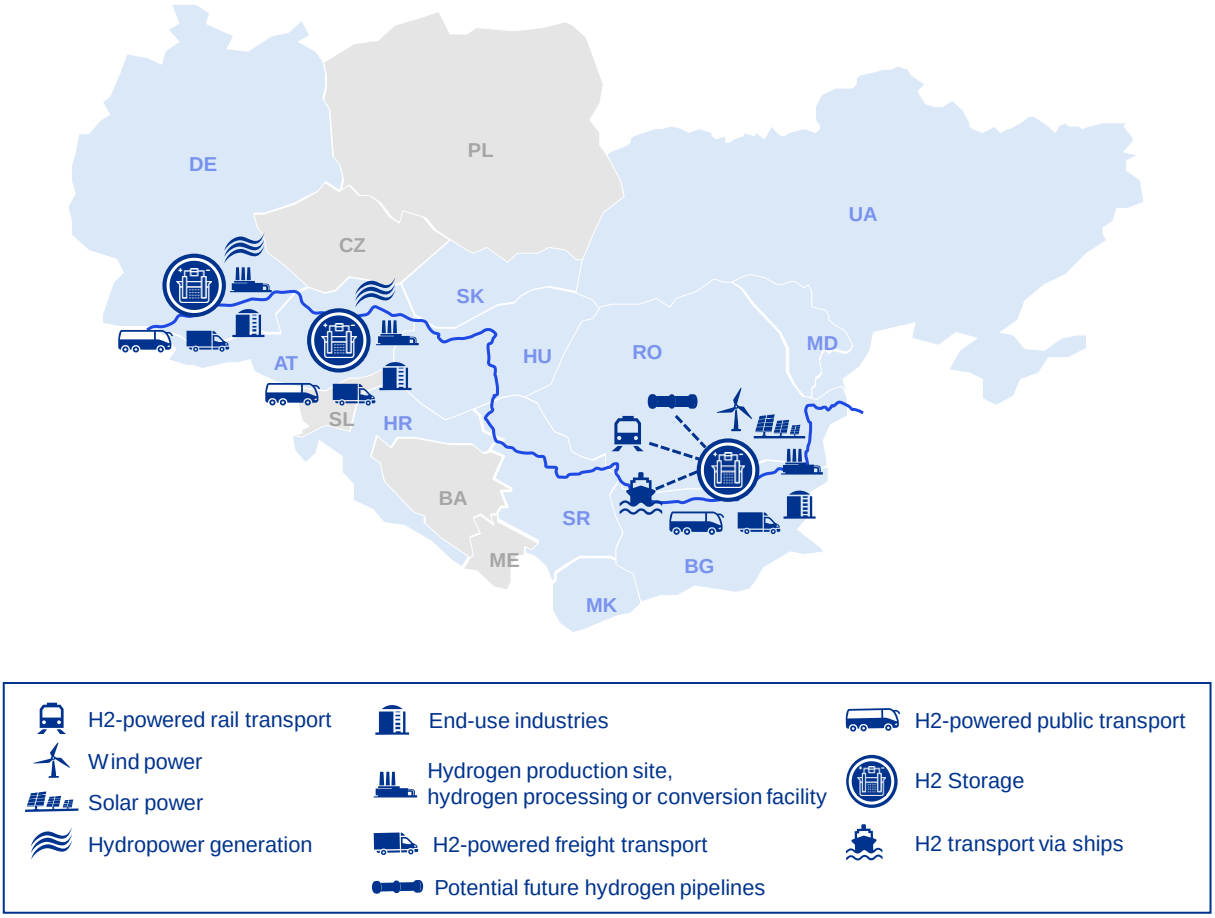


Figure 20. Green Hydrogen @ Blue Danube IPCEI project concept map

Source: CEEnergy News[15]

6.1.7 North Adriatic Hydrogen Valley (NAHV)

A cross-border initiative spanning **Slovenia, Croatia,** and **Italy**'s Friuli Venezia Giulia region – that aims to establish a sustainable hydrogen economy and drive regional cooperation. The project is coordinated by Holding Slovenske Elektrarne – Slovenia's largest electricity producer and trader – in collaboration with 37 organizations comprising companies, universities, institutes, and other public institutions from the three involved countries. Launched on September 2023, the NAHV project is set to span 72 months and encompasses 17 testbed application pilot projects across the participating regions covering the entire hydrogen value chain, from production to end-use applications and storage. These projects will act as real-life cases for piloting global hydrogen markets, moving from Technology Readiness level (TRL) 6 (Technology demonstration in a

relevant environment) at the beginning to TRL 8 (Actual system completed and qualified through test and demonstration) by the end of the project.[70,71]

The pilot initiatives are clustered into 3 main pillars:

- Hard-to-abate industries,
- Energy sector, and
- Transport sector

The NAHV has received a EUR 25m grant from the Clean Hydrogen Partnership under the Horizon Europe program, underscoring its significance as a transnational approach in strengthening technological expertise, infrastructure development, and cross-border trade in hydrogen, fostering an integrated energy market in the region.[27]

Key targets of the initiative include:

- Production of over 5,000 tons of renewable hydrogen annually, supporting industrial applications, transport, and energy storage
- Trade more than 20% of this hydrogen across the NAHV region, reinforcing regional energy integration.
- Deployment of hydrogen refuelling stations and infrastructure for land and maritime transport, strengthening sustainable mobility[27,70]

The NAHV project is therefore a catalyst for regional energy transition, economic growth, and industrial innovation within the Danube Region. Through this cross-border collaboration, the initiative has the potential to enhance energy security, economic competitiveness and job creation in hydrogen production, infrastructure development, and research, supporting long-term sustainability.[27,70]

[70] *NAHV (2023): NAHV's objectives and ambition*
[71] *US Department of Defences (2023): Technology Readiness Assessment Guidebook*

6.2 Potential for further future cooperations

Beyond the already established initiatives (discussed in the previous chapter) there are multiple prospected areas where significant potential might exist for developing further cooperations and partnerships within the Danube Region. A few of the options could be the regulatory alignment, joint funding applications, or common R&D initiatives. Since the foundations for these initiatives are still to be laid down, it is essential to highlight that further initiatives need a stronger stakeholder involvement and joint effort to establish respective concepts, operational frameworks, financing mechanisms, and specific institutional collaboration details to ensure successful project start and later on a smooth implementation. For this, Germany could provide a solid foundation for knowledge sharing in regulatory frameworks, as well as in R&D&I, given that it has the most advanced hydrogen market and supporting regulatory framework in the Danube Region. This makes it a strong reference point for hydrogen market developments across the region.

6.2.1 Cooperation of hydrogen fuelled mobility & transportation

The development of hydrogen mobility and transport infrastructure across the DRS countries could be strengthened through two main areas:

1. Strengthening the existing initiatives on the development of alternative hydrogen transportation routes and means of transportation among DRS countries. This could include **speeding up the ongoing process of deploying hydrogen refuelling stations along the TEN-T routes** (on which numerous highways have been identified as the basis for establishing a refuelling and recharging network for alternative fuels, including hydrogen).[72]
2. Furthermore, DRS countries could develop a region-wide action plan for the **joint procurement of hydrogen-fuelled transport fleets** such as buses, heavy-duty vehicles, trains, and optionally freight barges.

[72] *European Commission: Trans-European Transport Network (TEN-T)*

6.2.2 Cross-border research, training & workforce development cooperation

Further efforts could center on initiatives that enable better knowledge sharing for enabling a successful transition to a hydrogen-based economy through a well-trained workforce equipped with specialized knowledge. This could be achieved via development of **common, standardised, hydrogen-related trainings** and **academic programs** for engineers, technicians, and logistics experts, including topics on hydrogen production, storage, transport, and applications. Additionally, universities and laboratories in could establish **joint R&D centres** and **knowledge sharing platforms**, allowing faster progress in successfully identifying technical solutions for improving hydrogen storage, fuel cells, and electrolyser efficiency.

6.2.3 Industrial partnerships

Regarding industrial cooperation initiatives, as far as they represent local interests and specificities, regional industrial collaborations could be realistic for DRS countries through involving cities that are located in different countries, yet still close to each other having mutually developed trade routes and related infrastructure in place with a decent accessibility. Opportunities could include **partnerships based on green hydrogen** and **ammonia production** to **decarbonize certain industrial processes** e.g., industrial heat production, fertilizer manufacturing, and chemical and petrochemical production. A good example could be to organize industrial hydrogen supply-demand cooperation between cross-border cities located in the vicinity of each other.

6.2.4 H2U Hydrogen Valley initiative in Ukraine

More specific collaboration opportunities could arise through the **H2U Hydrogen Valley initiative in Ukraine** which – if realised – would directly link Ukraine with Central European markets via Moldova and the Black Sea.

Neighbouring nations could participate by **co-developing infrastructure**, investing in transport and storage, and securing long-term hydrogen supplies for their industries.

For instance, for Romania, Moldova, and Bulgaria, through **co-investing in hydrogen transport via the Black Sea** and **along the Danube** would allow flexible imports and

potential re-exports. Romania and Bulgaria, could integrate Ukrainian hydrogen into their ammonia and fertilizer production, reducing dependence on imported natural gas and supporting industrial decarbonization.

Additionally, there is potential for these countries to attract **joint investments for transport infrastructure** and **port upgrades**.

6.2.5 Regulatory alignment to foster cross-border hydrogen trade

Collaboration in designing a structured region-wide regulatory framework could facilitate establishing common foundations for ensuring coordinated hydrogen market operations in DRs countries.

For instance, DRS countries could create a **regional roadmap** for developing rules and **regulations aiming at** providing **a common ground** for integrating hydrogen into their energy systems and operating DRS hydrogen markets, as part of their energy transition, and in line with EU decarbonization goals and targets. Such common regulations should cover – among others – **licensing, tariff setting, HSE standards (Health, Safety, and Environment), cross-border cooperation and hydrogen transport, common hydrogen system operation rules and blending limits, rules for connecting new hydrogen producers/consumers to the system, measurements, settlements**, etc.

Furthermore, **extending** the currently formulating **EU renewable gas** (including hydrogen)[73] **certification system to non-EU DRS countries** could ensure their compliance with EU sustainability and gas decarbonization criteria. This unified certification framework would enhance transparency in hydrogen trade, support regulatory alignment, and facilitate cross-border transactions among DRS countries.

Additionally, establishing a **regional hydrogen trading platform** could optimize supply-demand across DRS countries by facilitating efficient market operation and price transparency and potentially convergence.

[73] *European Commission: Questions and Answers on the Decarbonised Gases and Hydrogen package*

6.2.6 Joint policy and strategy approaches

Joint policies or **common strategies** for hydrogen development among DRS countries could potentially address the existing **fragmentation in national hydrogen policies, regulatory frameworks**, and **market incentives**, thereby enabling the scale up of an integrated regional **hydrogen economy**.

While most **EU DRS countries** have developed **Nationally Hydrogen Strategies**, these **vary significantly** in targets, regulatory approaches, and financial support mechanisms, leading to inconsistencies that may **hinder cross-border cooperation** and **market alignment**. A **shared hydrogen strategy** would provide **a structured framework for aligning national roadmaps**, targets and common goals, ensuring that infrastructure investments, hydrogen demand projections, and industrial decarbonization efforts complement each other in the long run.

DRS countries could establish a **regional hydrogen governance body** to oversee **policy alignment, regulatory updates,** and **long-term strategic planning**, alongside monitoring progress and potentially developing measures, ensuring that national roadmaps contribute to a **cohesive regional hydrogen market** rather than isolated individual approaches.

A **joint framework for hydrogen trade** could potentially create a solid base for **establishing trade agreements within the DRS countries** with a uniform approach, setting clear terms for cross-border hydrogen transport, pipeline access, and hydrogen blending in gas networks**.**

A common approach to funding mechanisms – such as **state aid alignment, coordinated applications for EU funding**, and **joint investment platforms** – could maximize the DRS countries' ability to secure financing from programs such as Horizon Europe, the Clean Hydrogen Partnership, and the Innovation Fund and other applicable EU funding frameworks.

Additionally, **joint decarbonization strategies** (e.g. industrial, transport and heating decarbonization plans and roadmaps) could be established to drive and support the adoption of **hydrogen in hard-to-abate sectors**, encouraging shared research and

development efforts, joint technology pilot initiatives, knowledge sharing and learning programs, and coordinated deployment of hydrogen hubs.

Appendices

1. Appendix: Abbreviations and expressions used in the Study

A

AIB	Association of Issuing Bodies
ARENA	Australian Renewable Energy Agency
AUD	Australian dollar

B

BGN	Bulgarian Lev
Bn	Billion

C

CCfD	Carbon Contracts for Difference
CEHC	Central European Hydrogen Corridor
CHP	Clean Hydrogen Partnership
CO_2	Carbon-dioxide
CSA	Coordination and Support Actions

D

DRS	Danube Region Strategy

E

EHA	European Hydrogen Academy
EHB	European Hydrogen Backbone
EHO	European Hydrogen Observatory
ESU50	Energy Strategy of Ukraine 2050
EU	European Union
EUR	Euro

EV	Electric Vehicle
F	
FCEV	Fuel cell electric vehicles
FVG	Friuli Venezia Giulia
G	
GTSO	Gas Transmission System Operator
GW	Gigawatt
GWh	Gigawatt hour
H	
HSE	Health, Safety, and Environment
H2	Hydrogen
H2I	Hydrogen Initiative
I	
IHTF	International Hydrogen Trade Forum
INECP	Integrated National Energy and Climate Plan
IPCEI	Important Projects of Common European Interest
IPHE	International Partnership for Hydrogen and Fuel Cells in the Economy
IRENA	International Renewable Energy Agency
IEA	International Energy Agency
J	
K	
Km	Kilometer
kt	Kiloton
KTF	Special Climate and Transformation Fund

ktoe	Kilotons of oil equivalent
L	
LNG	Liquide natural gas
LOHC	Liquide organic hydrogen carrier
M	
M	Million
MoU	Memorandum of Understanding
MW	Megawatt
N	
NAHV	North Adriatic Hydrogen Valley
NECP	National Energy and Climate Plan
NHS	National Hydrogen Strategy
O	
P	
PV	Photovoltaics
Q	
R	
R&D	Research and development
R&D&I	Research, development, and innovation
RES	Renewable Energy Sources
RoW	Rest of the World
S	
T	
TAG	Trans Austrian Gas (Trans Austria Gasleitung)

TEN-T	Trans-European Transport Network
TSO	Transmission system operators
TRL	Technology Readiness level
TWh	Terawatt hour

U

V

W

WAG	West Austrian Gas (West Austria Gasleitung)

X

Y

Z

2. Appendix: Table of figures

3. Appendix: Table of tables

Disclaimer

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CONTACT INFORMATION

Losonczy Géza

Associate Partner

KPMG Advisory Ltd.
H-1134 Budapest, Váci út 31.

T: +36 70 370 1932
E: geza.losonczy@kpmg.hu

Márton Sipos

Senior Manager

KPMG Advisory Ltd.
H-1134 Budapest, Váci út 31.

T: +36 70 520 5541
E: marton.sipos@kpmg.hu

kpmg.hu